Mt Piper Ash Placement Project Lamberts North

Annual Environment Management Report

September 2019 – August 2020

Lamberts North Annual Environment Management Report

Name of Operation	**Mt Piper Ash Placement Lamberts North**
Name of Operator	**EnergyAustralia NSW**
Development Consent / Project Approval #	**09_0186**
Environment Protection Licence (EPL) #	**13007**
Water Access Licence (WAL) #	**10AL116411**
Water Supply and Water Use Approval #	**10CA117220**
AEMR start date	**1^{st} September 2019**
AEMR end date	**31^{st} August 2020**

I, Ben Eastwood, certify that this report is a true and accurate record of the compliance status of Mt Piper Ash Placement – Lamberts North for the period 1^{st} September 2019 to 31^{st} August 2020 and that I am authorised to make this statement on behalf of EnergyAustralia NSW.

Note:

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

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

Name of authorised reporting officer	**Ben Eastwood**
Title of authorised reporting officer	**NSW Environment Leader**
Signature of authorised reporting officer	
Date	**30/11/2020**

This report may be cited as:

EnergyAustralia NSW (2020) Lamberts North Annual Environmental Management Report September 2019 – August 2020. EnergyAustralia NSW, NSW Australia.

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1. Summary of compliance

EnergyAustralia NSW (EA) owns and operates Lamberts North Ash Repository (LNAR) in accordance with Project Approval 09_0186 which was granted by the Minister for Planning on 12 February 2012. The LNAR is located approximately 18 kilometres north-west of the city of Lithgow and is situated adjacent to the Mount Piper Ash Repository and 700 meters to the east of the Mt Piper Power Station.

Built over two stages in 1992 and 1993, the Mt Piper Power Station (MTPPS) comprises two 700 MW coal-fired steam turbine generators which have the capacity to meet the energy needs of approximately 1.18 million homes in New South Wales every year. Mt Piper Power Station is fuelled using black coal sourced from mines in the local area. The power station's furnaces are designed to utilise the characteristics of the locally available coal to improve its efficiency and help keep the power station's emissions below statutory requirements. Ash is produced during coal combustion by the transformation of the non-combustible mineral matter present in coal.

The Lamberts North Annual Environment Management Report (AEMR) has been prepared pursuant to Schedule 2, Condition E21 of the Project Approval 09_0186. 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 LNAR compliance achieved during the reporting period is provided in Table 1. No non-compliance was identified during the reporting period. An extended review of compliance with the Conditions of Approval (CoA) presented in Appendix A.

The AMER contains a summary of all monitoring carried out under the conditions of Project Approval 09_0186 during the reporting period. The groundwater and surface water monitoring carried out during the reporting period identified some elevated results above the surface water and groundwater environmental goals identified in the relevant sub-plans contained in the approved Lamberts North Ash Placement Project Operation Environmental Management Plan dated September 2019 (OEMP). These elevated results have been demonstrated to be associated with other adjacent approved activities in the area. EnergyAustralia is undertaking further investigations into the elevated results observed in surface water and groundwater results.

Table 1 Statement of compliance

Were all conditions of the relevant approval(s) complied with	
Project Approval #09_0186	**YES/~~NO~~**
Environment Protection License (EPL) #13007	**YES/~~NO~~**
Water Access License (WAL) #10AL116411	**YES/~~NO~~**

Table 2 Details on Non-Compliance

Relevant Approval	Condition No.	Condition Summary	Compliance Status	Comment	Section where addressed within AEMR

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:

- Noise from the LNAR site was inaudible at sensitive receivers during the reporting period.
- Analysis of the air quality data excluding the bushfire and regional dust events indicates air quality emissions from the Lamberts North Ash Repository have been managed effectively during the reporting period and comply with CoA D3 (d) and E18.
- There were no incidents that caused or threatened material harm to the environment at this time.

2. Introduction

2.1 Background

The MTPPS comprises of two 700 MW coal-fired steam turbine generators, built over two stages in 1992 and 1993. The power station is located approximately 17 km northwest of Lithgow and five kilometer's east of Portland (**Figure 1**). In 1990 Lithgow City Council granted Delta Electricity (now EnergyAustralia NSW consent for ash placement in the former Western Main open cut mine void adjacent to the power station. The ash placement area is near the MTPPS and is identified as Area 1 (**Figure 2**) in the "Mt Piper Power Station Ash Placement Project Environment Assessment" (SKM, 2010). EnergyAustralia acquired MTPPS and associated land holdings and infrastructure from the state-owned Delta Electricity in September 2013.

Ash from the power station is placed in a dry ash repository, and approximately 680,000 m^3 of ash has been placed in this area on an annual basis. Based on the rate of ash emplacement, it was anticipated that this area would reach capacity by 2015. A proposal to create a new ash placement area in the Lamberts Gully area was submitted to the Department of Planning and Infrastructure (now Department of Planning and Environment) in 2009 and was approved in February 2012. The approved emplacement area is situated above former coal workings, and was also used for coal washery operations by the previous landholder.

Subsequent to Project Approval, it was proposed to increase the area of ash placement within the Northern section of the Lamberts Gully site and to change the direction and location of the drainage line proposed to take clean water from the south west boundary (SKM, 2012). At this point the Project was essentially divided into two parts - Lamberts North and Lamberts South; this was in response to the uncertainty of Lamberts South becoming available in the future for ash placement.

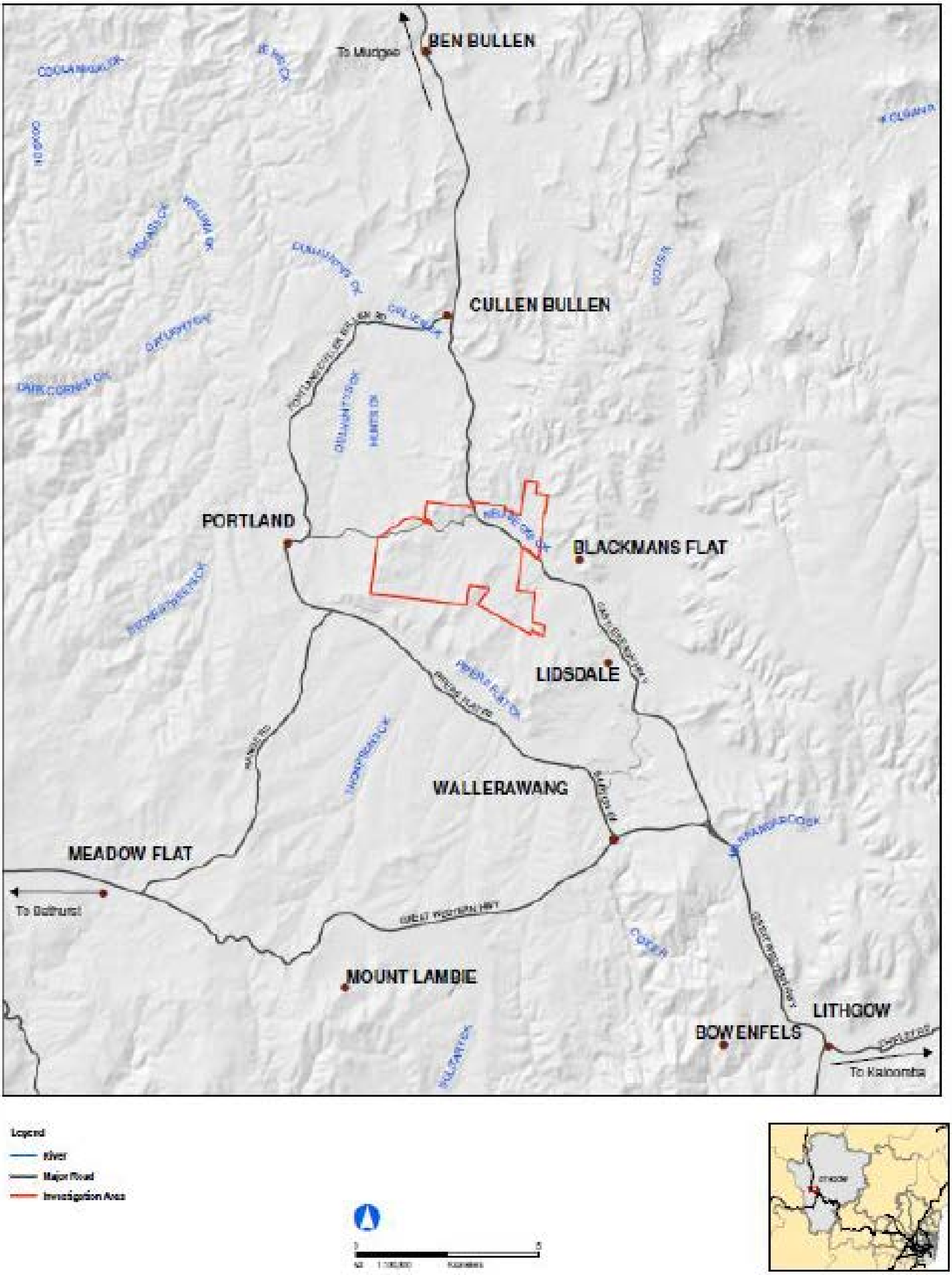


Figure 1 Regional context map

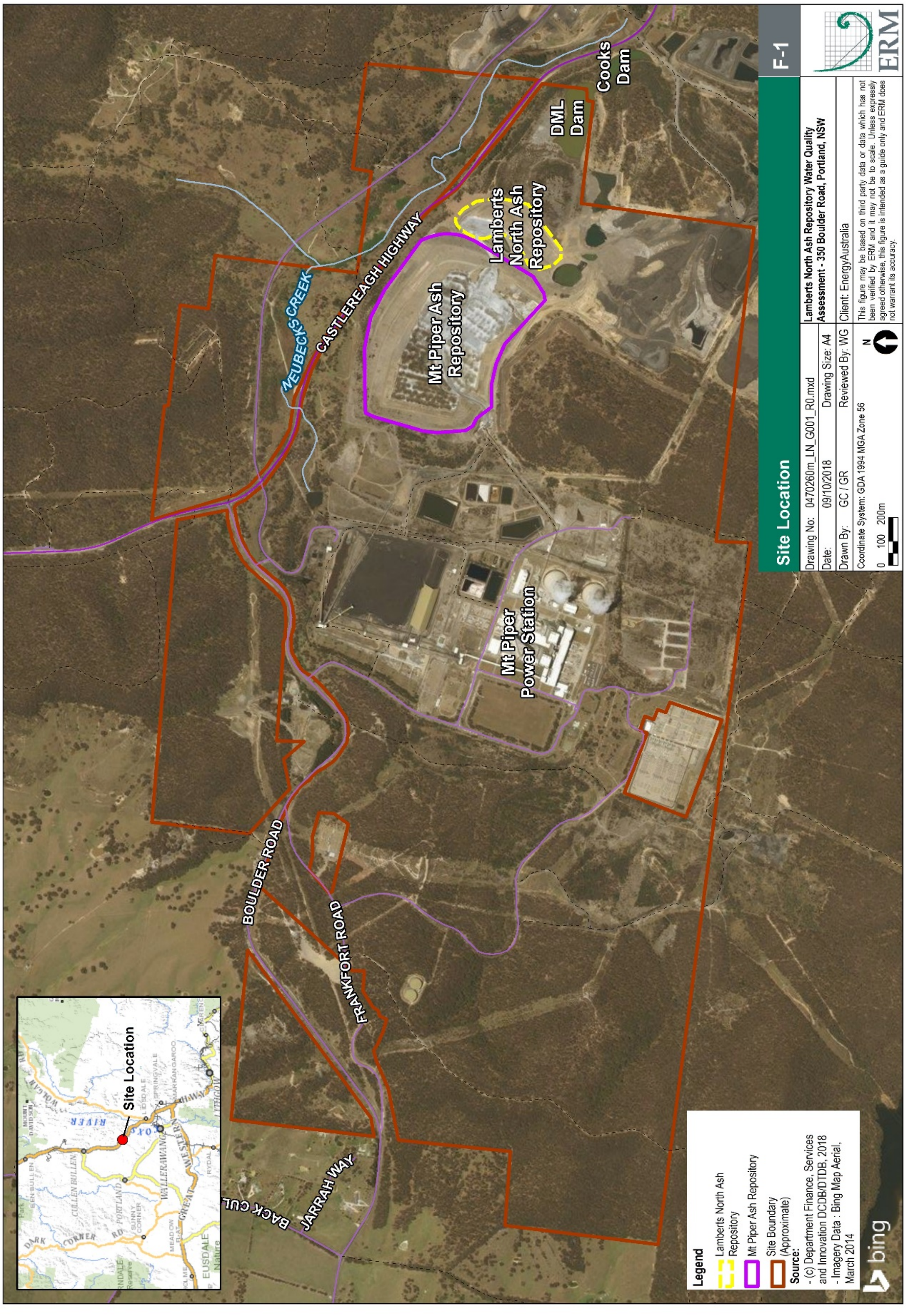


Figure 2 Site location

2.2 Purpose of the AEMR

The Project Approval contains a number of conditions with which EnergyAustralia NSW needs to comply, as the proponent, at different stages of the Project (Section 3). Condition E21 of the Project Approval (DPI, 2012) requires that EnergyAustralia NSW prepare and submit an AEMR for the approval of the Secretary (formerly the Director-General), DPIE.

The AEMR is to include, but not necessarily be limited to:

- Review of project performance against the Operation Environmental Management Plan (OEMP) (CoA D2) and the Conditions of this Approval;
- Details of compliance with CoAs;
- A copy of the Complaints Register (refer to CoA B11) for the preceding twelve-month period (exclusive of personal details), and details of how these complaints were addressed and resolved;
- Identification of any circumstances in which the environmental impacts and performance of the project during the 12-month period have not been generally consistent with the environmental impacts and performance predicted in the documents listed under CoA A1, with details of additional mitigation measures applied to the project to address recurrence of these circumstances;
- Results of all environmental monitoring required under CoA, including interpretations and discussion by a suitably qualified person; and
- 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.

This AEMR has been prepared in order to satisfy Condition E21 of the Project Approval 09_0186 (DPI, 2012). This report covers the operations, environment and community performance of the LNAR from September 2019 to August 2020 (reporting period).

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

2.3 Project contacts

The contact details for LNAR are listed in Table 4

Table 4 Lamberts North Ash Placement Contact

Contact Person	Position	Telephone
Ben Eastwood	Lamberts North Environment Representative	(02) 63548111

3. Consents, Leases and Licences

This AEMR has been prepared to address the relevant conditions of the project approval and the Statement of Commitments (SoC) which have been triggered during the reporting period. The operation of the Lamberts North project must comply with the following statutory requirements (Table 5):

Table 5 Key Consents, Leases, Licenses and Permits

Approval/Lease/Licence	Issue Date	Expiry Date	Details/Comments
Project Approval 09_0186	16 February 2012	-	Granted by Minister for DPE, under Section 75J of the EP&A Act.
Environment Protection License (EPL) No. 13007	23 July 2020		EPL held by EnergyAustralia NSW for Mt Piper Power Station
Water Access Licence No. 27428	28 February 2014	-	Granted by DPI Water, under the Water Management Act 2000
Water Supply Work and Water Use Approval 10CA117220	28 February 2014	-	Granted by DPI Water, under the Water Management Act 2000

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

3.1 Operations Environmental Management Plan

The OEMP provides the framework to manage the environmental aspects associated with the operation of the LNAR. The OEMP (CDM Smith, 2013) outlines the requirements associated with the project as stipulated in the relevant provisions of the Project Approval 09_0186 issued by the now DPIE, the EPL 13007 issued by the NSW EPA, and the SoC presented in the Submissions Report (SKM, 2011).

The scope of the OEMP covers the operations involving the movement and placement of ash from MTPPS to LNAR. The environmental performance against the OEMP is provided in Sections 6 - 10.

3.2 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) for the Lamberts North Ash Repository was developed in consultation with EnergyAustralia NSW's Western Environment Section and approved by the then DPIE in November 2012. The CEMP meets the requirements of CoA B4, providing the framework to manage the environmental aspects associated with construction works during Lamberts North operations. The CEMP has been prepared to address the requirements associated with the project as stipulated in the relevant provisions under Project Approval 09_0186 issued by the DPIE (CDM Smith, 2012a).

4. Operations during reporting period

Ash placement operations for MTPPS, including LNAR, are undertaken by a contracted specialist in the handling and management of ash. Lend Lease is the current service provider for EnergyAustralia NSW in regard to ash and dust management associated with the repository. The LNAR is currently managed under an 'operate and maintain' contract.

A summary of operations at the LNAR within the reporting period can be found in Table 6.

Table 6 Operations Summary

Activity	Previous reporting period	This reporting period	Next reporting period*
Fly Ash delivered (T)	152,792	0	400,000
Total ash produced at Mt Piper (T)	749,055	672,002	500,000
Total Ash Footprint (ha)	12.2 ha	16.7 ha	16.7
Area of repository capped (ha)	Nil	1.3	1.3

*Figures are based on average of previous years.

4.1 Normal operating hours

The normal hours of operation for the Project are between 6 am and 8 pm Monday to Friday, and 6 am to 5 pm Saturday and Sunday in accordance with Condition E1. Operations outside these hours are defined as abnormal or emergency operating conditions and are subject to specific requirements in accordance with E2 (Section 2.2.2 OEMP).

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 and can be described as follows:

- Where it is required to avoid the loss of lives, property and/or to prevent environmental harm; or
- Where a breakdown of plant and/or equipment at the repository or the Mt Piper Power Station and the proposed Mt Piper Power Station Extension project with the effect of limiting or preventing ash storage at the power station outside the normal operating hours Condition E1 (Section 3.1 OEMP).
- Where a breakdown of an ash haulage truck(s) or the conveyor belts prevents haulage during the operating hours stipulated under Condition E1 combined with insufficient storage capacity at Mt Piper Power Station to store ash outside of the normal operating hours; or
- 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 Mt Piper Power Station to allow for the ash to be stored.

Under these circumstances, EnergyAustralia NSW is required to notify the EPA, and nearby sensitive receivers prior to any emergency ash haulage or placement operations outside of the '*normal operation*' hours, and the Director-General of the DPIE within 7 days after the emergency operations have occurred.

No abnormal or emergency operating conditions occurred during the reporting period that required activities to be undertaken outside of the normal operating hours during the reporting period.

4.3 Activities conducted during the current reporting period

The following activities were undertaken during the reporting period:

- No Fly Ash placed in the LNAR for the reporting period.
- Construction of one additional lined water storage pond for managing surface water runoff has been completed.
- A workshop was held with government representatives from DPIE, Water NSW and EPA on the findings from the groundwater assessment.
- A workshop was held with government representatives from DPIE, Water NSW and EPA on the approval pathway for groundwater interception project in the vicinity of the Mt Piper and Lamberts North Ash Repositories.
- Installation of 7 additional groundwater monitoring bores in the vicinity of the Mt Piper and Lamberts North ash repositories as part of the independent groundwater investigation.
- Revised the AEMR with the correct noise monitoring dates and resubmitted the document to DPIE.
- Uploaded a copy of the independent environmental audit onto the MTPPS webpage.
- The Lamberts North Ash Placement OEMP was updated during the reporting period.
- The Biodiversity Offset Management plan was updated during the reporting period.

5. Actions required from previous AEMR review

Table 7 Actions required from last AEMR

Item	Action required from 2018 AEMR	Requested by	Action taken	Status	Where discussed in AEMR
1	*Update Section 6.2.1 of the AEMR that referred to monitoring dates outside the monitoring period.*	DPIE	Updated section 6.2.1 with noise monitoring dates for the reporting period.	C	4.3
2	*Make a copy of the IEA and Response Plan publicly available on the EA website*	DPIE	The IEA and Response Plan has been uploaded to the website	C	4.3

6. Environmental management and performance

Environmental monitoring for the operations at Lamberts North Ash Placement Area is designed to comply with the regulatory requirements specified in Section 3 of the AEMR, and to provide an ongoing analysis of the condition of the environment surrounding the operations. Environmental monitoring is performed at the sites indicated within Figure 3 and the results are used as indicators of the effectiveness of the environmental controls and management practices at the LNAR.

Detailed procedures outlining the environmental monitoring responsibilities of key stakeholders and the impacts to be mitigated are described in the relevant sub-plans of the OEMP. Details regarding the environmental responsibilities, key stakeholders and the impacts to be mitigated regarding construction activities are described in the CEMP. A summary of the environmental management measures and associated performance are provided in Table 8.

Table 8 Environmental Performance

Aspect	Approval Criteria / EIS prediction	Performance during reporting period	Trends / Management Implications	Management Actions
Noise	Criteria day 42 dB(A) Evening 38 dB(A) Night 35 dB(A)	Compliant	No change from previous years	No action required
Air Quality	PM10 annual <30ug/m^3 24 hour <50ug/m^3 Depositional dust Increase in total 2g/m^2/month to maximum of 3.5g/m^2/month	Compliant	PM_{10} trends impacted by 2019-2020 drought, dust storms and bushfires. Minor increase in depositional dust trends	No additional action required
Biodiversity	Submit a biodiversity offset plan for approval	Compliant	The 2017 revegetation works continue to establish. Direct seeding work completed in 2020	Continue ecological monitoring and management in accordance with the biodiversity offset plan

Performance against contract 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 – 6.7) and in Appendix G.

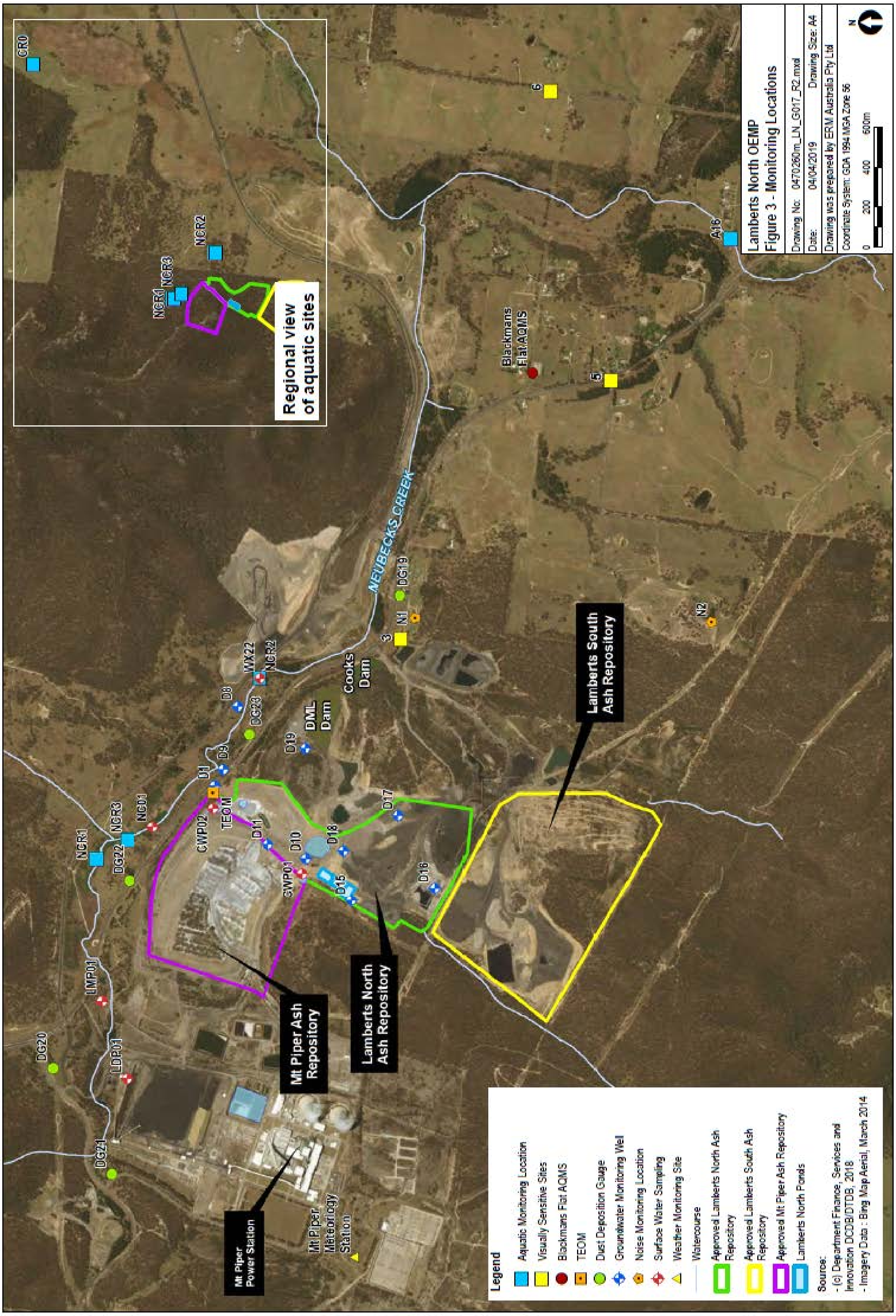


Figure 3 Environmental monitoring locations

6.1 Ash delivery and placement

6.1.1 Environmental Management

Ash generated as a by-product from the operation of MTPPS is transported by conveyer from the Station to ash silos at the Mount Piper Ash Repository as part of the existing approved operations. Ash is then transported by heavy haulage vehicles (generally one to two trucks) from the silos to either the previously established Mt Piper Ash Repository, or to LNAR. Transport to LNAR is facilitated via the southern boundary haulage road in the existing ash repository. On delivery to the LNAR, the water conditioned ash is deposited at the working face where compactors and bulldozers are then used to place the ash in stable landforms with appropriate drainage infrastructure. Ash placement can be broadly described as including the following processes:

- Identifying the current operational location for placement of ash.
- Placing ash at the existing face using truck and shaping of ash with a bulldozer.
- The ash is treated to achieve an average compaction of 95%, relative to its maximum standard compaction, through controlled combination of water addition and machine compaction with the use of rollers and rubber-tyred vehicles.
- Ash is placed in layers and stepped to produce an overall batter slope of approximately 1(V):4(H), with benches added every 10 m in vertical height change. This process of ash placement produces an average batter length of 40 m.
- The sequence of ash placement will entail initially placing ash across the site starting from the most northerly part, then towards the east and south of LNAR, working to reach a final design height of 980 m AHD through abutment with Mount Piper Area 1 ash placement.
- Boundary faces are sequentially covered with material to be sourced from locally available material and commence replanting and restoration activities. The process is repeated until LNAR is filled to its maximum permissible height and extent.
- Ash will be placed to the desired height (0.5 m to 1 m lifts) in pads, with materials that have been moisture-conditioned with water placed in the lower layers to an elevation as specified in approved design drawings, with corresponding heights of 10 m.
- Methods for the placement of ash materials to optimise compaction and stability of the emplacement areas include target moisture contact, compaction density, and progressive capping and vegetation.

Capping of exposed ash areas has been undertaken progressively as batters are developed. Progressive revegetation of batters will commence once the final perimeter batters are constructed and keyed into the adjoining Mt Piper Ash Repository.

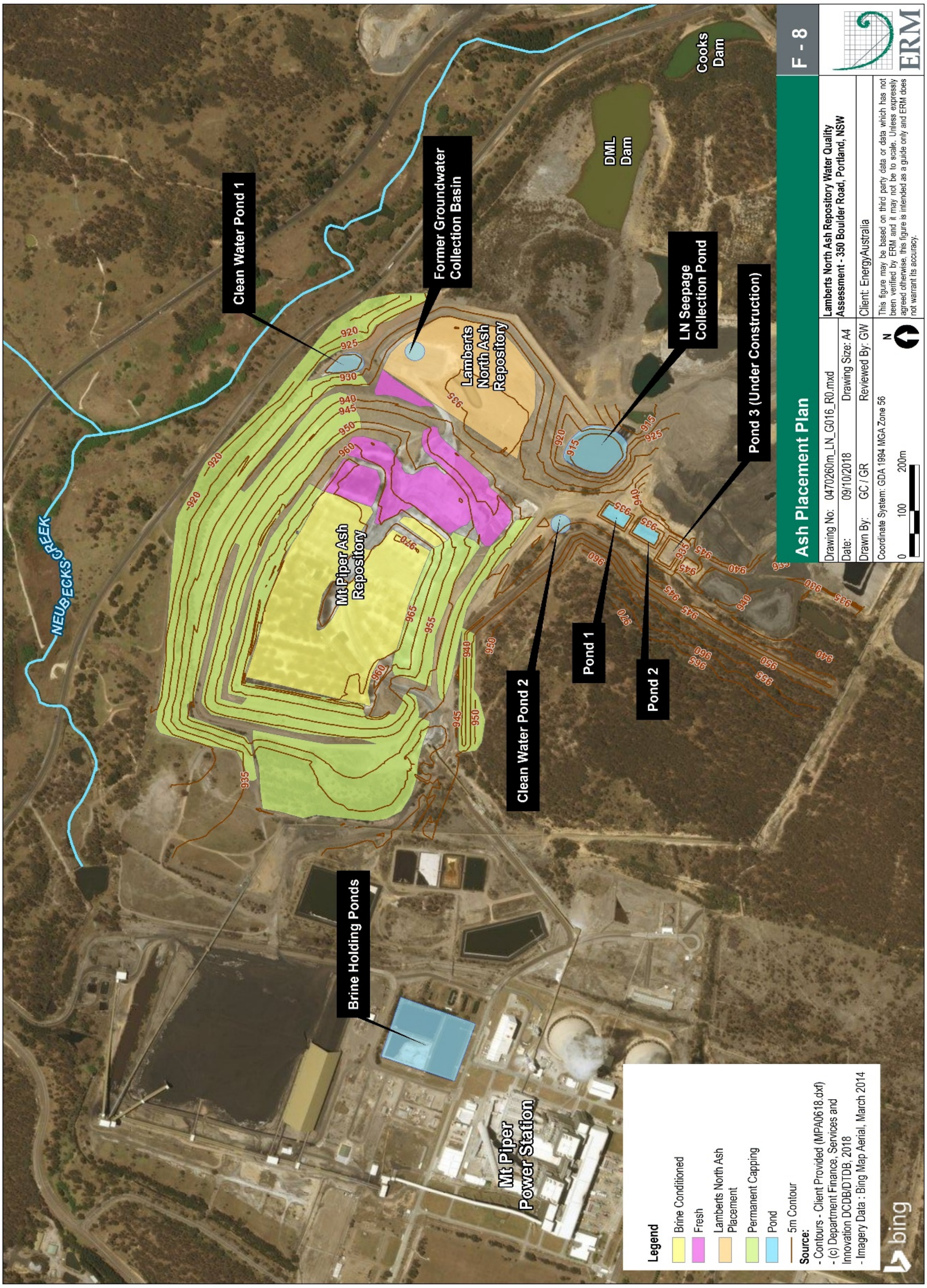


Figure 4 Ash Placement Plan

6.1.2 Environmental Performance

During the reporting period, no fly ash has been placed in LNAR. Temporary stockpiles of bottom ash are stored on Lamberts North prior to being sold or reused to upgrade roads on the ash repository. Up to 150,677 tonnes of fly ash has been diverted from emplacement for recycling and use in cement production.

NuRock have completed a pilot plant testing of the Mt Piper ash as the main constituent for their products and are moving into the first production phase, they have a contract until 31 March 2020 to be able to produce up to 30,000 tonnes per year. NuRock have an approved Development Application from Lithgow City Council and have been granted an Environment Protection License from the EPA.

Inspections on the ash repository are performed on a monthly basis by the contractor and the results are summarised in Appendix G. The management and mitigation measures specified in the approved OEMP were found to be complied with.

6.1.3 Reportable Incidents

No reportable incidents have been recorded against ash delivery and placement for the reporting period.

6.1.4 Further Improvements

- Support NuRock with the development of its business onsite to reuse fly ash.
- Continue to market the reuse of fly ash to cement manufacturers.
- Support a new negotiation for further use of on-site fly ash.

6.2 Operational Noise Monitoring

6.2.1 Environmental Management

The Lamberts North Operational Noise Management Plan (ONMMP) has been developed to address the specific requirements of the Conditions of Approval (CoA) D3 (a) and E7 to E14 for the Project. The ONMMP provides the framework to manage operational noise emissions and minimise potential noise impacts to sensitive receivers during the operation of the Project. The level of noise received by a sensitive receiver 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 Blackmans Flat is located to the east of the private haul road and ash repository site. The following residential properties, located within 1100 m from LNAR, have been identified as the nearest potentially affected sensitive receivers to noise from the repository site (Table 9):

Table 9 Representative noise measurement locations

Sensitive Receiver	Distance to Haulage Road (m)
1. Blackmans Flat (east of Lamberts North)	1100
2. Blackmans Flat (west of Castlereagh Highway)	1100

During the reporting period compliance monitoring was conducted in October 2019 and May 2020 during the early morning and evening periods as per the requirements outlined in the ONMMP. The applicable operational noise criteria are outlined in the Project Approval (No. 09_0186), the OEMP and ONMMP. The criteria are summarised as follows:

The cumulative operational noise from the ash placement area and ash haulage activity shall not exceed a $L_{Aeq\ (15\ minute)}$ dB(A) as defined in condition E7 and identified in **Table 10**.

Table 10 Operational Noise Criterion (LAeq(15 minutes) dB(A))

Location	Day (7 am – 6 pm)	Evening (6 pm – 10pm)	Night (10 pm – 7 am)
All private sensitive receivers within the township of Blackmans Flat	42	38	35
Blackmans Flat (west of Castlereagh Highway)	42	38	35

This criterion applies under all meteorological conditions except for any of the following:

a) Wind speeds greater than 3 m/s at 10 meters above ground;

b) Stability category F temperature inversion conditions and wind speed greater than 2m/second at 10m above ground level; and

c) Stability category G temperature inversion conditions.

6.2.2 Environmental Performance

Aurecon was engaged by EnergyAustralia NSW to carry out independent operational noise monitoring for the Lamberts North Project located in Blackmans Flat, NSW. The noise measurements were performed in October 2019 and May 2020 (Appendix B & Appendix C). Noise monitoring for LNAR was performed in accordance with the methods described in the approved ONMMP.

The results of the measured noise levels at the sensitive receivers stipulated in the CoA (Location 1 and Location 2) can be found in Appendix B&C. The maximum 15-minute daytime equivalent sound pressure levels (LAeq) at both the receiver locations were dominated by Castlereagh Highway traffic noise, birds, insects and low hum industrial noise and noise from adjacent coal mines. Subjectively on site there was no evidence of noise originating from the north-westerly direction, thus indicating negligible noise contribution from ash repository sites to ambient noise levels at this location. These measured equivalent sound pressure levels were in excess of the 42 dBA day time noise target, however it is not possible to conclusively determine the noise contribution from operational ash placement activities at LNAR at Locations 1 and 2 due to presence of other surrounding simultaneous noise sources and activities.

From site observations at the south-eastern site boundary of LNAR (Location 3) during attended noise monitoring, noise was clearly audible from the mobile plant operating on LNAR. Measurements of dozer, roller and water cart operations, measured at the western edge of the ash sediment basin. Operational noise clearly audible at this location and included sources such as engine noise and reverse beeps.

To quantify the likely noise contribution at Location 1 and Location 2 from the LNAR, calculations were undertaken to estimate the environmental noise emissions from the various identified activities. The measurements are based on a worst-case operational scenario at both assessment locations and include adjustments for annoying activities as outlined in the NSW Environment Protection Authority's (EPA) Interim Construction Noise Guideline (ICNG). The above prediction methodology takes into account the number of individual machines operating as well as the percentage in use during a 15-minute period, with all scheduled equipment operating at the minimum distance from the nearest sensitive receiver.

The predicted levels in Table 11 provide a theoretical maximum cumulative noise impact. The distances shown in Table 11 are considered minimum between the operational works and the respective receiver zones. The calculation also assumes that each item of equipment is operating at maximum capacity (i.e. maximum sound power level). In reality the mobile plant operates at much lower capacity during its operation and hence the levels shown in Table 12 are considered conservative and should be interpreted as indicative worst case only.

Based on the worst–case noise modelling predictions undertaken, the noise resulting from the operation of equipment and mobile plant at the LNAR are below the LAeq(15min) 42dBA CoA criterion and are therefore deemed to comply with the OEMP at the representative residential receivers Location 1 and Location 2 (Table 12).

Table 11 Predicted Noise Emissions

Equipment at Lamberts North	Sound Power Level (SWL), dBA	Predicted Noise Levels, dB(A)Leq(15min)	
		Location 1 – Blackmans Flat (approx. 1.4km)	Location 2 Wallerawang (approx.2.5 km)
Dozer / Crawler	105	31	26
Water Truck x 2	100	26	21
Roller	96	22	<20
Dump Truck x 4	100	30	25
Light commercial vehicles x 2	98	26	21
Cumulative predicted noise levels from the operation of the above equipment		35	30

Table 12 Summary of Cumulative Noise Emissions against the Noise Criteria (dBA)

Location*	Description	Maximum theoretical predicted noise	Day limit 42 dBA (07:00-18:00)	Evening limit 38 dBA (18:00-22:00) ^	Night limit 35 dBA (22:00-07:00) ^
1	Blackmans Flat	35	Compliant	N/A	N/A
2	Wallerawang	30	Compliant	N/A	N/A

6.2.3 Reportable Incidents

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

6.2.4 Further Improvements

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

6.3 Biodiversity Offset Area (BOA)

Thompsons Creek Reservoir was identified as a suitable BOA for LNAR following the results of a decision-making review process of EnergyAustralia NSW owned land in the vicinity of LNAR. Through this process, various government and community organisations were consulted and the BOA was selected to build upon existing revegetation programs undertaken at Thompsons Creek Reservoir, with the aim of improving native vegetation connectivity in the region.

The BOA is a 6.8 ha land parcel comprised of two lots:

- Lot 243 of DP 801915 east site estimated 4.7 ha with approximately 605 m of foreshore
- Lot 432 of DP 803501 south side estimated 2.1 ha with 200 m of foreshore.

The BOA is located on the eastern foreshore of Thompsons Creek Reservoir that is owned and operated by EnergyAustralia NSW for water storage purposes. The BOA is bounded by EnergyAustralia NSW landholdings except for private landholdings along the southern boundary (refer to Figure 5).

6.3.1 Environmental Management

Revegetating works were undertaken across the BOA in 2017, with approximately 2,000 seedlings planted across a 1 ha (approximate) section of the BOA. The species planted are outlined below in Table 2. A total of 547 successfully established seedlings were recorded during the 2018 monitoring, with the highest abundance occurring in the south-west corner. Eucalypt species were the most successful establishers, which included key canopy species characteristic of the surrounding vegetation communities. During 2018 monitoring, both native and feral herbivore scats were abundant throughout the planting area, as well as chewing marks on some seedlings, highlighting the active grazing pressure placed on the plantings by these species. Planting success rates were also likely limited by prolonged drought conditions experienced across the region. Despite this, the rate of successfully established plantings is still well in excess of the target density of 160 stems/ha. The next monitoring period is scheduled for September 2020 with the results included in 2021 AEMR. Management of the revegetation works during the reporting period included the removal of loose tree guards, the replacement of fertiliser tablets and regular watering.

Plate 1. Eucalypt species have successfully established from revegetation undertaken in 2017.

To improve the native vegetation connectivity in the BOA, EnergyAustralia engaged a contractor in 2020 to undertake direct seeding works in areas devoid of native tree cover (Refer to plate 2). A total area of 1.5 hectares was directly sown with a tree, shrub, and groundcover seed mixture. Areas identified for revegetation works were slashed and deep ripped using Bobcat Positrack fitted with rear ripper tines to a depth of 300mm to relieve compaction, allow moisture to penetrate and create a seed bed. Native seed establishment is a slow, steady process and over the next two years seedlings will continue to germinate. An exclusion zone of 30-40 meters from the Thompson Creek Reservoir high-water level was created to maintain access along the foreshore for recreational fishing activities.

Plate 2. Bobcat Positrack fitted with rear ripper tines creating a seed bed at the BOA.

6.3.2 Reportable Incidents

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

6.3.3 Further Improvements

EnergyAustralia NSW are committed to securing the Thompsons Creek Reservoir BOA in perpetuity by the 30 June 2021. Guidance will be sought from the Biodiversity Conservation Trust for the suitability of managing the BOA under a formal conservation mechanism. The intention of this is to secure the BOA and provide the financial and management resources required to enhance its biodiversity values.

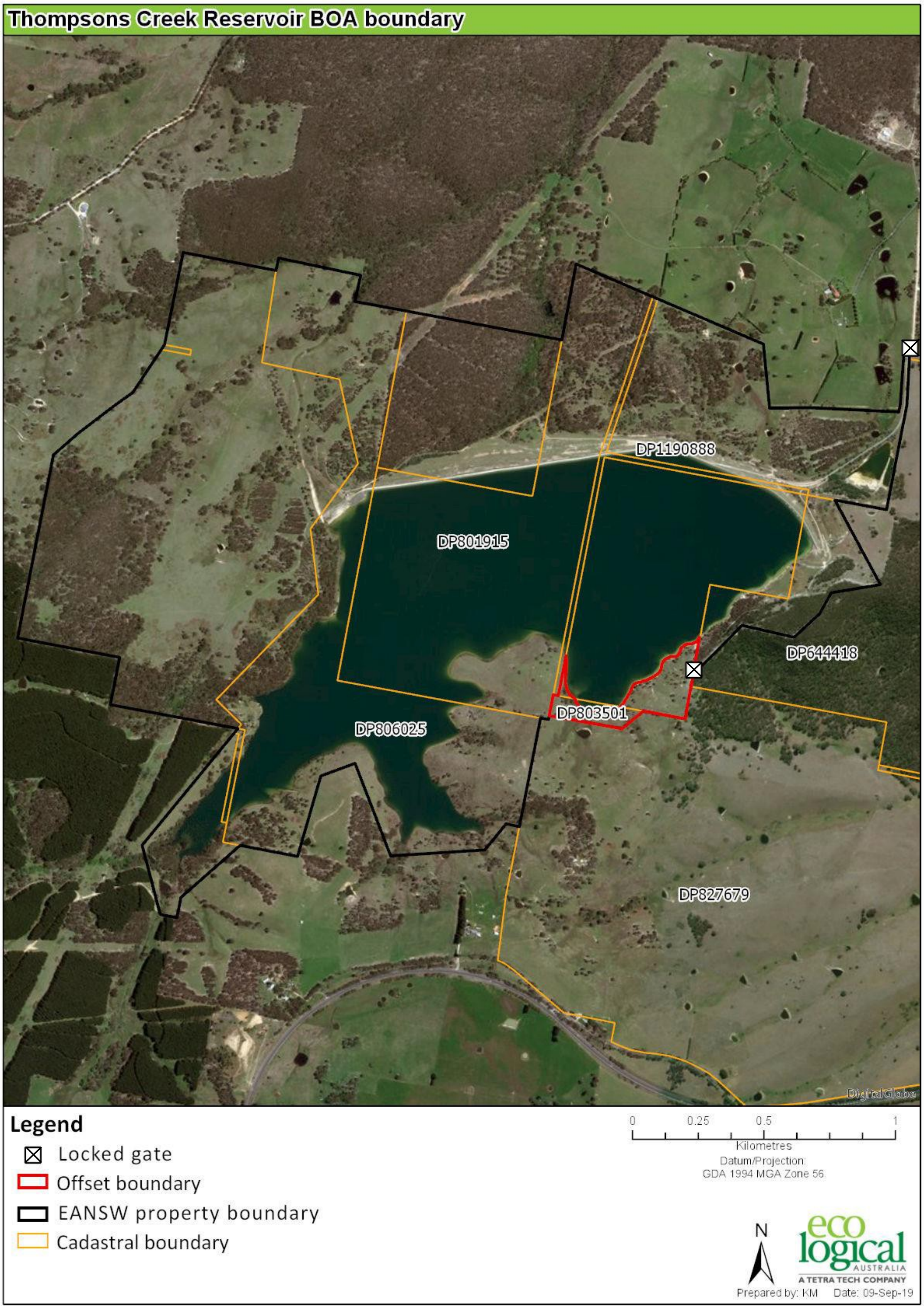


Figure 5 Biodiversity Offset Area

6.4 Ecological Monitoring

6.4.1 Environmental Management

The Ecological Monitoring Program (EMP) of the OEMP seeks to address the specific requirements of the CoA. The EMP provides for the requirements for the monitoring of aquatic ecology, in particular macro-invertebrates aquatic habitat in accordance with CoA B7. EnergyAustralia will maintain the EMP for a minimum of five years after the final capping of the LNAR in accordance with approval conditions.

The EMP was implemented in November 2012 prior to construction activities and then during construction in April 2013. In May 2018, the sample sites included in the program were, NCR1 downstream of surface water discharge point, NCR2 which is downstream of the gauging site (WX22), NCR3 on Wangcol Creek upstream of Lamberts North and Control A16 on the Cox River downstream of the confluence with Wangcol Creek. The EMP aims to monitor and quantify the impacts on the ecology of Wangcol Creek and the associated riparian environment.

The specific objectives of the 2019-2020 study were to:

- Sample indicators of ecological health in Wangcol Creek potentially affected by the Project and at unaffected control sites on the creek and on the Coxs River in autumn 2020
- Compare the findings with those of previous studies also undertaken in autumn as part of the EMP
- Assess whether any impacts to the aquatic ecology of Wangcol Creek occurred since the last autumn survey (in May 2018) and determine whether any such impacts were attributable to the Project; and
- Provide recommendations on any actions, if any, that may be required to minimise, mitigate or ameliorate any impacts to aquatic ecology that may have occurred and on any refinements to subsequent monitoring events that would improve the efficacy of the EMP.

6.4.2 Environmental Performance

EnergyAustralia engaged Cardno to conduct the ecological monitoring program in accordance with the requirements of the OEMP. The assessment of aquatic habitat, water quality and macroinvertebrate assemblages was undertaken on 20 May 2020 during the autumn sampling season.

The biotic indices used in the monitoring program include the total number of taxa, number of pollution sensitive taxa (EPT), taxa score(OE50) and signal 2 index to determine whether any changes to macroinvertebrates due to the Project have occurred.

There was evidence to suggest a reduction in the number of EPT taxa occurred at NCR2 between autumn 2018 and autumn 2020 that could be associated with the Project. This reduction followed elevations in electrical conductivity and elevated concentrations of several metals in Wangcol Creek at this location, apparently following a few months of low rainfall and flow. Although a reduction was observed at this site, examination of trends in this indicator at other sites (albeit not always statistically significant) and of the associated taxa (rare taxa, the occurrence of which is difficult to relate to such impacts) suggests that this finding may be due to natural variation unrelated to the project. In any case, the observed small magnitude of the reduction in this indicator relative to other sites does not raise concern for aquatic ecology in Wangcol Creek at present. No such changes were detected in any other of the biotic indices (number of taxa, SIGNAL2 Scores, OE50 Taxa Score and multivariate assemblage structure) considered.

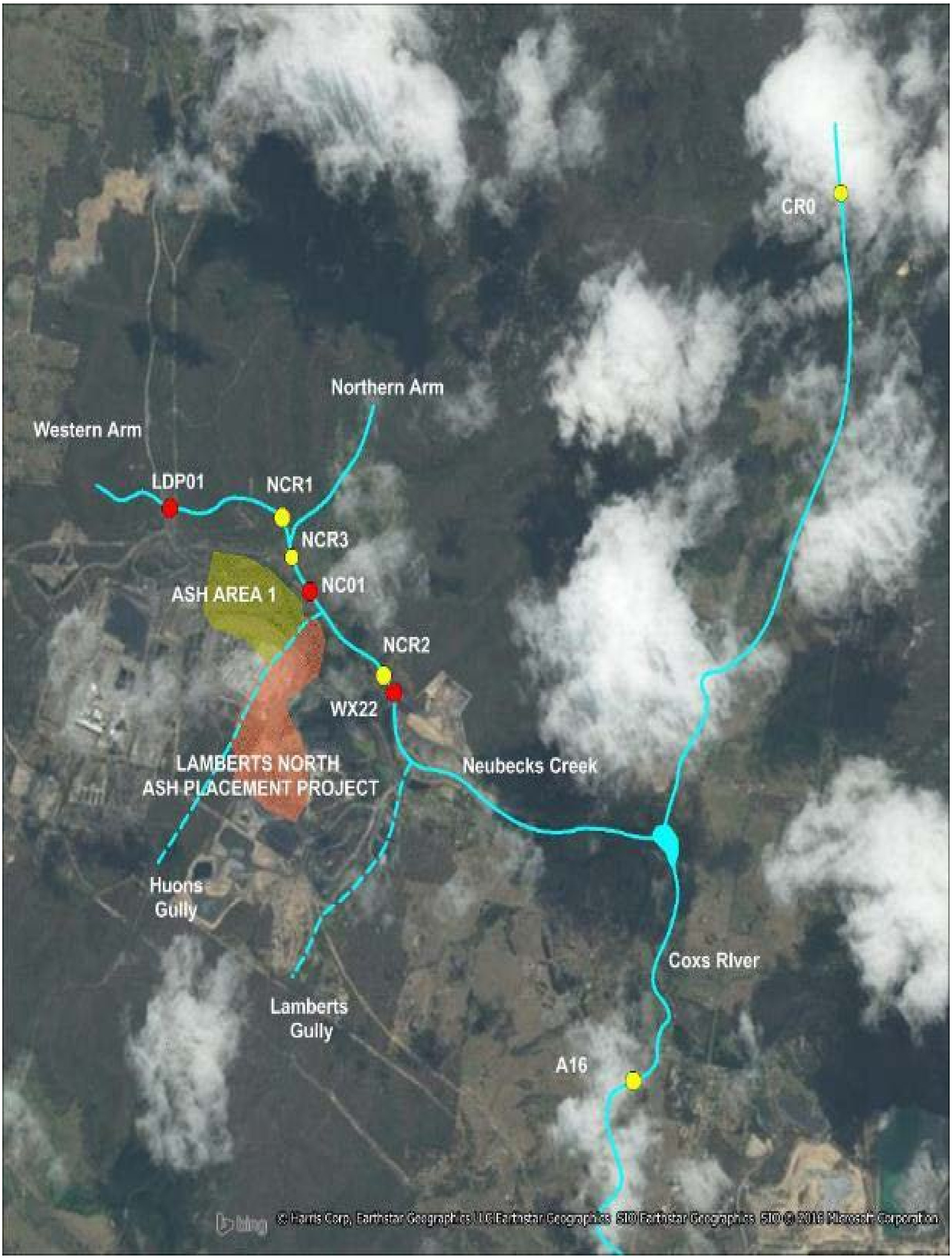


Figure 6 Aquatic ecology monitoring sites and long term water quality monitoring sites.

The OE50 Taxa Score sampled in autumn at NCR1 has ranged from 0.26 to 0.74, 0.30 to 0.90 at NCR2, 0.31 to 0.51 at NCR3 and 0.43 to 0.60 at A16. OE50 Scores from 0.12 to 0.46 indicate severely impaired habitat (Band C), those from 0.47 to 0.81 indicate significantly impaired habitat (Band B) and those from 0.82 to 1.17 indicate habitat equivalent to reference condition (Band A). These results indicated that on all but one occasion (NCR2 in May 2014) the macroinvertebrate assemblages sampled were less diverse than predicted (i.e. OE50 Taxa Score < 0.82).

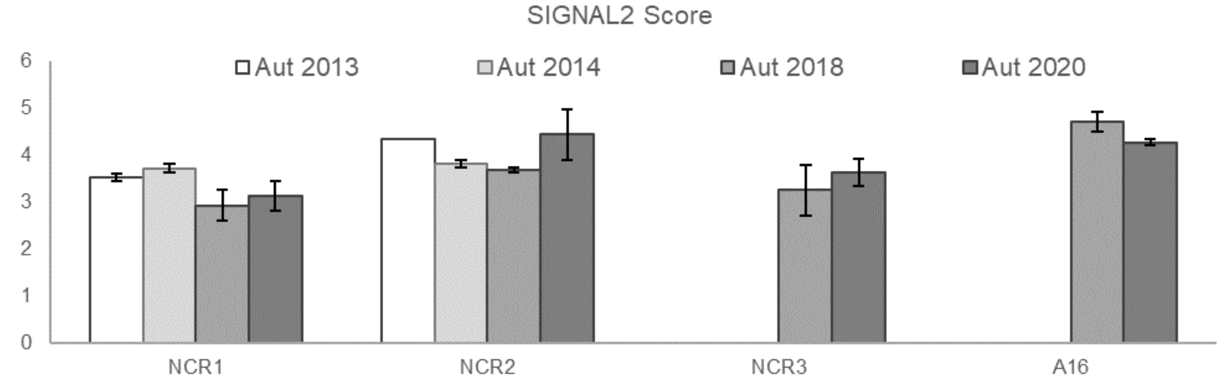


Figure 7 Signal2 results for impact and control site for the period of 2013-2020

The SIGNAL2 Indices recorded during autumn at NCR1 ranged from 2.5 to 3.8 at NCR1, 3.7 to 5.5 at NCR2, 2.7 to 4.1 at NCR3 and 4.2 to 4.9 at A16. These are indicative of severe to mild water pollution and suggest that Wangcol Creek and the Coxs River at these sites experience some degree of environmental stress due to poor water quality.

Plate 3: Gospers Mountain Bushfire adjoining Wangcol Creek at the Pinedale Mine.

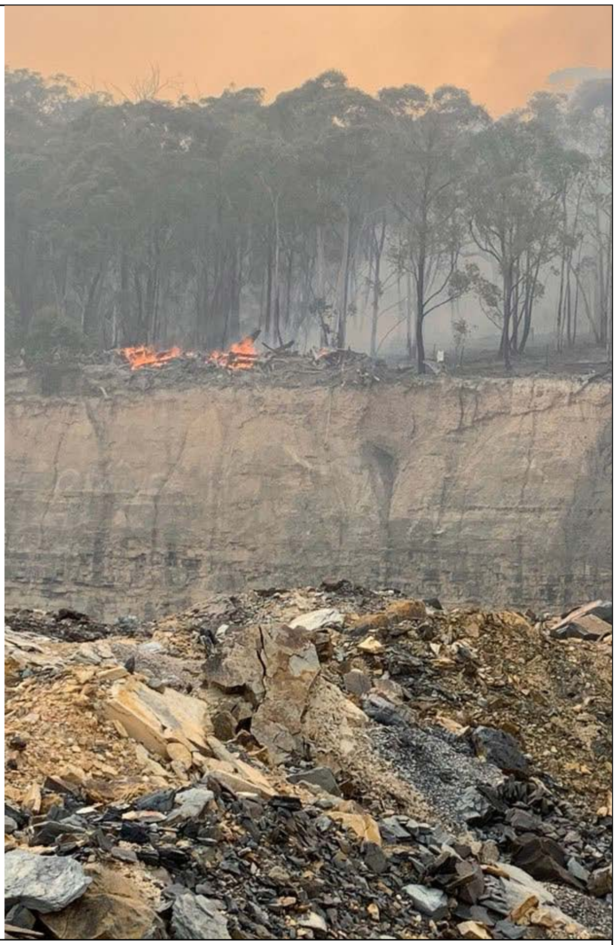


Plate 4: Gospers Mountain Bushfire adjoining Wangcol Creek at the Pinedale Mine.

The complex interaction that exists between the various types of disturbances including the Gospers Mountain Fire (Plates 3 and 4) (e.g. those to habitat, water quality and flow) experienced in Wangcol Creek make any changes in water quality, and thus associated changes in macroinvertebrates, difficult to distinguish from those that could be due to the Project. Nevertheless, the Environmental Monitoring Program adds value to the wider monitoring program, and it is expected that any large magnitude and / or cumulative impacts to aquatic biota would be detected, allowing appropriate management actions to be implemented. Recent changes to the monitoring of aquatic ecology, including the addition of two further macroinvertebrate control sites, will assist in identifying any future impacts, were they to occur, and help inform future impact minimisation and remediation efforts as necessary.

6.4.3 Reportable Incidents

No reportable incidents have been recorded against ecological monitoring for the reporting period.

6.4.4 Further Improvements

- Further monitoring should be undertaken as planned in spring of 2020. This will maximise the validity of comparisons among data collected following Project commencement and between these data and baseline data collected in spring 2012. Data from this survey will allow more confident conclusions to be made on the presence and duration of any potential impact in Wangcol Creek following the changes in water quality observed here in January 2020.
- Three replicate AUSRIVAS samples should continue to be collected from each site during all future surveys. This will provide a measure of the variation present in each indicator at each site, thereby, improving the ability to detect any future impact by enabling the use of appropriate statistical analysis.

6.5 Air Quality Monitoring

6.5.1 Environmental Management

The Repository Site Management Plan (Lend Lease, 2012) for the LNAR operations contains an Implementation Strategy in accordance with the Air Quality Monitoring Program, as required under the CoA as stipulated by DPIE and as outlined in the OEMP. These conditions include CoA D3 (d) and E18. 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. Sprinklers and compaction are used to minimise fugitive dust from the LNAR. Water trucks are used to manage fugitive dust from the haul roads.

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

- Daily monitoring from weather station.
- Fly ash conditioning.
- Mobile sprinkler system
- Use of perimeter sprays at the ash placement area
- Wash-down of security roadways, haul road/s and vehicle access roads – water carts
- Static dust monitors
- Ash placement operations
- Final and temporary capping of ash; and
- General maintenance of the ash placement area (Lend Lease, 2012)

6.5.1.1 Sprinklers and Pumps

Dust suppression is a key performance objective for ash placement activities. Dust suppression concerns all aspects of exposed ash and ancillary aspects of vehicular traffic during permanent capping and other activities. The main dust suppression method on exposed ash is the use of sprinklers with water sourced from wash down ponds and the blow down towers from Mount Piper's cooling water system – no clean water is used in this application. Water application (measured in sprinkler hours) is based on wind velocity, humidity and temperature. Sprinklers are also used for haul roads. Water source, volumes and sprinkler numbers are monitored daily by Lend Lease and reported to EnergyAustralia NSW monthly.

The Repository Management Plan (Lend Lease, 2015a) 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 13.

Table 13 Water use guideline

<table>
<tr><th>Water use guidelines</th><th>Water use guidelines</th></tr>
<tr><td>>25o >20km/hr (10hrs/day)</td><td rowspan="3">15o <20km/hr (<4 hours/day)</td></tr>
<tr><td>15-24o <20km/hr (8 hrs/day)</td></tr>
<tr><td>15o <20km/hr (4 hours/day)</td></tr>
<tr><th>Evaporation 3 – 7 mm per day</th><th>Evaporation < 3 mm per day</th></tr>
<tr><td>Oct, Nov, Dec, Jan, Feb, Mar</td><td>April, May, June, July, Aug, Sept</td></tr>
</table>

Operation of sprinklers in extreme hot and dry conditions requires extended irrigation hours

6.5.1.2 Air quality monitoring

Air quality impacts at Lamberts North are managed pursuant to Development Consent 09_0186 and the approved Air Quality Management Plan (AQMP). The AQMP provides the assessment criteria for the LNAR which are monitored through a network of dust monitors.

The monitoring network consists of

- 5 dust deposition gauges
  - Dust Gauge 19, 20, 21, 22 and 23 at five locations
- 1 Tapered Element Oscillating Microbalance (TEOM) measuring <10 µm (PM10) as shown on Figure 3.
- Air Quality Monitoring Station (AQMS). The AQMS is located at Blackmans Flat.

Dust monitoring results are recorded monthly with colour and textural observations.

Performance indicators recommended in the OEMP for air quality monitoring are as follows:

- Increase in Total Suspended Particulates (TSP) by > $2g/m^2$/month to a maximum of $3.5g/m^2$/month at dust deposition gauges outside the ash placement area
- PM_{10} annual average is <$30µg/ m^3$ and 24 hour maximum does not exceed $50µg/m^3$

A review of the depositional dust monitors was performed at the end of March 2017. The review found that the gauges meet the requirements for the methods for sampling and analysis of ambient air (AS/NZS 3580.10.1:2003).

6.5.2 Environmental Performance

6.5.2.1 Dust suppression – Lamberts North Sprinkler system

Figure 8 reflects a relationship between sprinkler application and evaporation to identify that the target or maximum application rates for irrigation at 5 mm / day was achieved. Net irrigation was calculated by subtracting the daily evaporation from the daily sprinkler irrigation rate.

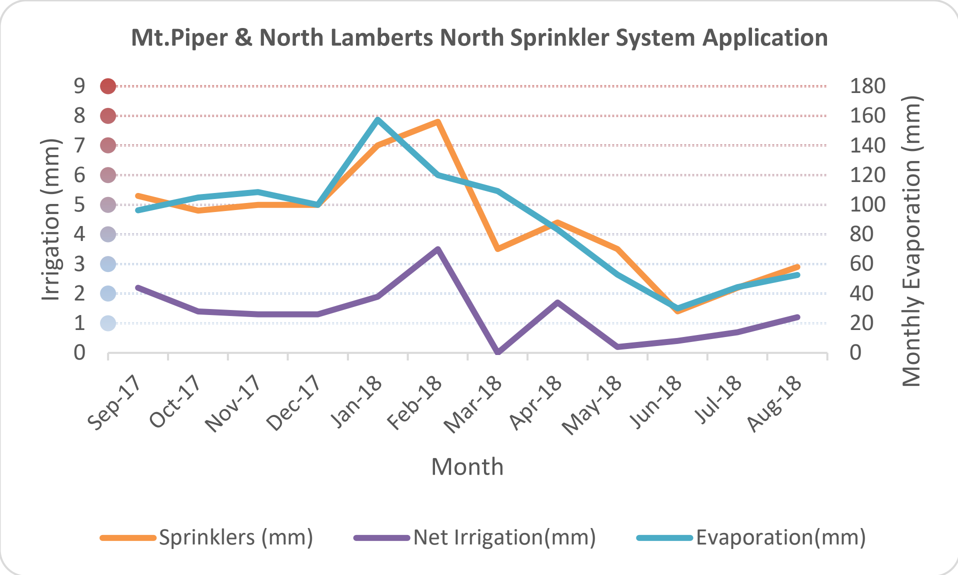


Figure 8 Efficacy of irrigation operations September 2017 - August 2018

6.5.2.2 Air quality monitoring

The 2019/20 reporting period was characterised by somewhat extreme weather events including state-wide dust storms, bush fires and extended drought conditions. These events influenced air quality near the LNAR which are reflected in the air quality results in this years AEMR. These extreme weather events which impacted air quality in the Lithgow Local Government Area were not related to impacts or activities at the LNAR. Some of these events that were experienced during the reporting period are shown in Plates 5 to 7.

Climatic conditions throughout the reporting period were dry, with 2019 being Australia's driest year on record. Nationally-averaged rainfall was 40% below average and most of the country was affected by drought, which was particularly severe in NSW.

State-wide dust storms were experienced throughout November 2019 to January 2020 (OEH, 2020). A large state-wide dust storm swept through NSW on the 11th January 2020 (OEH, 2020) and raised dust fell as dirty brown rain over the Sydney basin on 24th January 2020 as reported by the Bureau of Meteorology (BOM, 2020c).

Two bushfires occurred in the area during the reporting period – the Lidsdale bushfire in September 2019 and the Gospers Mountain fire (Plate's 3&4) which started in October 2019 and continued to January 2020 when it was extinguished.

Plate 5: Dried farm dam during drought conditions located at Meadow Flat in the Lithgow LGA, 23 Jan 2020

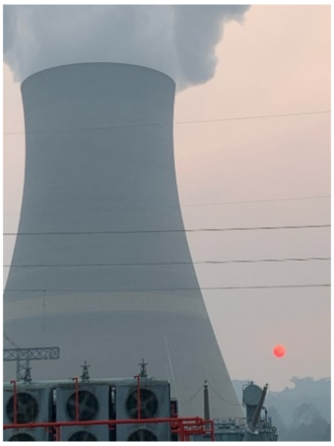


Plate 6: Sunrise at Mt Piper Power Station showing air quality impacted by dust and bushfire smoke, 11 Dec 2019

Plate 7: Dusty sky at Meadow Flat in the Lithgow LGA, 23 Jan 2020

Elevated depositional results across gauges W19-W23 from September 2019 to February 2020 are shown in Table 14. The results for February 2020 for all gauges except gauge W22 were above the assessment criteria of 3.5 g/m2. The January 2020 DustWatch Report released by OEH advised of massive dust storms that were up to 2500 kilometres long and up to 5oo kilometres wide that swept across inland New South Wales confirms the extent of regional dust storms during this period.

The depositional dust results across all gauges is significantly reduced from March 2020 to August 2020. The March 2020 DustWatch Report released by OEH attributes the reduction in dust activity to above average rainfall and much improved pasture coverage.

The Annual average depositional dust for gauges 21 and 23 decreased slightly whereas gauge 20 had no change in the reporting period. Dust gauge 22 was damaged by the Gospers Mountain Bushfire in December 2019.

Comparative annual average depositional dust data for the combined average over the previous six-year period is presented in Table 14.

Table 14 Annual depositional dust summaries

Date	Total Insoluble solids (g/m2/month)				
	19	20	21	22	23
	Insol.	Insol.	Insol.	Insol.	Insol.
Sep-19	1.5	1.3	2.1	3.4	6.1
Oct-19	1.9	1.4	1.4	1.7	2.6
Nov-19	2.2	2.3	2.8	2.5	3
Dec-19	3.1	3.7	3.4	NS	2.2
Jan-20	1.5	2	2.2	0.7	0.2
Feb-20	9.8	8.3	8.6	0.2	7.8
Mar-20	1.1	1.0	1.5	NS	1.4
Apr-20	0.7	0.5	0.5	0.1	1.0
May-20	0.8	0.5	0.9	0.2	0.9
Jun-20	0.9	0.5	0.6	0.7	0.8
Jul-20	1.3	0.6	0.8	0.8	0.8
Aug-20	0.5	0.2	0.7	0.5	0.6
Annual averages					
2020	1.8	1.8	2.1	1.1	2.3
2019	1.7	1.8	2.4	2.2	2.7
2018	0.9	1.4	1.4	1.1	1.0
2017	0.4	0.7	1.1	1.4	1.0
2016	0.6	0.7	1.5	0.6	0.7
2015	1.1	0.8	1.4	0.8	0.8
2014	0.8	0.9	1.5	0.9	0.8

The general increase in depositional dust concentrations from 2017 through to February 2020 is generally reflective of the extended drought conditions, increased frequency in state-wide dust storms and bush fires impacting the local air shed in the vicinity of the LNAR. There was a sudden increase in insoluble solids experienced in February 2020 which was recorded in four of the five monitoring gauges (refer Figure 9 to Figure 13). This is understood to be attributed to elevated levels of dust particles from dust storms and bushfires settling in the gauges following rainfall which occurred in late February. The general increase in depositional dust levels and spike in February is not attributed to activities at the LNAR. Comparative annual average depositional dust data for each of the five OEMP dust deposition gauges are presented in Figure 9-Figure 13.

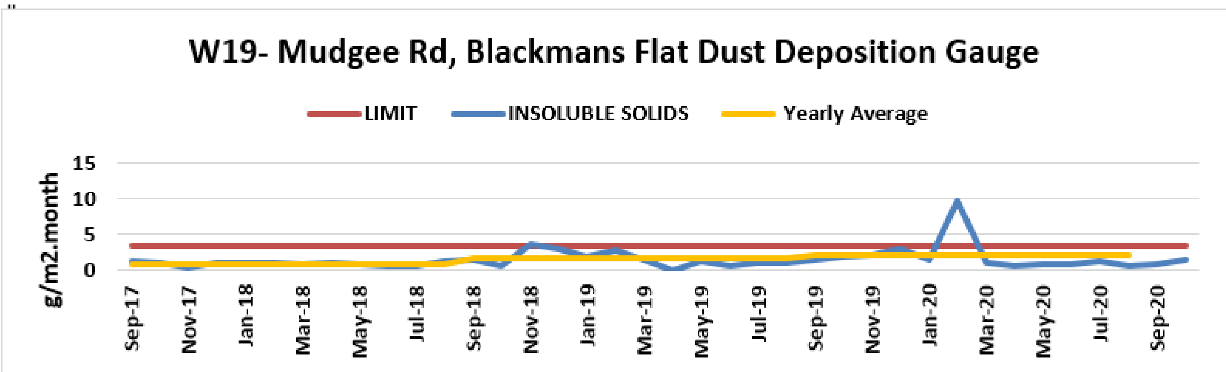


Figure 9 Depositional Dust Summary for Dust Gauge 19

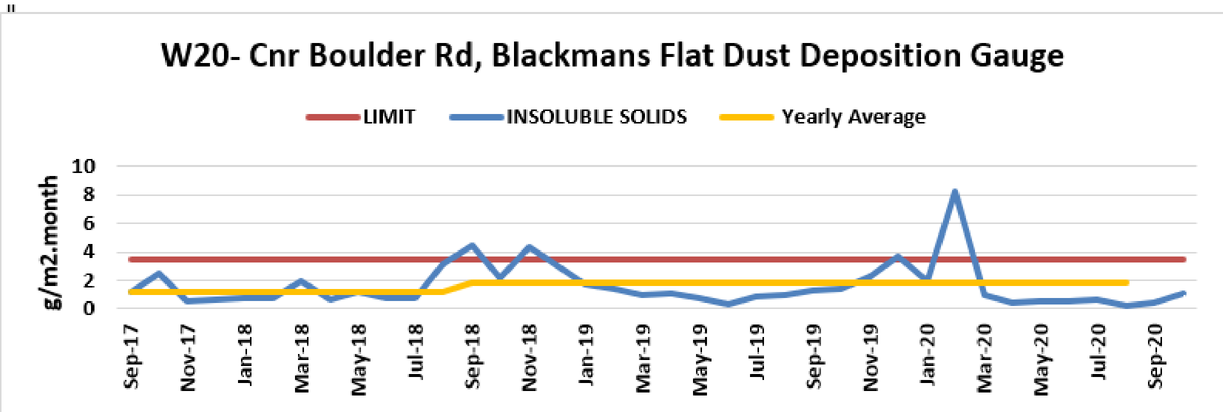


Figure 10 Depositional Dust Summary for Dust Gauge 20

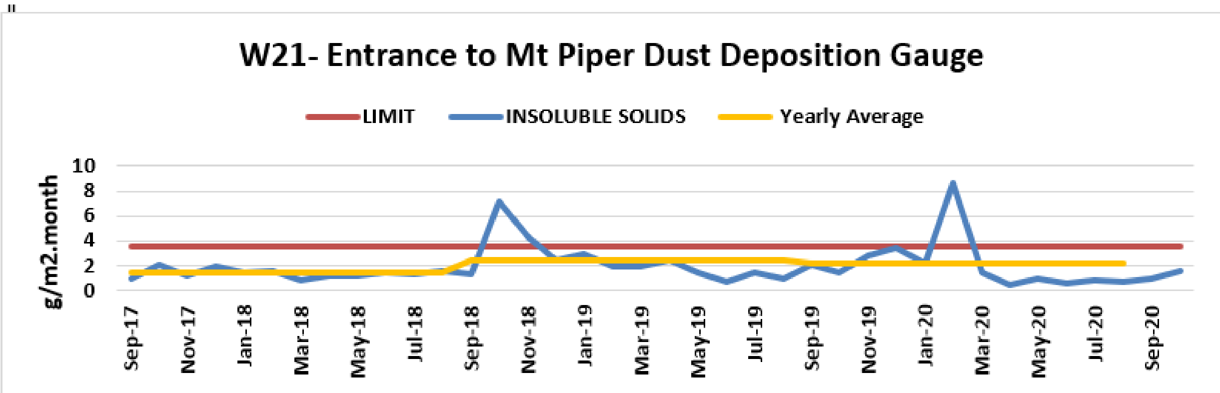


Figure 11 Depositional Dust Summary for Dust Gauge 21

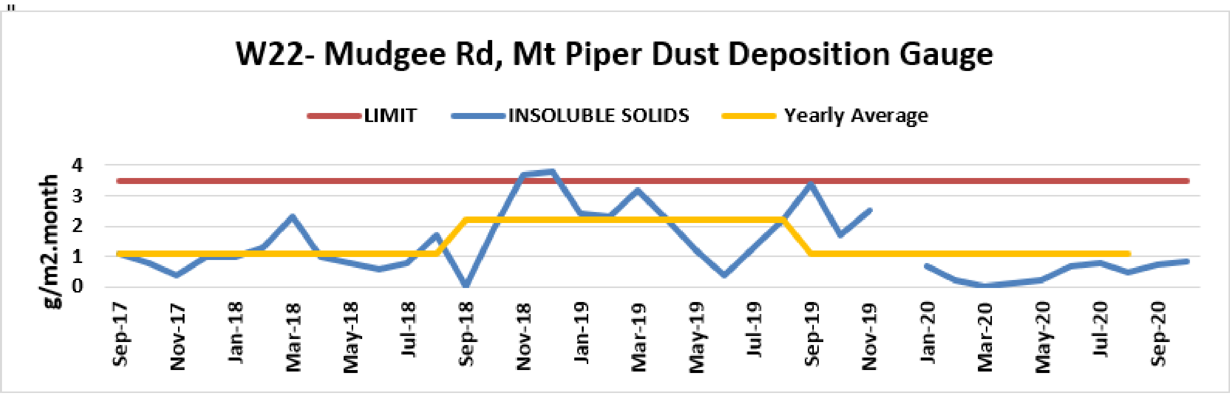


Figure 12 Depositional Dust Summary for Dust Gauge 22

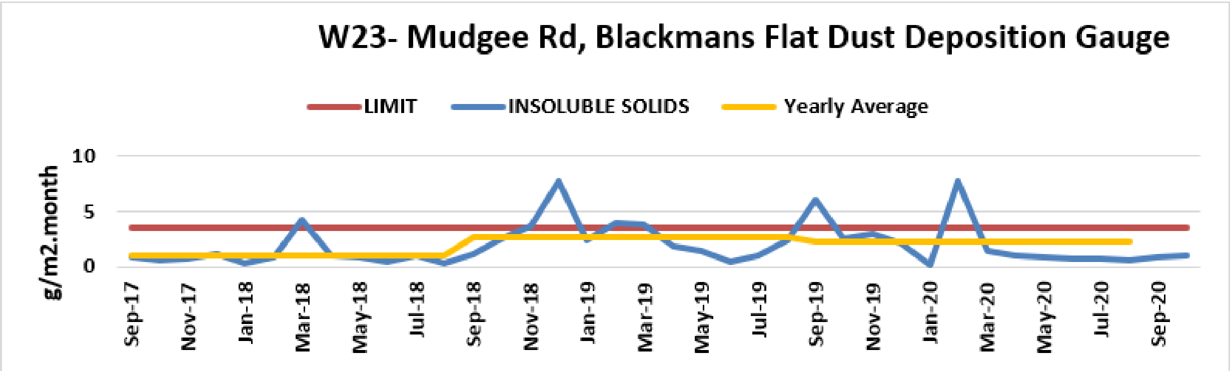


Figure 13 Depositional Dust Summary for Dust Gauge 23

EnergyAustralia monitors fine particulates at LNAR, Blackmans Flat and Wallerawang air quality stations. These are located to the northwest, east and southern directions from the LNAR. The results show an increase trend of fine particulate matter over the summer months (Figure 14). These elevated results are reflective of the deteriorating air quality in the Lithgow LGA due to the extended drought, state-wide dust storms and local bushfires.

There is a sudden decrease in particulate concentrations from late February 2020 which correlates to rainfall received during this period. Ongoing rainfall throughout 2020 has attributed to the fine particulate concentration levels returning to typically normal background levels for the region. With the rainfall received in 2020 the annual average PM $_{10}$ result for the reporting period was 23 µg/m^3 which is below the annual average criteria of 30µg/m^3.

Analysis of continuous air quality (PM$_{10}$) monitoring data from the Blackmans Flat, Wallerawang and Lamberts North air quality stations was undertaken for the reporting period (Figure 14). The analysis indicates that all high-level events may be attributed to sources other than the LNAR. Furthermore, there was no fly ash placement at the LNAR during the reporting period and the dust suppression systems were operating and functional.

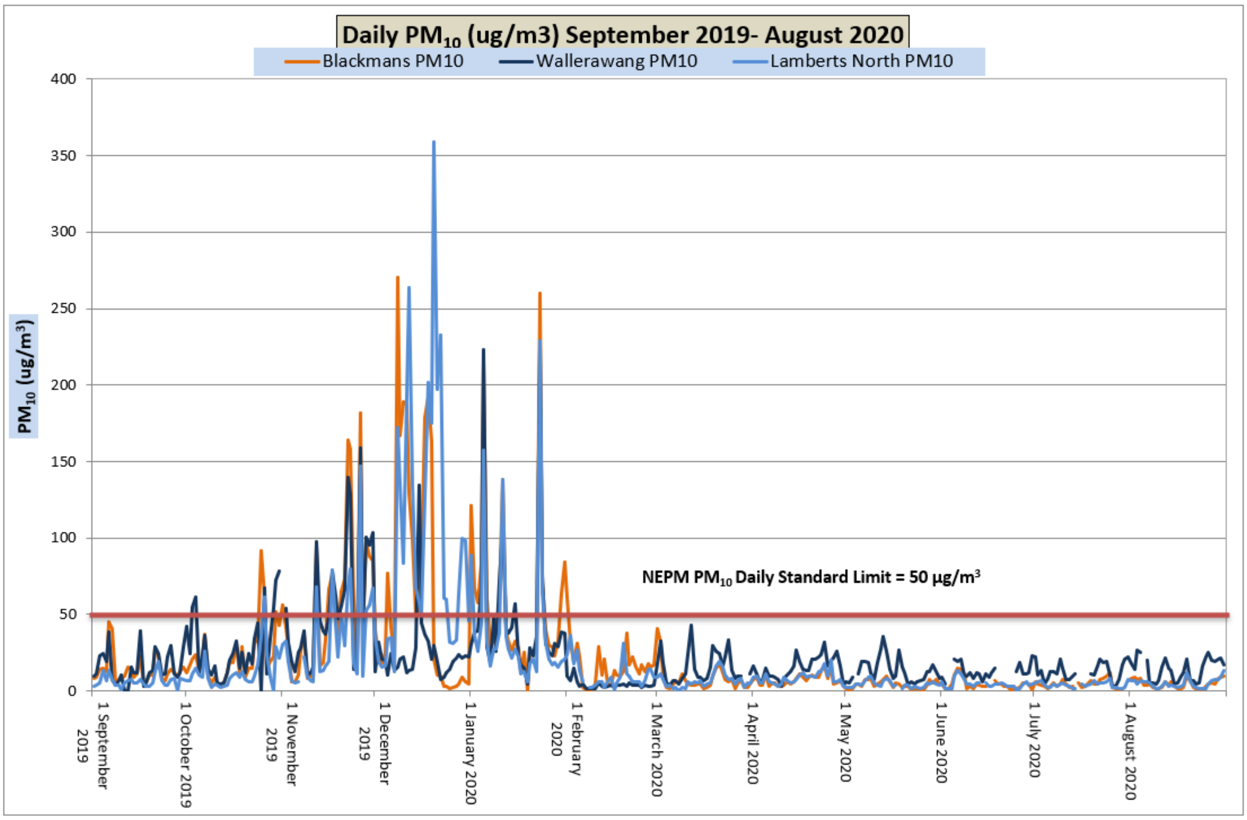


Figure 14 Average PM10 from the Mt Piper TEOM from September 2019 to August 2020

6.5.3 Reportable Incidents

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

6.5.4 Further Improvements

The air quality management controls have been effective and will continue to be implemented for the LNAR, as such no further improvements have been identified for the next reporting period.

6.6 Waste Management

6.6.1 Environmental Management

Waste disposal practices at the LNAR are managed in accordance with Environmental Protection Licence 13007 and the Waste Management Sub-Plan (OEMP, Section 6.8). 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). The WMP addresses waste management on site, and satisfies CoA D2 (g), E23, E24 and E25.

The WMP provides a framework for EnergyAustralia NSW, its contractors and vendors to manage waste and to minimise the potential for adverse impacts to sensitive receivers during the operation of the Project and is comprised of the following targets:

- To ensure waste at the LNAR is managed in accordance with the conditions of EPL 13007.
- To ensure that all Staff and associated contractors involved in the LNAR operations are made aware of the waste management measures (OEMP, Section 6.8), that waste generated on Lamberts North is recycled or disposed of in accordance with this OEMP Sub Plan.

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 except as permitted by the licence or an exemption certificate.
- Waste generated by site personnel (including maintenance wastes such as oils and greases) are collected on a regular basis to be recycled or disposed of at an appropriate facility.
- Evidence of a recycling system in use and site-generated waste being disposed of to an appropriate facility.
- Waste management details are recorded in the monthly environmental report.

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 6.8).

6.6.2 Environmental Performance

Pond sediments are sourced from settling basins located within the licenced premises at the MTPPS. The activities at the LNAR were deemed to have met the OEMP targets for waste management for the 2019-2020 reporting year. There were no non-conformances identified and the OEMP requirements with respect to waste management, were found to be compliant.

6.6.3 Reportable Incidents

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

6.6.4 Further Improvements

No further improvements are planned for the next reporting year.

6.7 Heritage Management (Aboriginal & non-Aboriginal)

6.7.1 Environmental Management

Project Approval 09_186 contains CoA's concerning heritage management in Part B - Prior to Construction (B5 (f)) and Part C – During Construction (C8 – 9). These conditions are managed under Section 5.6 of the CEMP. The Project has progressed into the operational phase and CoA Part B and C no longer apply.

Whilst there are no specific CoAs for Project Approval 09_0186 for Part E – During Operations, regarding Heritage Management, contract personnel are educated on their due diligence duties in respect of the protection of Aboriginal and non-indigenous heritage sites and items.

6.7.2 Environmental Performance

No additional sites have been recorded within the vicinity of the LNAR.

6.7.3 Reportable Incidents

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

6.7.4 Further Improvements

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

7. Water management

7.1 Surface Water Quality Monitoring.

7.1.1 Environmental Management

The Soil and Surface Water Quality Management Plan (SSWMP) is a sub-plan as outlined in the OEMP and addresses the specific requirements of the CoA D3 (c) and E16. The SSWMP addresses soil and water cycle management on site, including a surface water monitoring program at receiving waters that is comprised of the following targets:

- The water quality at Wangcol Creek is not impacted by Lamberts North ash placement operations;
- Zero environmental incidents that relate to pollution of waters at Wangcol Creek.
- Erosion to be effectively managed on site and not have an influence and/or impact on surrounding lands outside the boundary of Lamberts North.

Performance criteria:

- The Environmental Goals adopted have taken into consideration local baseline surface water conditions in Wangcol Creek prior to the commencement of ash placement in the Stage I area (eastern side) of the Mt Piper Ash Repository (referred to as pre-placement). Baseline conditions were specifically established based on the 90th percentiles of the water quality dataset from monitoring site WX22 in Wangcol Creek. An early warning is triggered when the post-ash placement 50th percentiles for the various water quality indicators at each of the surface water monitoring sites, exceed the pre-placement 90th percentiles (Aurecon 2017).
- Ecological results at Wangcol Creek will indicate no significant variation from historical baseline data.
- No visual evidence of erosion and sedimentation impacts on Wangcol Creek following significant rainfall events.

Runoff water from the LNAR is contained in clean and dirty water sediment ponds and forms the primary source of water for dust suppression on exposed ash and capped areas as well as irrigation of the revegetated areas. 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. The OEMP for the LNAR requires sampling at three locations (Figure 3).

Table 15 Location of Surface Water Monitoring Points

Site ID	Location Description	Monitoring Frequency
LMP01	Final Holding Pond Weir - Licence discharge/monitoring point is located north-west of the Mt Piper Ash Repository. This monitoring site is located in an upstream position relative to the Lamberts North Ash Placement Area.	Weekly[1]
NC01	Located in Wangcol Creek. This monitoring site is located upstream to the Lamberts North Ash Placement Area and to the north of the Mt Piper Ash Repository and is an aquatic life background site.	Weekly[1]/Monthly[2]
WX22	Located in Wangcol Creek at a stream gauge to the east/down-stream of the Mt Piper and Lamberts North Ash Repositories and monitoring site LDP01. This monitoring site is also situated down-stream of monitoring bore D8.	Weekly[1]/Monthly[2]

1. Selected field parameters monitored on a weekly basis
2. Monitoring undertaken by analytical laboratory Nalco Water – Ecolab

Changes in the water quality and trace metals at Wangcol Creek receiving water site (WX22), from pre-ash placement (October, 2012 to August, 2013) to the post-ash placement period (September, 2013 to August, 2017) was examined in the past by Aurecon Water Quality Monitoring Report. For the reporting period 2019-2020 ERM was commissioned by EnergyAustralia NSW to carry out the Water Quality Monitoring Report (WQMP) refer to Appendix D.

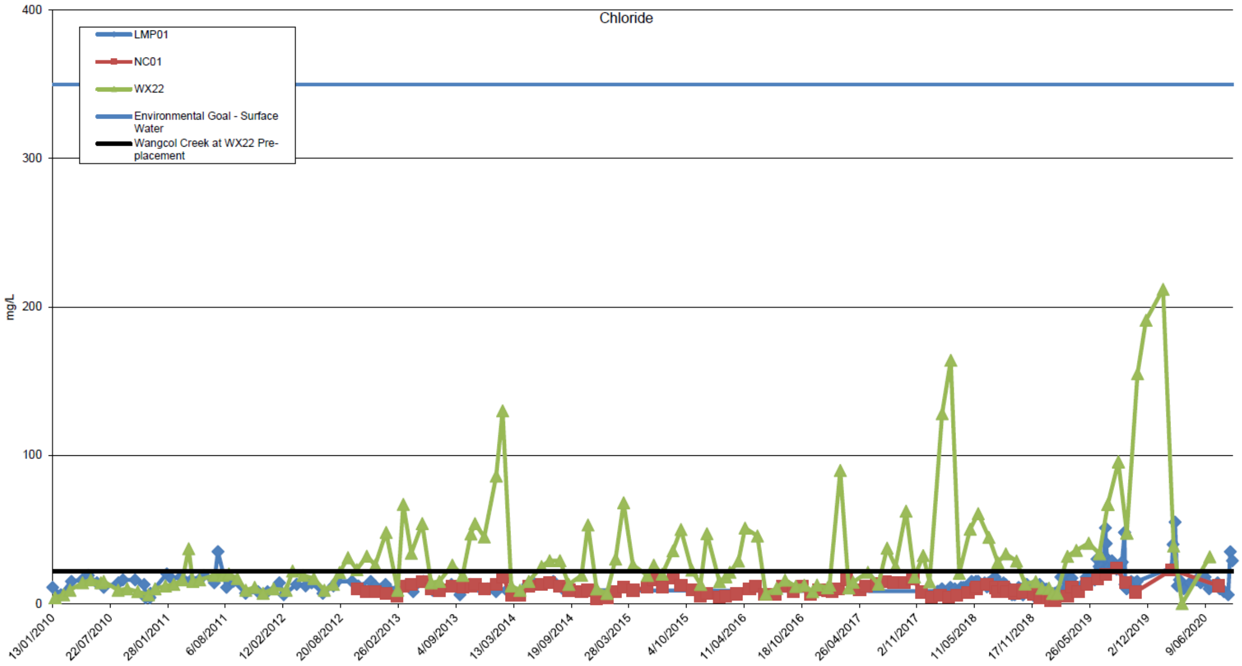
7.1.2 Environmental Performance

ERM was commissioned to carry out the surface water monitoring program required by Project Approval 09_0186 during the reporting period. A copy of the Water Quality Monitoring Report is contained in Appendix D. The surface water monitoring carried out during the reporting period identified a number of exceedances of water quality goals contained in the SSWMP and this triggered contingency measures requiring the commencement of a surface water investigation. This investigation is currently under way.

Exceedance of water quality goals were recorded during the reporting period with respect to surface water. Concentrations for the last 12 months, including those that exceeded the Environmental Goals, are presented in the tabulated surface water results in the annual water quality monitoring report in Appendix D.

Review of the surface water data presented in Appendix D indicates that, for specific analytes, concentrations at WX22 were generally higher than those reported at upstream locations LMP01 and NC01. Concentrations of chloride, sulphate, manganese, nickel and zinc in surface water from WX22 were generally higher than in samples from the upstream monitoring locations. However, these results are not considered to be due to ash placement activities occurring at LNAR. As reported in the Annual Environmental Monitoring Report – Water Management and Monitoring for the Mt Piper Power Station Brine Conditioned Fly Ash Co-Placement Project (the AEMR) (ERM, 2020), the results are considered likely related to be related to Brine Conditioned Ash (BCA) placement activities at the MPAR.

Figure 15 Chloride Concentrations in Surface Water



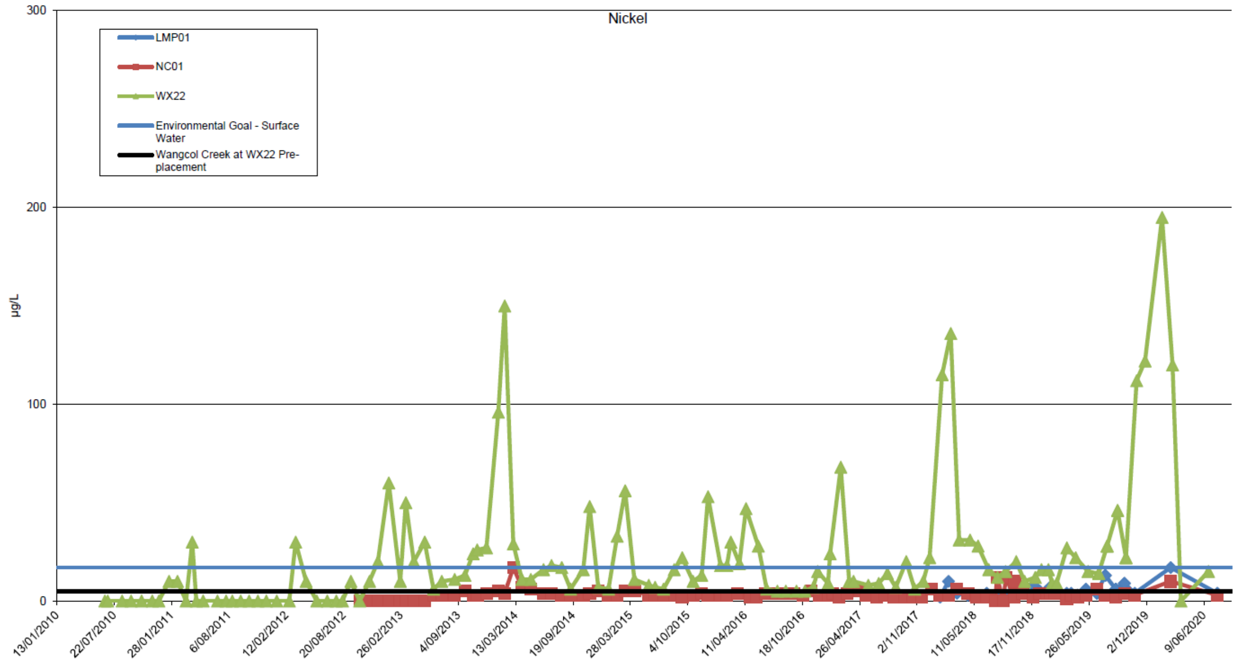
A review of concentration trends in surface water with respect to key indicators including chloride (Figure 15) and nickel (Figure 16) is presented. These indicators were selected based on their exceedances of ANZECC (2000) Trigger Values and/or the potential increase in concentration observed down-stream of the ash repository. Additional graphs generated and reviewed as part of the trend analysis are presented in Appendix D.

Chloride concentrations for all surface water monitoring locations were consistently below the Environmental Goal of 350 mg/L throughout the period 2010-2020. Chloride concentrations at WX22 during the 2019/20 monitoring period appear to be comparable with previous years, with the highest concentrations reported during the summer months. These peaks are likely associated with low stream flows, and increased influence of groundwater seepage during the summer months.

Nickel concentrations at LMP01 and NC01 have been generally stable since monitoring commenced in 2012. These upstream monitoring locations have reported concentrations of nickel equal to the Environmental Goal for surface water in March 2014 (NC01 – 17 µg/L) and February 2020 (LMP01 - 17 µg/L), however there is no concentration trend apparent.

The maximum nickel concentration of 195 µg/L was reported in a surface water at WX22 in January 2020. Similar to chloride, the highest nickel concentrations at WX22 typically occurred during periods of lower surface water flows. Nickel concentrations in surface water from WX22 exceeded the pre-placement trigger level on numerous occasions during the 12 months of the current monitoring period, and as with chloride, the peak concentrations of nickel in surface water at WX22 appear to becoming higher over time.

Figure 16 Nickel Concentrations in Surface Water



7.1.3 Reportable Incidents

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

7.1.4 Further Improvements

Surface water will continue to be monitored and appropriate action taken to mitigate potential impacts to Wangcol Creek. Mitigation controls will be informed following the completion of the independent groundwater investigation.

7.2 Groundwater Monitoring

7.2.1 Environmental Management

The Groundwater Management and Monitoring Plan (GMMP) is a sub-plan of the OEMP and seeks to address the specific requirements of the CoA D3 (b), E15 and E17. The objective of the GWMP is to assess compliance with the CoAs. The GMMP provides for the requirements for the ongoing groundwater monitoring program in accordance with CoA E15. The GMMP was established and implemented in October 2012 prior to construction activities and in addition to the existing monitoring regime for Mt Piper Ash Repository. A summary of the groundwater monitoring site locations is presented in Figure 3.

Performance criteria: Water quality trigger values set out in the OEMP (CDM Smith 2013) and modified by Aurecon (2017) have been adopted as Environmental Goals for the analytes. In addition to the Environmental Goals outlined above, an early warning is triggered when the post-ash placement 50th percentiles for the various water quality indicators at each of the surface water monitoring sites, exceed the pre-placement 90th percentiles (Aurecon 2017).

The GMMP provides the procedures and protocols that apply to the monitoring and testing of water quality and involves monthly sampling of existing long-term bores associated with Mt Piper Ash Repository and new bores located south of Huon Gully.

- Bore D9: East of Huon Gully and south of Wangcol Creek, located outside the ash placement area. Used to monitor groundwater quality and potential influence on Wangcol Creek
- Bore D8: North of Wangcol Creek. Used to monitor groundwater quality and potential influence on Wangcol Creek
- Bore D10 & D11: The Mt Piper Ash Repository bores, on the western side of the ash placement area are used to monitor inflows from Mt Piper to the Lamberts North placement in Huon Gully.
- Bore D1: North of Huon Gully, used to detect seepage from the north-eastern Mt Piper Ash Repository where BCA is emplaced and monitor groundwater quality and potential influence on Wangcol Creek.
- BoreD20: North-east of Lamberts North. Used to monitor groundwater quality and potential influence on Wangcol Creek.

Bores D20, D1, and D8 and D9, are used to enable management actions to be undertaken to minimise effects of the LNAR water conditioned ash placements. The GMMP also provides a contingency plan for events that have the potential to pollute or contaminate groundwater.

7.2.2 Environmental Performance

ERM was commissioned to carry out the groundwater monitoring program required by Project Approval 09_0186 during the reporting period. A copy of the Water Quality Monitoring Report is contained in Appendix D. The groundwater monitoring carried out during the reporting period identified a number of exceedances of water quality goals contained in the GMMP and this triggered contingency measures requiring the commencement of a groundwater investigation. This investigation is currently under way.

Exceedance of water quality goals were recorded during the reporting period with respect to groundwater. Concentrations for the last 12 months, including those that exceeded the Environmental Goals, are presented in the tabulated groundwater results in the annual water quality monitoring report Appendix D.

Based on groundwater quality data from bores located up gradient (and between the Mt Piper and Lamberts North ash repositories), these concentrations (particularly chloride) are unlikely to be related solely to the LNAR. Based on these results, EnergyAustralia NSW is undertaking further assessment and an independent investigation of groundwater and surface water in the vicinity of the Mt Piper and Lamberts North ash repositories.

A review of concentration trends with respect to key indicators including Chloride (Figure 17) and nickel (Figure 18) is presented. Chloride concentrations are above the Environmental Goal for groundwater at D9 and D11, and generally below the Environmental Goal for groundwater at D15. Each of these locations have concentrations of chloride above the pre-placement trigger value.

Nickel concentrations in groundwater from D9 increased from at least 2010 to the beginning of 2014. Nickel concentrations at bore D9 were generally stable from 2014 to mid-2017, after which concentrations have generally increased. Additional graphs are presented in WQMR, Appendix D.

Figure 17 Chloride in Groundwater

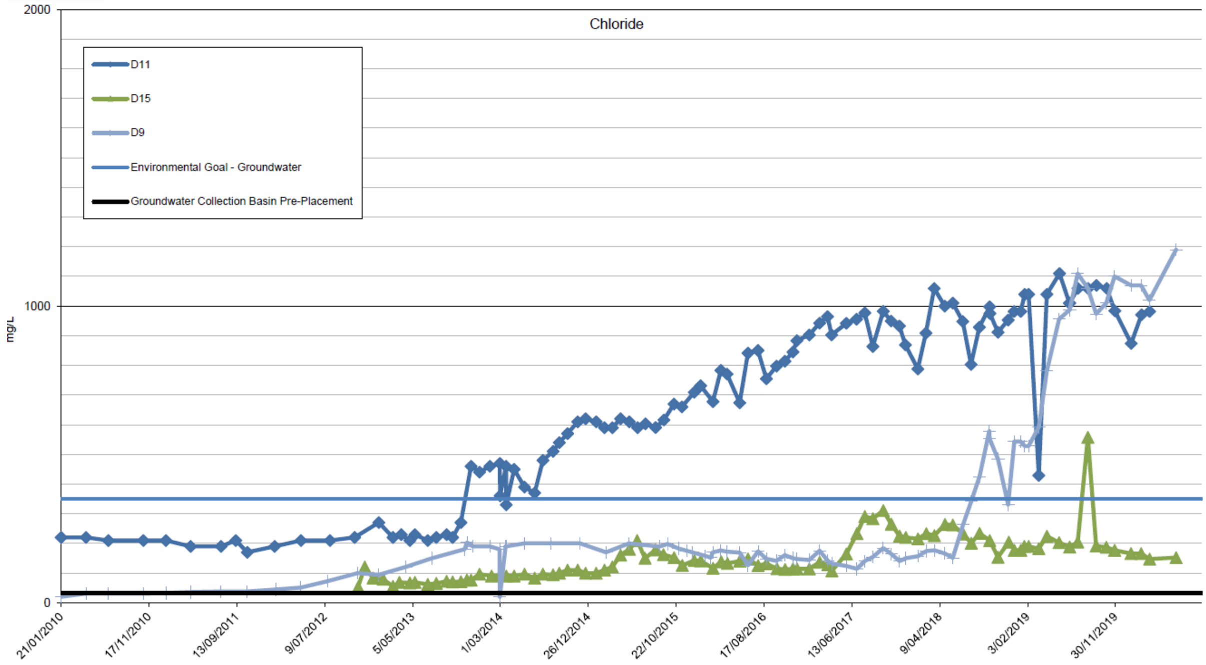
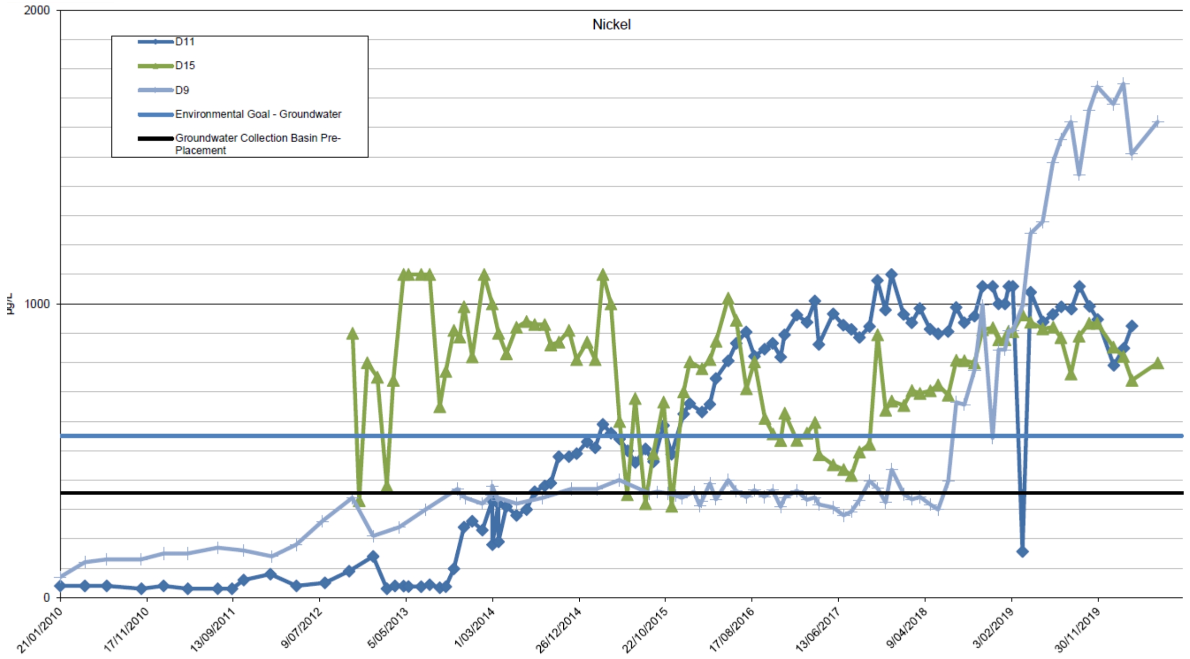


Figure 18 Nickel concentrations in Groundwater



7.2.3 Reportable Incidents

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

7.2.4 Further Improvements

An independent groundwater assessment is currently underway to investigate the variation of chloride concentrations in groundwater. This will assist in determining the source and pathway of elevated chlorides to Bore D10 and other sites near the LNAR.

7.3 Hydrological Monitoring

The hydrological monitoring program was incorporated into the GMMP because of the change in design to Lamberts North addressed in the Consistency Report (SKM, 2012), as indicated in Section 5.5.

7.4 Erosion and Sediment Control

7.4.1 Environmental Management

The LNAR catchment area uses external batters and laybacks to stabilise the ash placement and direct runoff to swale drains that are situated parallel to the batters. The swale directs the water towards a controlled point, being an off-flow structure placed approximately every 100m along the batter. The off-flow structure, which is typically a rock-lined chute, directs the water to a containment pond.

The trucks deliver ash to the working face and create a number of piles next to each other, prior to final placement. The piles of ash allow for any runoff to be directed to the dirty water sediment pond(s). The ash is then graded into its final position and compacted by rollers to specific compaction criteria to mitigate erosion and infiltration.

7.4.2 Environmental Performance

Management of the ash benches is with the primary principle of eliminating uncontrolled runoff over any batter. All benches associated with the LNAR area are graded west to ensure security against a breach from any external boundary. All surface water runoff from the ash footprint of the LNAR is managed within the boundary of the ash placement area.

The location of water retention within the LNAR has remained unchanged since 2014 in that surface water flow is retained over the original drainage line installed on the base of the placement site. All water collected on the LNAR is directed to the west side retention location. Free water is drained through the ash via a furnace bottom ash drainage line previously installed at the original floor level of the North Lamberts North placement area. Seepage reports to the lined LN Pond 2.

Based on site observations and information reviewed potential impacts from the operation of the LNAR on erosion and sediment control have been effectively mitigated and managed.

7.4.1 Reportable Incidents

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

7.4.2 Further Improvements

EA propose to construct a further lined water retention pond to assist in the management of surface water resources at the site. The construction of lined sediment ponds for the management of surface water drainage is approved under existing operating licences and approvals.

8. Landscape and Revegetation

8.1.1 Environmental Management

During the reporting year, no rehabilitation work was undertaken. Rehabilitation works at the LNAR is planned to occur when the 937m contour layback has been constructed around the perimeter of the ash repository. The completion of the 937m contour layback is anticipated to occur during the 2019 reporting year.

8.1.2 Environmental Performance

The LNAR is in the early stages of its development. As such no land preparation or rehabilitation work was conducted during the reporting period. The rehabilitation status of the LNAR is detailed in Table 16. The rehabilitation status of the Lamberts North and the adjoining Mt Piper Ash Repository is shown in Appendix E.

Table 16 Rehabilitation Status

Area Type	Prev Reporting Period Sept 2018 – Aug 2019 Hectares	This Reporting Period Sept 2019 – Aug 2020 Hectares	Next Reporting Period Sept 2020 – Aug 2021 Hectares
Total Footprint	19.8	19.8	19.8
Total active disturbance	12.2	16.7	16.7
Land being prepared for rehabilitation	0	1.30	1.30
Land under active rehabilitation	0	0	0
Completed rehabilitation	0	0	0

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

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

9. Community

9.1 Community Engagement

During the reporting period Community Reference Group meetings were held on 2 December 2019, 2 March 2020 and 1 June 2020. 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

The MTPPS and the associated LNAR 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 list of these organisations and events are included in Appendix H.

9.3 Community Complaints

There were no community complaints reported to EnergyAustralia NSW relating to the LNAR during the reporting period. EnergyAustralia NSW maintains a 24-hour hotline for the public to report incidents, complaints or enquiries with contact details available on the EnergyAustralia website. EnergyAustralia records the details of all complaints received in a Complaints Register (Appendix J).

9.4 Website Information

A project specific webpage has been developed to keep the broader community up to date with recent activities at the LNAR in accordance with Condition B10 of the Project's Conditions of Approval. Copies of the following documents are made publicly available on the EnergyAustralia NSW website:

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

- Environment Assessment
- Project Approval 09_0186
- Construction Environment Management Plan
- Operation Environmental Management Plan
- Annual Environmental Management Reports
- Environment Protection Licence 13007
- Pollution Incident Response Management Plan
- Community Reference Group Minutes

10. Independent Environmental Audit

10.1 Independent Environmental Audit

Actions from the independent environmental audit completed in October 2018 that are yet to be closed out are detailed below.

Table 17 Audit response action timeline

Recommendation Number	Recommendation	EnergyAustralia Response	Proposed date of completion
9	Include DPI Water response in Appendix E (Stakeholders Consultation) of the OEMP	Noted, recommendations 9, 10, 11,and 12 will be incorporated into the OEMP when updated. An independent groundwater investigation has been commissioned by EnergyAustralia NSW. The Department of Planning &Environment, Environment Protection Authority and Water NSW have been consulted throughout this process to-date. The independent groundwater investigation is anticipated to be progressively completed throughout 2020 The OEMP will be updated at the completion of the independent groundwater study	Q2 2021
10	Update the Groundwater Management Plan following the completion of the independent groundwater investigation		
11	Include a site water balance in the OEMP		
12	Undertake further assessment and an independent investigation of surface water in the vicinity of the LNAR		
	Clarify with EPA whether or not stainless-steel clips and mild steel caps are permitted to be disposed of at LNAR	Submission lodged with the EPA seeking clarification for disposal of these items.	Q1 2021

10.2 Environmental Representative Audit

An internal audit was conducted on the landscape revegetation and rehabilitation commitments detailed in Operation Environmental Management Plan. No non-compliance matters were identified. The report can be found in Appendix F.

11. Activities Proposed in the next reporting period

EnergyAustralia is currently reviewing its ash management and brine disposal arrangements. This may change the way that ash and brine is disposed of in the future which may require a Modification to be submitted to the DPIE. Any material changes to the existing operating arrangements at the LNAR will be subject to a Modification of the existing Project Approval and relevant environmental Management Plans will be updated accordingly.

Activities to be conducted in the next reporting period will include:

- Ash placement into Lamberts North building to 937m external layback.
- 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 LNAR.
- Continue monitoring the ecological health of Wangcol Creek throughout the life of the Project. The monitoring will continue after final capping of the LNAR for a minimum of five years in accordance with approval conditions.
- Continue the independent assessment of groundwater and surface water conditions at the site.
- Review the need for a possible project modification to allow for the ongoing management of brine waste at the site and other changes to provide for improved environmental outcomes.

11.1 Environmental Management Targets and Strategies for the Next Year

Environmental measures to be implemented in the next reporting period are detailed in Table 18.

Table 18 Measures to be implement in the next reporting period

Environment Management Area	Target / Strategy	Timeframe
Water Quality	Review the groundwater management and monitoring plan	Q2 2021
Water Quality	Implement mitigation and control measures to manage potential groundwater and surface water impacts	2020 onwards.

12. References

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13. Glossary of Terms

AEMR	Annual Environmental Management Report
AQMP	Air Quality Monitoring Program
CEMP	Construction Environmental Management Plan
CIP	Community Information Plan
CoA	Condition of Approval (also known as MCoA – Minister's CoA)
CPM	Construction Project Manager
CSM	Construction Site Manager
DECC	Department of Environment & Climate Change
DP&E	Department of Planning and Environment
DPI / DP&I	Department of Planning and Infrastructure
EA	EnergyAustralia
EPL	Environment Protection Licence
LN	Lamberts North
mAHD	Metres Australian Height Datum
NEMMCO	National Electricity Market Management Company
NSW RFS	NSW Rural Fire Service
NPWS	Nation Parks and Wildlife Services
OEH	Office of Environment & Heritage
OEMP	Operation Environmental Management Plan
ONVMP	Operational Noise and Vibration Management Plan
RL	Relative Level
WQMP	Water Quality Management Program
WQMR	Water Quality Management Report

Appendix A Detailed review checklist for Conditions of Approval

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
PART A - ADMINISTRATIVE CONDITIONS								
Terms of approval	A1	The Proponent shall carry out the project generally in accordance with the:	Project Approval, Environmental Assessment	Approved		Secretary	Based on the review undertaken, the Lamberts North operations have been carried out in accordance with the requirements.	**Compliant**
	a)	Major Project Application 09_0186;			Feb-12			
	b)	Mt Piper Ash Placement (two volumes) – Environmental Assessment (EA), prepared by Sinclair Knight Merz, August 2010;			Aug-10			
	c)	Mt Piper Ash Placement – Submissions Report, prepared by Sinclair Knight Merz, March 2011;			March 2011 & June 2012			
	d)	Delta's Letter to the Department – Submissions Report Response to the Department and Agency Issues (dated 22 June 2011); and			Jun-11			
	e)	the conditions of this approval.			n/a			
	A2	In the event of an inconsistency between:	Project Approval	Obligation			No inconsistencies were observed between the listed documents during implementation of the project or during the course of the review of operations for the AEMR.	**Compliant**
	a)	the conditions of this approval and any document listed from condition A1a) to A1(d) inclusive, the conditions of this approval shall prevail to the extent of the inconsistency; and						
	b)	any of the documents listed from conditions A1a) to A1(d) inclusive, the most recent document shall prevail to the extent of inconsistency.						
	A3	The Proponent shall comply with the reasonable requirements of the Director-General arising from the Department's assessment of:					In a letter dated 9 January 2019, the Secretary of the DPIE requested eight (8) actions arising from their assessment of the 2017-18 AEMR. These actions have been addressed in Section 5 of the 2018-19 AEMR.	**Compliant**
	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.						
	A4	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 A1 of this approval.					A request was made from the Secretary of the DPIE on April 2018 to have an Independent Environmental Audit (IEA) commissioned by June 2019. The IEA was performed in October 2018 (SLR, 2018)	**Compliant**
Limits of Approval	A5	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.	Project Approval	n/a	n/a	Secretary	The Project Approval for Lamberts North Ash Repository (DPI, 2012) is dated 16 February 2012 with construction works on the Lamberts North Ash Repository project commencing 7 January 2013, following approval of the CEMP by DPE in December 2012. Ash placement commenced in September 2013, well before the 'deadline' date.	**Compliant**
Statutory Requirements	A6	The Proponent shall ensure that all licences, permits and approvals are updated and/or 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.	Project Approval	on-going	on-going	TBA	Based on the Environmental Assessment (SKM, 2010) and OEMP (EANSW, 2019), no permits were required during the operational phase of the project. Prior to construction licences for sinking boreholes were obtained from the NSW Office of Water. No Commonwealth permits, licences or approvals have been identified for the project. The project complies with the requirements of EnergyAustralia NSW's EPL 13007 (See Section 1 of the 2019-20 AEMR)	**Compliant**
Staging	A7	Where the Proponent intends to construct and operate the project in discrete stages (i.e Lamberts North and Lamberts South) it may comply with the requirements in conditions B4, B5, D2, D3 and D4 separately for each stage.	Project Approval	on-going	on-going	Secretary	A CEMP (CDM Smith, 2012a) for construction (CoA B4) including the Construction Noise Management Plan (CoA B5) was approved by the DPI 1 December 2012. An OEMP (CDM Smith, 2013) for operation (CoA D2) of Lamberts North including the Operational Noise Management Plan (CoA D3) and Groundwater Management Plan (CoA D4) was approved by the DPI on 13 May 2013. The OEMP was reviewed and updated by EnergyAustralia (2019) in the 2018-19 reporting period which was approved by the DPIE on 1 October 2019. The abovementioned conditions are compliant for the Lamberts North and have not applied to Lamberts South as no construction works have commenced.	**Compliant**

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
PART B - PRIOR TO CONSTRUCTION CONDITIONS								
Environmental Representative	B1	Prior to the commencement of any construction 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). 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:	Project Approval	Approved	1/12/2012	Secretary	In October 2012 Delta Electricity nominated the Senior Environment Officer Kelly Gillen as the Environmental Representative. The Senior Environment Officer was approved as the Environmental Representative by the DPI on 01 December 2012. The Senior Environment Officer oversees the implementation of Lamberts North operations through attendance at Monthly Client Meetings with Lend Lease. The Senior Environment Officer guides the project through site visits, sampling, auditing and other regulatory activities to ensure compliance with the environmental requirements of the CoAs and all relevant licences. In April 2015, EnergyAustralia NSW notified the DPE of Ms Gillen's new position within the organisation and nominated the new Senior Environment Officer Coleen Milroy as the Environmental Representative. In April 2018, EnergyAustralia NSW advised the DPE of Mrs. Skye Zorz's nomination for the role of Environmental Representative for the Mount Piper Ash Placement Project and this was approved by the Secretary and Mrs. Zorz was approved for the role of Environmental Representative. Ben Eastwood NSW Environment Leader is the current Environmental Representative for the site.	**Compliant**
	a)	oversee the implementation of all environmental management plans and monitoring programs required under this approval, and advise the Proponent upon the achievement of these plans/programs;						
	b)	consider and advise the Proponent on its compliance obligations against all matters specified in the conditions of this approval and the Statement of Commitments; and						
	c)	have 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.						
Groundwater Modelling	B2	The Proponent shall undertake groundwater modelling by either adapting the existing UTS (2007) groundwater model to Lamberts North or developing a new groundwater model for Lamberts North. The updated model should be calibrated to site-specific data. In either case, the model shall incorporate the findings of groundwater monitoring of the existing ash placement areas. The Proponent shall consult with the SCA in the preparation of the groundwater model and the model shall be provided to the SCA within five months of project approval, unless otherwise agreed by the Director-General. The model shall address but not necessarily be limited to the following:	CEMP - Section 8	Complete	14/11/2012	Secretary	A Groundwater modelling report was prepared by CDM Smith in November 2012 (CDM Smith, 2012b). The report was prepared in consultation with the SCA and evaluated the potential impacts of construction and operational activities at the site and to assist in determining appropriate surface and groundwater management measures. No construction work has commenced at Lamberts South.	**Compliant**
	a)	the findings of the groundwater monitoring of existing ash placement areas and be based on average groundwater quality data;	Groundwater Model Report Version #2	Complete	8/10/2012	Secretary		
	b)	updated predictions of the long term behaviour, fate and impacts of ash placement, in particular for water quality parameters such as sulphates, chlorides, boron, manganese, nickel, zinc, molybdenum copper, arsenic and barium;						
	c)	updated risk assessment for ground and surface water quality impacts under a range of rainfall events of differing duration and intensities (including up to a 100 year ARI event);						
	d)	calibration to site-specific data; and						
	e)	identification of appropriate surface and groundwater management measures required in order to achieve a neutral or beneficial effect on water quality.						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Groundwater Monitoring	B3	Baseline groundwater monitoring data, including groundwater quality, location of groundwater monitoring wells, depth and flow of groundwater in the project area should be obtained for a minimum of two sampling events prior to construction and a minimum of two sampling events after construction and prior to ash placement commencing. The baseline monitoring data along with the modelling predictions in B2 should be used in the consideration of the design of the ash placement facilities. The location of groundwater monitoring wells and parameters to be monitored should be undertaken in consultation with the SCA. Prior to construction of Lamberts South the Proponent shall conduct baseline groundwater data collection as set out above, and use the results and the modelling predictions in B2 in the consideration of the design of the ash placement facilities.	Groundwater report version #2	Complete for Lamberts North	12/11/2012 & 9/11/2012	Secretary	Groundwater bores were installed in July 2012 and were licenced for their construction with NSW Office of Water. The first sampling event for baseline testing was performed upon installation and prior to construction. The location and parameters to be undertaken were done in consultation with SCA. Existing historical groundwater bores that were established since the construction of Mt Piper are used to supplement the newly installed groundwater bores.	**Compliant**
Construction Environmental Management Plan	B4	The Proponent shall prepare and implement a Construction Environmental Management Plan (CEMP) to outline environmental management practices and procedures to be followed during construction of the project. The Plan shall be prepared in consultation with Lithgow City Council and relevant government agencies, and be consistent with the Guideline for the Preparation of Environmental Management Plans (DIPNR, 2004 or its latest revision) and shall include, but not necessarily be limited to:	Section 8 CEMP	Approved	1/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in November 2012.	**Compliant**
	a)	a description of all relevant activities to be undertaken on the site during construction including an indication of stages of construction, where relevant;	CEMP	Approved	1/12/2012	Secretary		
	b)	identification of the potential for cumulative impacts with other construction activities occurring in the vicinity and how such impacts would be managed;						
	c)	details of any site compounds and mitigation, monitoring, management and rehabilitation measures specific to the site compound(s) that would be implemented;						
	d)	statutory and other obligations that the Proponent is required to fulfil during construction including all relevant approvals, consultations and agreements required from authorities and other stakeholders, and key legislation and policies;						
	e)	evidence of consultation with relevant government agencies required under this condition and how issues raised by the agencies have been addressed in the plan;						
	f)	a description of the roles and responsibilities for all relevant employees involved in the construction of the project including relevant training and induction provisions for ensuring that all employees, contractors and subcontractors are aware of their environmental and compliance obligations under these conditions of approval;						
	g)	details of how the environmental performance of construction will be managed and monitored, and what actions will be taken to address identified potential adverse environmental impacts;						
	h)	specific consideration of relevant measures to address any requirements identified in the documents referred to under conditions A1(b) and A1(d);						
	i)	a complaints handling procedure during construction;						
	j)	emergency management measures including measures to control bushfires;						
	k)	details of waste management including reuse and/or recycling of waste material, to minimise the need for treatment or disposal of those materials outside the site; and						
	l)	the additional requirements of this approval.						
		The CEMP 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.						

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2019-20 Observation	Compliance Finding
Construction Noise Management Plan	B5	As part of the CEMP for the project, the Proponent shall prepare and implement the following plans:	CEMP Noise Sub Plan	Approved	1/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing a Construction Noise Management Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in November 2012.	Compliant
	a)	a Construction Noise Management Plan to detail how construction noise impacts would be minimised and managed. The Plan shall be developed in consultation with the EPA 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)	identification of noise criteria and procedures for assessing noise levels at sensitive receivers;						
	iv)	details of reasonable and feasible actions and measures to be implemented to minimise noise impacts;						
	v)	details of noise monitoring and if any noise exceedance is detected, how any non-compliance would be rectified; and						
	vi)	procedures for notifying sensitive receivers of construction activities that are likely to affect their noise amenity.						
Groundwater Management Plan	b)	a Groundwater Management Plan to detail measures to manage groundwater impacts. The Plan shall be prepared in consultation with the NOW and the SCA and include, but not necessarily be limited to:	CEMP Groundwater Sub plan	Approved	1/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing a Groundwater Management Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in November 2012.	Compliant
	i)	identification of the construction activities that could affect groundwater at the site, including groundwater interference and impacts to groundwater users and dependent species;						
	ii)	ii) a description of the management controls to minimise impacts to groundwater during construction;						
	iii)	methods for monitoring groundwater during construction including a program to monitor groundwater flows and groundwater quality in the project area;						
	iv)	a response program to address indentified exceedances of existing groundwater quality criteria approved for Area 1 (the existing ash placement area); and						
	v)	provisions for periodic reporting of results to the SCA during construction.						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Soil and Surface Water Management Plan	c)	a Soil and 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 lands and/or waters throughout the construction period. The Plan shall be based on best environmental practice and shall be prepared in consultation with the SCA and the NOW and any other relevant government agency. The Plan shall include, but not necessarily be limited to:	CEMP Soil and Surface Water Sub Plan	Approved	1/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing a Soila nd Surface Water Management Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in November 2012.	**Compliant**
	i)	baseline data on the water quality and available flow data in Huons Creek, Lamberts Gully Creek and Neubecks Creek;						
	ii)	water quality objectives and impact assessment criteria for Huons Creek, Lamberts Gully Creek and Neubecks Creek;						
	iii)	a geomorphic assessment of the capacity of Lamberts Gully Creek to accommodate additional flow under a range of rainfall events and duration, prior to commencement of construction works;						
	iv)	identification of the construction activities that could cause soil erosion or discharge sediment or water pollutants from the site;						
	v)	description of stockpile locations and disposal methods;						
	vi)	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;						
	vii)	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);						
	viii)	a site water management strategy identifying drainage design including the separation of clean and dirty water areas for the project, details of the lining of surface water collection ponds 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 consideration to the treatment of water prior to discharge to the environment;						
	ix)	measures to monitor and manage soil and water impacts in consultation with NOW and DPI (Fisheries) including: control measures for works close to or involving waterway crossings (including rehabilitation measures following disturbance and monitoring measures and completion criteria to determine rehabilitation success);						
	x)	measures to monitor and manage flood impacts in consultation with NOW and shall include, but not necessarily be limited to a flood model for predicted water levels and contingency measures for the site during potential floods;						
	xi)	a program to monitor surface water quality, including Lamberts Gully Creek and Neubecks Creek;						
	xii)	a protocol for the investigation of identified exceedances in the impact assessment criteria;						
	xiii)	a response plan to address potential adverse surface water quality exceedances; and						
	xiv)	provisions for periodic reporting of results to the DPI (Fisheries), NOW and the SCA as per condition B8.						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Air Quality Management Plan	d)	a Air Quality Management Plan, to provide details of dust control measures to be implemented during the construction of the project. The Plan shall be prepared in consultation with the EPA and should include, but not necessarily be limited to:	CEMP - Air Quality Sub plan	Approved	1/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing an Air Quality Management Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in November 2012.	**Compliant**
	i)	identification of sources of dust deposition including, truck movements, regrading, backfilling, stockpiles and other exposed surfaces;						
	ii)	identification of criteria, monitoring and mitigation measures for the above sources; and						
	iii)	a reactive management programme detailing how and when construction operations are to be modified to minimise the potential for dust emissions, should emissions exceed the relevant criteria.						
Flora and Fauna Management Plan	e)	a Flora and Fauna Management Plan, to outline measures to protect and minimise loss of native vegetation and native fauna habitat as a result of construction of the project. The Plan shall be prepared in consultation with the EPA and shall include, but not necessarily be limited to:	CEMP Flora and Fuana Sub Plan	Approved	1/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing a Flora and Fauna Management Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in November 2012.	**Compliant**
	i)	plans showing terrestrial vegetation communities; important flora and fauna habitat areas; locations of threatened flora and fauna and areas to be cleared. The plans shall also identify vegetation adjoining the site where this contains important habitat areas and/or threatened species, populations or ecological communities;						
	ii)	procedures to accurately determine the total area, type and condition of vegetation community to be cleared;						
	iii)	methods to manage impacts on flora and fauna species and their habitat which may be directly or indirectly affected by the project, procedures for vegetation clearing or soil removal/stockpiling and procedures for identifying and re-locating hollows, installing nesting boxes and managing weeds; and						
	iv)	a procedure to review management methods where they are found to be ineffective.						
Aboriginal Heritage Plan	f)	an Aboriginal Heritage Plan to monitor and manage Aboriginal heritage impacts in consultation with registered Aboriginal stakeholders and prepared in consultation with the EPA. The plan should include but not necessarily limited to:	CEMP Aboriginal Sub plan	Approved	1/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing an Aboriginal Heritage Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in November 2012.	**Compliant**
	i)	an updated Cultural Heritage Management Plan to cover the protection of sites previously recorded in the 2005 Aboriginal heritage assessment;						
	ii)	procedures for the management of unidentified objects and/or human remains, including ceasing work;						
	iii)	Aboriginal cultural heritage induction processes for construction personnel; and						
	iv)	procedures for ongoing Aboriginal consultation and involvement should Aboriginal heritage sites or objects be found during construction.						
Ash Transportation Plan	g)	An Ash Transportation Plan to provide details on the preferred option for the transportation of ash from the Mt Piper Power Station to the ash placement areas. The Plan shall include but not necessarily limited to:	CEMP Ash Transport Plan	Approved	1/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing an Ash Transportatoin Management Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in November 2012.	**Compliant**
	i)	justification of the proposed option for ash transportation (either haulage access roads and/or conveyor) for ash transportation;						
	ii)	details of the proposed option, including construction requirements, impacts and mitigation measures;						
	iii)	plans showing the location of the chosen option; and						
	iv)	provision of mitigation measures should the conveyor breakdown						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Biodiversity Offsets	B6	The Proponent shall develop and submit for the approval of the Director-General, a Biodiversity Offset Management Plan. The Biodiversity Offset Management Plan is to be submitted within 12 months of the project approval, unless otherwise agreed to by the Director-General. The Plan shall be developed in consultation with the EPA and shall:	BOMP	Approved	24/08/2015	Secretary	A Biodiversity Offset Management Plan (BOMP) for Lamberts North in consultation with OEH was submitted 14 May 2013 to DPI. The BOMP (Delta Electricity, 2012) was not approved 18 June 2013 and DPI requested the BOMP to be revised to include an offset of 1:1 to the existing rehabilitation site and be resubmitted. The BOMP was revised in consultation with OEH and submitted 23 July 2015. The revised BOMP (EANSW, 2015) was approved 24 August 2015. The BOMP was later updated and approved by DPIE on the 19 December 2019. A Biodiversity Offset Strategic Outline (BOSO) was prepared for Lamberts South and was considered appropriate by the Department.	**Compliant**
	a)	identify the objectives and outcomes to be met by the Biodiversity Offset Management Plan;						
	b)	describe the size and quality of the habitat/vegetation communities of the offset;						
	c)	identify biodiversity impacts, including impacts related to the loss of impacted flora and fauna including threatened Capertee Stringybark (Eucalyptus cannonii), nine (9) hectares of remnant vegetation (including, Red Stringy Bark Woodland, Scribbly Gum Woodland, Ribbon Gum Woodland), habitat for microbat and woodland bird species and the 31 ha of rehabilitated vegetation to be removed;						
	d)	describe the decision-making framework used in selecting the priority ranking of compensatory habitat options available in the region. Where possible, this should include purchase of land, development of agreements with identified land management authorities (e.g EPA, local Council) for long term management and funding of offsets and mitigation measures, and installation of identified mitigation measures;						
	e)	include an offset for direct and indirect impacts of the proposal which maintains or improves biodiversity values;						
	f)	identify the mechanisms for securing the biodiversity values of the offset measures in perpetuity and identify a monitoring regime, responsibilities, timeframes and performance criteria; and						
	g)	detail contingency measures to be undertaken should monitoring against performance criteria indicate that the offset/ rehabilitation measures have not achieved performance outcomes. Rehabilitation measures are required to be implemented to ensure that the biodiversity impacts are consistent with a maintain or improve biodiversity outcome.						
Ecological Monitoring Program	B7.	The Proponent shall prepare and implement an Ecological Monitoring Program prior to construction, in consultation with the NOW and the DPI (Fisheries), to monitor and quantify the impacts on the ecology of Neubecks Creek and the associated riparian environment. The Program shall include, but not necessarily be limited to:	EMP	Approved	31/11/2012	NOW, (DPI Fisheries	The Ecological Monitoring Plan (EMP) was produced 31 November 2012 in consultation with NOW and DPI (Fisheries). Baseline data was sampled 7 November 2012 and autumn and spring sampling obtained for 2013 and 2014. Spring sampling for the September 2016 – August 2017 reporting period was performed in December 2016 (Cardno, 2017). Autumn sampling for the September 2017 – August 2018 reporting period was performed in May 2018 (Cardno, 2018). Spring sampling for the September 2018 – August 2019 reporting period was performed in December 2018 (Cardno, 2019). The most recent sampling work was conducted in May 2020 (Cardno, 2020).	**Compliant**
	a)	a sampling, data collection and assessment regime to establish baseline ecological health and for ongoing monitoring of ecological health of the instream environment during construction and throughout the life of the project (including operation);	EMP	Complete	31/11/2012	Secretary		
	b)	at least one in-stream sampling period prior to ash placement at Neubecks Creek and at least two (2) sampling periods following ash placement at each of Lamberts North and Lamberts South;	Report for Spring 2012, Autumn 2013: (Annual),Spring 2013	Complete	15/07/2015	Secretary		
	c)	an assessment regime for monitoring the ecological health of the riparian environment for a period of at least five (5) years after final capping; and	EMP	Complete	31//11/2012	Secretary		
	d)	management measures to address any adverse ecological impacts.	EMP	Complete	31//11/2012	Secretary		

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Compliance Monitoring and Tracking	B8.	The Proponent shall develop and implement a Compliance Tracking Program for the project, prior to commencing construction, to track compliance with the requirements of this approval and shall include, but not necessarily be limited to	This document	Approved	13/12/2012	Secretary	A Compliance Tracking program (this document) was developed & implemented prior to commencing construction. The Compliance and Tracking document was approved by DPI on 13 December 2012.	**Compliant**
	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 A1c) of this approval;	This document	Complete	Ongoing	Secretary		
	b)	provisions for periodic reporting of the compliance status to the Director-General;	AEMR, CoA and CEMP compliance	Complete	Ongoing	Secretary		
	c)	a program for independent environmental auditing in accordance with AS/NZ ISO 19011:2003 - Guidelines for Quality and/or Environmental Management Systems Auditing;	EMS procedures #13 & #16	Complete	Ongoing	Secretary		
	d)	procedures for rectifying any non-compliance identified during environmental auditing or review of compliance;	EMS procedure #14	Complete	Ongoing	Secretary		
	e)	mechanisms for recording environmental incidents and actions taken in response to those incidents;	EMS procedure #14	Complete	Ongoing	Secretary		
	f)	provisions for reporting environmental incidents to the Director-General during construction and operation; and	EMS procedure #14	Complete	Ongoing	Secretary		
	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.	CEMP+ CEMP compliance doucment + training + induction	Complete	Ongoing	Secretary		
		The Compliance Tracking Program shall be implemented prior to construction of the project with a copy submitted to the Director-General for approval at least four weeks prior to the commencement of the project, unless otherwise agreed by the Director- General.	This document	Approved	13/12/2013	Secretary		
	B9.	Nothing in this approval restricts the Proponent from utilising any existing compliance tracking programs administrated by the Proponent to satisfy the requirements of condition B8. 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.	EMS inlcuding Ellipse, Lawlex in addtion to this document	on-going	n/a	Secretary		

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Community Information and Complaints Management Provision of Information	B10.	Prior to the construction 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:	EA web page	Complete	5/12/2012	Secretary	A project website is available for the Lamberts North Project: https://www.energyaustralia.com.au/about-us/energy-generation/lamberts-north-ash-repository The webpage hosts the Environmental Assessment, Submissions report and approvals, as well as Environmental Management Plans, Annual Environmental Management Reports and Compliance Tracking. Progress on operations and outcomes of compliance tracking are detailed within the Quarterly Community meeting and the minutes from this meeting are available from the following website: https://www.energyaustralia.com.au/about-us/energy-generation/mt-piper-power-station/mt-piper-and-wallerawang-community	**Compliant**
	a)	the documents referred to under condition A1 of this approval;	EA web page	Complete	5/12/2012	Secretary		
	b)	this project approval, Environment Protection Licence and any other relevant environmental approval, licence or permit required and obtained in relation to the project;	EA web page	Complete	05/12/2012	Secretary		
	c)	all strategies, plans and programs required under this project approval, or details of where this information can be viewed;	EA web page	Complete	5/12/2012	Secretary		
	d)	Information on construction and operational progress; and	EA web page	Complete	5/04/2013	Secretary		
	e)	the outcomes of compliance tracking in accordance with the requirements of this project approval.	EA web page	Complete	5/12/2012	Secretary		
Complaints and Enquiries Procedure	B11.	Prior to the construction of the project, the Proponent shall ensure that the following are available for community complaints and enquiries during construction and operation:	EA web page	Complete	05/12/2012 and 04/2015	Secretary	The Project website contains a link to the following website with contains the relevant contact details are available from the following website: https://www.energyaustralia.com.au/about-us/energy-generation/mt-piper-power-station This website lists the following contact details for the project: 24 hour contact number – call Mt Piper Power Station on (02) 6354 8111 Postal Address: EnergyAustralia NSW – Mt Piper Power Station Locked Bag 1000 Portland NSW 2847 Email: contactus@energyaustraliansw.com.au	**Compliant**
	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 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 B11 of this approval.	Community information plan (CIP) article published in Lithgow Mercury 8/12/2012	Complete	5/12/2012	Secretary		

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Complaint register	B12	The Proponent shall record the details of complaints received through the means listed under condition B11 of this approval in a Complaints Register. The Register shall record, but not necessarily be limited to:	EMS procedure #14	on-going	Ongoing	EA	Any complaints to EnergyAustralia NSW go via the switchboard, or through email or mail 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 as per Environment Management System Administration Procedure for non-conformity, corrective and preventative action. If actions were necessary, a review of those actions is undertaken before the work order is closed. In addition, the ash contractors produce a monthly compliance report including a record of any complaints received. No complaints were received regarding the Ash Repository which included the Lamberts North Project for the reporting period (as per Appendix J of the AEMR).	**Compliant**
	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 complaint;						
	g)	any follow-up contact with, and feedback from, the complainant; and						
	h)	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.						
Community Information Plan	B13	Prior to the commencement of construction of the project, the Proponent shall prepare and implement a Community Information Plan which sets out the community communications and consultation processes to be undertaken during construction and operation of the project. The Plan shall include but not be limited to:	Community Information Plan	Approved	1/12/2012	Secretary	The Lamberts North Ash Placement Stakeholder Communications Plan (September 2012) was specifically prepared and implemented for the purposes of this project. The CIP was published in the local newspaper Lithgow Mercury 08 December 2012. A Community Information Plan (CIP) was also prepared in October 2013. The CIP was recently updated to reflect EnergyAustralia (EA) as the owners and remove any references to Delta Electricity in accordance with a recommendation from the Independent Environmental Audit (Aurecon, 2014).	**Compliant**
	a)	measures for disseminating information on the development status of the project and methods for actively engaging with surrounding landowners, including Forests NSW and affected stakeholders regarding issues that would be of interest/ concern to them during the construction and operation of the project; and						
	b)	procedures to inform the community where work has been approved to be undertaken outside the normal Construction hours, in particular noisy activities.						
		A copy of the Plan shall be provided to the Director-General one month prior to the commencement of construction.						
Design	B14	The ash placement areas shall be designed by a suitably qualified expert to ensure structural stability of the ash placement areas.	CDM Smith completed Design	Approved	1/12/2012	Secretary	Design approved by DPE 01 December 2012. The ash placement areas were designed by JK Williams, in consultation with Principal Contractors Lend Lease, to ensure structural stability of the ash placement areas. The ash placement areas were constructed in line with the design.	**Compliant**
PART C - DURING CONSTRUCTION- All Conditions in this section are covered in CEMP								
Environmental Incident Reporting	C1.	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.	PIRMP	Approved	Ongoing	EPA	No environmental incidents requiring notification of the Director-General occurred within the September 2019-August 2020 reporting period.	**Not applicable**
	C2	The Proponent shall meet the requirements of the Director-General to address the cause or impact of any environmental incident, as it relates to this approval, reported in accordance with condition C1 of this approval, within such period as the Director- General may require.						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Construction Hours		Construction activities associated with the project shall only be undertaken during the following hours:	CEMP - Section 4.3	Approved	1/12/2012	Secretary	No construction activities that trigger the requirements described under these conditions have occurred during the reporting period.	**Not applicable**
	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.						
	C4.	Construction outside the hours stipulated in condition C3 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.						
	C5	The hours of construction activities specified under condition C3 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 C3 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 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.						
Construction Noise	C6.	The construction noise objective for the project is to manage noise from construction activities (as measured by LAeq (15 minute) descriptor) so as not to exceed:	CEMP - Section 5.1 and Noise Sub Plan	Approved	1/12/2012	Secretary	No construction activities that trigger the requirements described under this condition have occurred during the reporting period.	**Not applicable**
		Location | **Day (LAeq (15 minute)) dB(A)**						
		All private receivers within the township of Blackmans Flat | 46						
		All other residences | 43						
		The Proponent shall implement reasonable and feasible noise mitigation measures with the aim of achieving the construction noise objective consistent with the requirements of the Interim Construction Noise Guideline (DECC, July 2009), including noise generated by heavy vehicle haulage and other construction traffic associated with the project. 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 to under condition B5a) of this approval).						
Dust Generation	C7.	The Proponent shall construct the project in a manner that minimises dust emissions from the site, including wind-blown from earth works and stockpiles and traffic generated dust. 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.	CEMP Air quality Sub plan	Approved	1/12/2012	Secretary	No construction activities that trigger the requirements described under this condition have occurred during the reporting period.	**Not applicable**

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Heritage Impacts	C8.	If during the course of construction the Proponent becomes aware of any previously unidentified Aboriginal object(s), all work likely to affect the object(s) shall cease immediately and the EPA (OEH) informed in accordance with the National Parks and Wildlife Act 1974. In addition, registered Aboriginal stakeholders shall be informed of the finds. Works shall not recommence until an appropriate strategy for managing the objects has been determined in consultation with the EPA (OEH) and the registered Aboriginal stakeholders and written authorisation from the EPA (OEH) is received by the Proponent.	CEMP aboriginal sub plan	Approved	1/12/2012	Secretary	The course of action for Aboriginal objects identified during construction is detailed in CEMP Aboriginal sub-plan approved by DPI 01 December 2012. No Aboriginal artefacts were discovered during construction.	**Compliant**
	C9.	If during the course of construction the Proponent becomes aware of any unexpected historical relic(s), all work likely to affect the relic(s) shall cease immediately and the EPA (OEH (Heritage Branch)) notified in accordance with the Heritage Act 1977. Works shall not recommence until the Proponent receives written authorisation from the EPA (OEH (Heritage Branch)).	CEMP Aboriginal Sub plan	Approved	1/12/2012	Secretary	No historical relics were discovered during construction.	**Compliant**
Soil and Water Quality Impacts	C10	The Proponent shall comply with section 120 of the Protection of the Environment Operations Act 1997 which prohibits the pollution of waters.	CEMP- Soil and Water Sub Plan	Approved	1/12/2012	Secretary	Compliance is achieved through the CEMP Soil and water sub-plan approved by DPI 01 December 2012 and EPL 13007.	**Compliant**
	C11	Soil and water management controls shall be employed to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters during construction activities, in accordance with:						
	a)	Managing Urban Stormwater: Soils and Conservation (Landcom, 2004);						
	b)	Managing Stormwater: Urban Soils and Construction 2A Installation of Services (DECC 2008); and						
	c)	Managing Stormwater: Urban Soils and Construction Vol 2C Unsealed Roads (DECC 2008).						
	C12.	During construction, the Proponent shall maintain a buffer of 50 metres from the construction work to Neubecks Creek.					Buffer was maintained as documented in JK Williams Contractor meeting minutes.	**Compliant**
	C13.	Surface water drainage must be appropriately engineered and stabilised to convey run off without collapse or erosion. Surface water run off collection ponds are to be lined.					Surface water drainage engineered and stabilised as per CEMP Soil and Water sub-plan approved by DPI 01 December 2012.	**Compliant**
Waste Generation and Management	C14	All waste materials removed from the site shall only be directed to a waste management facility lawfully permitted to accept the materials.	CEMP- Section 4.3	on-going	Approved 1/12/2012 by DG subject to conditions addressed in letter dated 1/02/2012	Secretary	EnergyAustralia NSW manages all site waste in accordance with EPL 13007 disposal and restricted waste area or via waste contractors with licenced waste contractor.	**Compliant**
	C15.	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.					No wastes generated outside the Lamberts North site were 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 personnel are required to report if they encounter any rubbish or wastes outside those that are allowed during routine operations	**Compliant**
	C16.	The Proponent shall ensure that all liquid and / or non-liquid waste generated and / or stored on the site is assessed and classified in accordance with the Waste Classification Guidelines (DECC, 2008), or any future guideline that may supersede that document.					EANSW manages all site waste in accordance with EPL 13007 disposal and restricted waste area or via waste contractors with licenced waste contractor.	**Compliant**
PART D - PRIOR TO OPERATION								
Ash Management	D1.	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 2020. The report shall be submitted to the Director-General six months prior to 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.	Long Term Ash Management Strategy	Approved	30/07/12	Secretary	Lamberts North Consistency Report (SKM, 2012) and Ash Management Strategy (DMC, 2010) approved by DPI 30 July 2012 detailing the long-term ash management strategy for ash re-use. EnergyAustralia NSW have provided two yearly update on the status of the Ash Management Strategy in 2016 and 2018 (EANSW, 2016a; 2018)	**Compliant**

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Operational Environmental Management Plan	D2.	The Proponent shall prepare and implement an Operational Environmental Management Plan (OEMP) to detail an environmental management framework, practices and procedures to be followed during operation of the project. The Plan shall be prepared in consultation with Lithgow City Council and relevant government agencies, and shall be consistent with the Guideline for the Preparation of Environmental Management Plans (DIPNR 2004) and shall include, but not necessarily be limited to:	OEMP	Completed	19/05/13	Secretary	The Operation Environmental Management Plan (CDM Smith, 2013) was approved by DPI in May 2013 and operations at Lamberts North commenced in September 2013. The OEMP was reviewed by EnergyAustralia NSW during the 2018-19 reporting period to ensure that it reflects the current activities and management. The OEMP (EANSW, 2019) was approved by the DPIE on the 1st October 2019.	**Compliant**
	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, approvals 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 environmental monitoring requirements outlined under conditions E12 to E18 inclusive;						
	g)	details of waste management including reuse and/or recycling of waste material, to minimise the need for treatment or disposal of those materials outside the site;						
	h)	specific consideration of relevant measures to address any requirements identified in the documents referred to under conditions A1(b) and A1(d) of this approval; and						
	i)	the additional requirements 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 plans administered by the Proponent.						
	D3	As part of the OEMP for the project, required under condition D2 of this approval, the Proponent shall prepare and implement the following Management Plans:						
Operational Noise Management Plan	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 the EPA and include, but not necessarily be limited to:	OEMP	Completed	19/05/2013	Secretary	The Operation Environmental Management Plan (CDM Smith, 2013) was approved by DPI in May 2013 and operations at Lamberts North commenced in September 2013. The OEMP was reviewed by EnergyAustralia NSW during the 2018-19 reporting period to ensure that it reflects the current activities and management. The OEMP (EANSW, 2019) was approved by the DPIE on the 1st October 2019.	**Compliant**
	i)	identification of activities that will be carried out in relation to the project and the associated noise sources;						
	ii)	identification of all relevant sensitive receivers and the applicable criteria at those receivers commensurate with the noise limit specified under condition E7 of this approval;						
	iii)	noise monitoring procedures (as referred to in condition E12 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 EA;						
	iv)	details of all management methods and procedures that will be implemented to control individual and overall noise emissions from the site during operation, including the feasibility of noise reducing benching;						
	v)	procedures to ensure that all reasonable and feasible noise mitigation measures are applied during operation of the project and procedures and corrective actions to be undertaken if non-compliance against the operational noise criteria as detailed in condition E7 is detected at the sensitive receivers; and						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
	vi)	provisions for periodic reporting of results to the EPA as per condition B8.						
Groundwater Management Plan	b)	a Groundwater Management Plan to detail measures to mitigate and manage groundwater impacts. The Plan shall be prepared in consultation with the NOW and the SCA and include, but not necessarily be limited to:	OEMP	Completed	19/05/2013	Secretary	The Operation Environmental Management Plan (CDM Smith, 2013) was approved by DPI in May 2013 and operations at Lamberts North commenced in September 2013. The OEMP was reviewed by EnergyAustralia NSW during the 2018-19 reporting period to ensure that it reflects the current activities and management. The OEMP (EANSW, 2019) was approved by the DPIE on the 1st October 2019. It is noted that the ground and surface water monitoring carried out during the reporting period identified some exceedances of the surface water and groundwater environmental goals identified in the relevant sub-plans contained in the approved Lamberts North Ash Placement Project Operation Environmental Management Plan dated May 2013 (Lamberts North OEMP) triggering the contingency measures contained in the Lamberts North OEMP. These contingency measures require the carrying out of a further surface water and groundwater investigations and these investigations are currently under way.	**Compliant**
	i)	consideration of the revised updated groundwater model as per condition B2;						
	ii)	baseline data on groundwater quality (including Huons Creek), location of groundwater monitoring wells, depth and available flow of groundwater in the project area;						
	iii)	identification of potential sources of water pollutants and management measures;						
	iv)	groundwater assessment criteria including trigger levels for remedial measures;						
	v)	a contingency plan for events that have the potential to pollute or contaminate groundwater sources of water. The plan shall include remediation actions and communication strategies (including notification of potentially affected nearby bore users) for the effective management of such an event to prevent discharge of these pollutants from all sources within the project area;						
	vi)	a monitoring program as per condition E15 for groundwater connectivity, water levels, groundwater flow and water quality over the short and long term that includes upstream and downstream locations. The program shall continue for a minimum of five years following final capping and landscaping;						
	vii)	a protocol for the investigation of identified exceedances of the groundwater impact assessment criteria; and						
	viii)	provisions for periodic reporting of results to the SCA as per condition B8.						
Soil and Surface Water Management Plan	c)	a Soil and 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 lands 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 the NOW and the SCA and DPI (Fisheries). The Plan shall include, but not necessarily be limited to:	OEMP	Completed	19/05/2013	Secretary	The Operation Environmental Management Plan (CDM Smith, 2013) was approved by DPI in May 2013 and operations at Lamberts North commenced in September 2013. The OEMP was reviewed by EnergyAustralia NSW during the 2018-19 reporting period to ensure that it reflects the current activities and management. The OEMP (EANSW, 2019) was approved by the DPIE on the 1st October 2019. It is noted that the ground and surface water monitoring carried out during the reporting period identified some exceedances of the surface water and groundwater environmental goals identified in the relevant sub-plans contained in the approved Lamberts North Ash Placement Project Operation Environmental Management Plan dated May 2013 (Lamberts North OEMP) triggering the contingency measures contained in the Lamberts North OEMP. These contingency measures require the carrying out of a further surface water and groundwater investigations and these investigations are currently under way.	**Compliant**
	i)	baseline data on the surface water quality and available flow in Neubecks Creek and Lamberts Gully Creek;						
	ii)	water quality objectives and impact assessment criteria for Neubecks Creek and Lamberts Gully Creek;						
	iii)	identification of the operation activities that could cause soil erosion or discharge sediment or water pollutants from the site;						
	iv)	a description of the management controls 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;						
	v)	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);						
	vi)	details of the water management system including separation of clean and contaminated/polluted water flows, provisions for the treatment, recycling/reuse and/or discharge of flows;						
	vii)	site water balance including water usage for ash placement, sources of water and quantity of run-off generated;						
	viii)	details of the lining for the surface water collection ponds;						
	ix)	measures to minimise potential surface water infiltration;						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
	x)	a flow and water quality monitoring program for Neubecks Creek and Lamberts Gully Creek that includes discharge points, upstream and downstream locations as per condition E16 and limits for identified pollutants;						
	xi)	specified remedial actions and contingency plans to mitigate any water quality exceedances on receiving waters including identified trigger levels for remedial measures or the activation of contingency plans; and						
	xii)	provisions for periodic reporting of results to the DPI (Fisheries) and the SCA as per condition B8.						
Air Quality Management Plan	d)	a 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 NSW Health and the EPA and include, but not necessarily be limited to:	OEMP	Completed	19/05/2013	Secretary	The Operation Environmental Management Plan (CDM Smith, 2013) was approved by DPI in May 2013 and operations at Lamberts North commenced in September 2013. The OEMP was reviewed by EnergyAustralia NSW during the 2018-19 reporting period to ensure that it reflects the current activities and management. The OEMP (EANSW, 2019) was approved by the DPIE on the 1st October 2019.	**Compliant**
	i)	baseline data on dust deposition levels;						
	ii)	air quality objectives and impact assessment criteria;						
	iii)	an assessment of alternative methods of ash placement to minimise the exposure of active placement areas to prevailing winds;						
	iv)	mitigation measures to be incorporated during ash placement activities, haulage, etc;						
	v)	an operating protocol for the ash placement irrigation system including activation rates, application rates and area of coverage and means of dealing with water shortages;						
	vi)	detail how ash placement moisture levels will be maintained;						
	vii)	a contingency plan to deal with high winds and dust suppression;						
	viii)	a protocol for the investigation of visible emissions from the ash placement area;						
	ix)	a response plan to address exceedances in visible emissions including PM10, TSP and deposited dust from the ash placement areas; and						
	x)	an air quality monitoring program as referred to in condition E18 of this approval including identified air quality monitoring locations (including monitoring at sensitive receivers) and meteorological monitoring to predict high wind speed events;						
	xi)	provisions for periodic reporting of results to the EPA as per condition B8; and						
	xii)	a protocol for suppressing dust emissions within licence limits under normal and adverse weather conditions at all stages of the ash placement process.						
Landscape/ Revegetation Plan	e)	a Landscape/Revegetation Plan to outline measures to minimise the visual impacts of the ash placement areas and ensure the long-term stabilisation of the site and compatibility with the surrounding landscape and land use. The Plan shall include, but not necessarily be limited to:	OEMP	Completed	19/05/2013	Secretary	The Operation Environmental Management Plan (CDM Smith, 2013) was approved by DPI in May 2013 and operations at Lamberts North commenced in September 2013. The OEMP was reviewed by EnergyAustralia NSW during the 2018-19 reporting period to ensure that it reflects the current activities and management. The OEMP (EANSW, 2019) was approved by the DPIE on the 1st October 2019.	**Compliant**
	i)	identification of design objectives and standards based on local environmental values, vistas, and land uses;						
	ii)	identification of the timing and progressive implementation of revegetation works for ash placement areas as they are completed, including short-term and long term goals including landscape plans;						
	iii)	a schedule of species to be used in revegetation, including the use of local native species in revegetation works selected by a qualified expert to ensure the rehabilitation works do not compromise the long term integrity of the capping; and						
	iv)	procedures and methods to monitor and maintain revegetated areas during the establishment phase and long-term.						

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2019-20 Observation	Compliance Finding
Site Rehabilitation Management Plan	f)	a Site Rehabilitation Management Plan to outline measures to stabilise and rehabilitate the site following project completion. The Plan shall be prepared in consultation with the SCA. The Plan shall include, but not necessarily be limited to:	OEMP	Completed	19/05/2013	Secretary	The Operation Environmental Management Plan (CDM Smith, 2013) was approved by DPI in May 2013 and operations at Lamberts North commenced in September 2013. The OEMP was reviewed by EnergyAustralia NSW during the 2018-19 reporting period to ensure that it reflects the current activities and management. The OEMP (EANSW, 2019) was approved by the DPIE on the 1st October 2019.	**Compliant**
	i)	reinstatement of geomorphologic stable drainage lines on the rehabilitated areas and a timeframe for rehabilitation;						
	ii)	restoration, rehabilitation and revegetation of the project's site;						
	iii)	measures to control water pollutants from rehabilitated areas; and						
	iv)	a program and timeframe for monitoring rehabilitated areas.						
Groundwater Quality and Geotechnical Impacts	D4.	Prior to commencement of operation the Proponent shall submit a geotechnical report prepared by a suitably qualified expert that demonstrates the site has been engineered as being suitable for ash placement. The report must also provide an evaluation of groundwater levels once re-profiling has been completed.	Lamberts North Environmental Geotechnical report	Complete	Report dated: 11/12/2012	Secretary	An evaluation of groundwater levels at Lamberts North (CDM Smith, 2012b) was provided to DPI May 2013. The groundwater level evaluation report demonstrated that the activities associated with preparation and re-profiling of Lamberts North area had minimal impact on groundwater levels on and immediately adjacent to the site.	**Compliant**
PART E - DURING OPERATIONS								
Operational Hours	E1	Operational activities associated with the project shall only be undertaken from 6.00 am to 8.00 pm Monday to Friday and 6.00am to 5.00pm Saturday and Sunday.	OEMP	Approved	On-going	Secretary	Lend Lease have advised that no operational activities have taken place outside the designated hours. Ash haul truck logs support this statement.	**Compliant**
	E2.	Operations outside the hours stipulated in condition E1 of this approval are only permitted in the following emergency situations:					Lend Lease have advised that no operational activities have taken place outside the hours. No emergencies requiring out of hours' operation have occurred within the reporting period.	**Not applicable**
	a)	where it is required to avoid the loss of lives, property and/or to prevent environmental harm; or						
	b)	breakdown of plant and/or equipment at the ash placement areas or the Mt Piper Power Station and the proposed Mt Piper Power Station Extension project with the effect of limiting or preventing ash storage at the power station outside the operating hours defined in condition E1; or						
	c)	a breakdown of an ash haulage truck(s) or the conveyor preventing haulage during the operating hours stipulated in condition E1 combined with insufficient storage capacity at the Mt Piper Power Station including the proposed Mt Piper Power Station Extension to store ash outside of the project operating hours; or						
	d)	in the event that the Australian Energy Market Operator (AEMO), or a person authorised by AEMO, 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 Mt Piper Power Station to allow for the ash to be stored.						
		In the event of conditions E2b) or E2c) arising, the Proponent is to take all reasonable and feasible measures to repair the breakdown in the shortest time possible.						
Emergency	E3	In the event that an emergency situation as referred to under condition E2b) or E2c) 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:	OEMP	Approved	On-going	Secretary	Lend Lease have advised that no operational activities have taken place outside the hours. No emergencies requiring out of hours' operation have occurred within the reporting period.	**Not applicable**
	a)	the dates and a description of the emergency situations;	OEMP	Approved	On-going	Secretary		
	b)	an assessment of all reasonable and feasible mitigation measures to avoid recurrence of the emergency situations;	OEMP	Approved	On-going	Secretary		
	c)	identification of a preferred mitigation measure(s); and	OEMP	Approved	On-going	Secretary		
	d)	timing and responsibility for implementation of the mitigation measure(s).	OEMP	Approved	On-going	Secretary		
		The report is to be submitted to the Director-General within 60 days of the second emergency situation occurring. The Proponent shall implement all reasonable and feasible mitigation measures in accordance with the requirements of the Director-General.	OEMP	Approved	On-going	Secretary		
	E4.	The Proponent shall notify the EPA prior to undertaking any emergency ash haulage or placement operations outside of the hours of operation stipulated in condition E1 of this approval and keep a log of such operations.	OEMP	Approved	On-going	Secretary	Lend Lease have advised that no operational activities have taken place outside the hours. No emergencies requiring out of hours' operation have occurred within the reporting period.	**Not applicable**

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
	E5	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 E1 of this approval.	OEMP	Approved	On-going	Secretary	Lend Lease have advised that no operational activities have taken place outside the hours. No emergencies requiring out of hours' operation have occurred within the reporting period.	**Not applicable**
	E6	The Proponent shall notify nearby sensitive receivers (as defined in the Operational Noise Management Plan required under condition D3(a) of this approval) prior to 8.00 pm where it is known that emergency ash haulage or placement operations will be required outside of the hours of operation stipulated in condition E1 of this approval.	OEMP	Approved	On-going	Secretary	Lend Lease have advised that no operational activities have taken place outside the hours. No emergencies requiring out of hours' operation have occurred within the reporting period.	**Not applicable**
Operational Noise	E7	The cumulative operational noise from the ash placement area and ash haulage activity shall not exceed the following LAeq(15 minute) dB(A):	OEMP	Approved	On-going	Secretary	Noise criteria is included in Table 6-4 of the approved OEMP. Meteorological conditions to which the above criteria apply are included in Section 6.3.5.3 of the approved OEMP.	Compliant
		Location | Day (7am to 6pm) | Evening (6pm to 10pm) | Night (10pm to 7am)	OEMP	Approved	On-going	Secretary		
		All private sensitive receivers within the township of Blackmans Flat | 42 | 38 | 35 | 42 | 38 | 35	OEMP	Approved	On-going	Secretary		
		This noise criteria set out above applies under all meteorological conditions except for any of the following:	OEMP	Approved	On-going	Secretary		
	a)	wind speed greater than 3 metres/second at 10 metres above ground level;	OEMP	Approved	On-going	Secretary		
	b)	stability category F temperature inversion conditions and wind speed greater than 2 metres/second at 10 metres above ground level; and	OEMP	Approved	On-going	Secretary		
	c)	stability category G temperature inversion conditions.	OEMP	Approved	On-going	Secretary		
		This criteria does not apply where the Proponent and an 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 EPA.	OEMP	Approved	On-going	Secretary		
	E8.	To determine compliance with the LAeq(15 minute) noise limits, the noise monitoring equipment must be located at the most affected point	OEMP	Approved	On-going	Secretary	Addressed in section 6.3.5.4 of the approved OEMP and section 6.2 of the 2019-20 AEMR.	Compliant
	a)	within 30 metres of a dwelling façade where any dwelling on the property is situated more than 30 metres from the property boundary that is closest to the premises; or	OEMP	Approved	On-going	Secretary		
	b)	approximately on the boundary where any dwelling is situated 30 metres or less from the property boundary that is closest to the premises.	OEMP	Approved	On-going	Secretary		
	E9	For the purposes of monitoring noise from the premises to determine compliance with the noise limits:	OEMP	Approved	On-going	Secretary	Addressed in section 6.3.5.4 of the approved OEMP.	**Compliant**
		Class 1 or 2 noise monitoring equipment as defined by AS IEC61672.1-2004 and ASIEC61672.2-2004, or other noise monitoring equipment accepted by the EPA in writing, must be used;	OEMP	Approved	On-going	Secretary		
		the modification factors in Section 4 of the NSW Industrial Noise Policy must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment;	OEMP	Approved	On-going	Secretary		
		the meteorological data to be used for determining meteorological conditions is the data recorded by the meteorological weather station at the premises; and	OEMP	Approved	On-going	Secretary		
		stability category temperature inversion conditions are to be determined by the sigmatheta method referred to in Part E4 of Appendix E to the NSW Industrial Noise Policy.	OEMP	Approved	On-going	Secretary		
	E10	The Proponent shall implement measures to ensure noise attenuation of trucks. These measures may include, but are not necessarily 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 braking, and ensuring trucks operate in a one-way system at the ash placement areas where feasible.	OEMP	Approved	19/05/2013	Secretary	The plant and equipment mitigation measures are included in Table 6-3 of the approved OEMP. No noise complaints have been received for Lamberts North within this reporting period.	**Compliant**

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Operational Noise Review	E11	Within 60 days of the commencement of operation of the project, unless otherwise agreed to by the Director-General, the Proponent shall submit to the Director General an Operational Noise Review to confirm the operational noise impacts of the project. The Operational Noise Review shall be prepared in consultation with the EPA. The Review shall:	Aurecon (2012) Lamberts North Operational Operational Noise Assessment Report	Complete	8-Oct-13	Secretary	The Operation Noise Review Report was prepared in October 2013 by Aurecon. The report was submitted to the DPI on 9th October 2013 and the EPA 10th October 2013 for review. The report concluded that the noise resulting from Lamberts North operations comply with the criteria specified in condition E7 at the representative residential receivers at Location 1 and Location 2. No complaints regarding noise from Lamberts North have been recorded during this reporting period.	**Compliant**
		identify the appropriate operational noise objectives and levels for sensitive receivers;						
		describe the methodologies for noise monitoring, including the frequency of measurements and location of monitoring sites;						
		document the operational noise levels at sensitive receivers as ascertained by the noise monitoring program;						
		assess the noise performance of the project against the noise criteria specified in condition E7 of this approval and the predicted noise levels as detailed in the report referred to under condition A1(b) of this approval; and						
		provide details of any entries in the Complaints Register relating to noise impacts.						
		Where monitoring indicates noise levels in excess of the operational noise criteria specified in condition E7 of this approval, the Proponent shall prepare a report as required by condition E13 of this approval.						
Ongoing Operational Noise Monitoring	E12	The Proponent shall prepare and implement an Operational Noise Monitoring Program to assess compliance against the operational noise criteria stipulated in condition E7 of this approval, throughout the life of the project. The noise monitoring program shall be prepared in consultation with the EPA and must include the proposed frequency of monitoring and as a minimum must include monitoring when there are any significant changes in work locations or processes.	CEMP and OEMP	on-going	6 monthly compliance monitoring reports	Secretary	The operational noise monitoring program is included in Table 6-5 of the approved OEMP. Monitoring was performed during 2019- 2020. Both reports state that the noise resulting from Lamberts North operations complies with the criteria specified under condition E7 at the representative residential receivers at Location 1 and Location 2.	**Compliant**
		The noise monitoring program shall be prepared in accordance with the requirements of the New South Wales Industrial Noise Policy (EPA, 2000) and shall include, but not be limited to:						
	a)	monitoring at Lamberts North, Lamberts South and Blackmans Flat during ash placement activities; and						
	b)	monitoring of the effectiveness of any noise mitigation measures implemented under condition D3(a) of this approval, against the noise criteria specified in condition E7 of this approval.						
		The Proponent shall forward to the EPA and the Director-General a report containing the results of any non-compliance within 14 days of conducting a noise assessment. The monitoring program shall form part of the Operational Noise Management Plan referred to in condition D3 (a) of this approval.						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
	E13.	Where noise monitoring including as required by condition E11 and E12 of this approval identifies any non-compliance with the operational noise criteria specified under condition E7 of this approval the Proponent shall prepare and submit to the Director-General a report including, but not limited to:	Not Triggered	On-going	n/a	Secretary	No non-compliances with the operational noise criteria specified under condition E7 has been reported during this reporting period.	**Not applicable**
	a)	an assessment of all reasonable and feasible physical and other mitigation measures for reducing noise at the source;						
	b)	identification of the preferred measure(s) for reducing noise at the source;						
	c)	feedback from directly affected property owners and the EPA on the proposed noise mitigation measures; and						
	d)	location, type, timing and responsibility for implementation of the noise mitigation measure(s).						
	e)	The report is to be submitted to the Director-General within 60 days of undertaking the noise monitoring which has identified exceedances of the operational noise criteria specified under condition E7, 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.						
	E14.	If after the implementation of all reasonable and feasible source controls, as identified in the report required by condition E13, the noise generated by the project continues to exceed the criteria stipulated in condition E7 the Proponent shall implement at the receiver reasonable and feasible noise mitigation measures, such as double glazing, insulation, air conditioning and or other building acoustic treatments, in consultation with and with the agreement of the affected landowner.	Not Triggered	On-going	n/a	Secretary	No non-compliances with the operational noise criteria specified under condition E7 has been reported during this reporting period.	**Not applicable**
Groundwater Monitoring	E15.	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 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 operation of the project and for a minimum of 5 years following project completion and include, but not be limited to:	OEMP	on-going	19/05/2013	Secretary	The Groundwater Monitoring program is included as part of the Groundwater Management Plan as Section 6.4.3 of the approved OEMP. Monitoring has been carried out on a continual monthly basis including the first 12 months of operations to establish baseline data. Results of Groundwater monitoring during the reporting period have been addressed in Section 7.2 and can be found in Appendix D of the 2019-20 AEMR.	**Compliant**
	a)	monitoring at established bore sites (or replacement bore sites in the event that existing sites are damaged or lost) as described in the Groundwater Management Plan as per condition D3(b); 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 D3(b) of this approval.						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2018-19 Observation	Compliance Finding
Surface Water Quality Monitoring	E16.	The Proponent shall prepare and implement a surface water quality monitoring program to monitor the impacts of the ash placement activities on Neubecks Creek and Lamberts Gully. The Program shall be developed in consultation with the DPI (Fisheries) and the 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 necessarilybe limited to:	OEMP	on-going	19/05/2013	Secretary	The Surface water monitoring programme is included in Table 6.21 of the approve OEMP. Monthly monitoring is performed at the Final Holding Pond monitoring station to Wangcol Creek (LDP01), and at NC01 and WX22. Wet weather monitoring was performed in October 2013 and March 2014. Results of Surface water monitoring during the reporting period have been addressed in Section 7.1. and can be found in Appendix D of the 2019-20 AEMR .	**Compliant**
	a)	monitoring at the existing water quality monitoring sites as described in the document referred to under condition A1b);						
	b)	monitoring at surface water discharge points from Lamberts Gully Creek;						
	c)	monitoring at surface water discharge points into Neubecks Creek;						
	d)	wet weather monitoring with a minimum of two events recorded within the first 12 months operation of the project; 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, monitoring of dissolved oxygen, turbidity, sulphates, salinity, boron, manganese, iron chloride, total phosphorus and total nitrogen.						
Hydrological Monitoring Program	E17	A Hydrological Monitoring Program to assess and quantify the impacts and effectiveness of the transformed section of Huons Creek into a sub-surface drainage line in consultation with the DPI (Fisheries). Monitoring is to be undertaken for a period of five (5) years upon completion of the creek transformation. The program must include sampling for identified pollutants before and after the transformation works and include a sampling site downstream of the sub-surface section of Huons Creek. In the first 12 months following completion of the transformation, monitoringis to be undertaken at least every three (3) months upon completion of the creek transformation and after any heavy wet weather event.The monitoring program shall form part of the Soil and Surface Water Management Plan referred to in condition D3(c) of this approval.	OEMP	on-going	19/05/2013	Secretary	Huons Creek was filled in during construction of the Lamberts North ash placement site commenced. As such, it was not developed as a sub-surface drain as was originally proposed. A Consistency report (SKM, 2012) was submitted to the DPI on 30 July 2012. The report states that groundwater modelling performed during construction demonstrated that the water contained within the creek was largely groundwater as a result of the Huon Void intersecting the groundwater table. Based on this finding, the hydrological monitoring program was incorporated into the Groundwater Management Plan.	**Compliant**
Air Quality Monitoring	E18	The Proponent shall prepare an Air Quality Monitoring Program, in consultation with the EPA and NSW Health. The Program shall include, but not necessarily be limited to, monitoring for dust. Monitoring sites shall be identified as per condition D3 (d). The air quality monitoring program shall be ongoing for the life of the project, and during final rehabilitation and stabilisation of the site.	CEMP and OEMP	on-going	19/05/2013	Secretary, EPA, NSW Health	The Air Quality Monitoring Program is included in section 6.6.6 of the approved OEMP. It states that air quality monitoring will be undertaken for the life of the project. TEOM and dust gauge data has been collected monthly in the first 12 months of operation to determine whether additional monitoring stations are required as a result of the project. The results of Air Quality monitoring during the reporting period are addressed in Section 6.5 of the 2019-20 AEMR.	**Compliant**
		The monitoring program shall form part of the Air Quality Management Plan referred to in condition D3(d) of this approval.						
Environmental Incident Reporting	E19	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.	PIRMP	Complete	N/A	EPA	No environmental incidents requiring notification of the Director-General occurred within this reporting period outside of those notified previously.	**Compliant**
	E20	The Proponent shall meet the requirements of the Director-General to address the cause or impact of any environmental incident, as it relates to this approval, reported in accordance with condition E19 of this approval, within such period as the Director- General may require.						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Annual Performance Reporting	E21.	The Proponent shall, throughout the life of the project, prepare and submit to 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 D2 of this approval) and the conditions of this approval. The AEMR shall include, but not necessarily be limited to:	AEMR	on-going	30 Nov (annually)	Secretary	The 2019-20 AEMR satisfies this requirement.	**Compliant**
	a)	details of compliance with the conditions of this approval;						
	b)	a copy of the Complaints Register (refer to condition B11 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 twelve month period have not been generally consistent with the environmental impacts and performance predicted in the documents listed under condition A1 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 of this approval, including interpretations and discussion by a suitably qualified person; and						
	e)	a list of occasions in the 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 fourteen months after the commencement of operation of the project unless otherwise agreed by the Director- General. The Director-General may require the Proponent to address certain matters in relation to the environmental performance of the project in response to the Director- General's review of the Annual Environmental Management Report. Any actionrequired 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. Copies of the AEMR shall be sent to the EPA and the SCA.						
Independent Environmental Auditing	E22	Within 12 months of commencement of operation of Lamberts North and Lamberts South and then as may be directed by the Director-General, the Proponent shall commission an independent person or team to undertake an Environmental Audit of the project. The independent person or team shall be approved by the Director- General prior to the commencement of the Audit. The Audit shall:	Lamberts North Environmental Audit report	Complete	24/09/2014 25/10/2018	Secretary	In accordance with the above condition, EnergyAustralia engaged Aurecon to undertake the independent environmental audit on 2nd – 3rd September 2014. An additional Independent Environmental Audit was performed in October 2018 upon request from the Secretary of the DPIE (SLR, 2018).	**Compliant**
	a)	be carried out in accordance with ISO 19011:2002 - Guidelines for Quality and or Environmental Management Systems Auditing;						
	b)	assess compliance with the requirements of this approval, and other licences and approvals that apply to the project;						
	c)	assess the environmental performance of the project against the predictions made and conclusions drawn in the documents referred to under condition A1 of this approval;						
	d)	review the effectiveness of the environmental management of the project, including any environmental impact mitigation works; and						
	e)	review the adequacy of the Proponent's response to any complaints made about the project identified in the Complaints Register.						
		The Environmental Audit Report shall be submitted to the Director-General within two months of the completion of the Audit, detailing the findings and recommendations of the Audit and including a detailed response from the Proponent to any of the recommendations contained in the Report.						

Heading	Number	Condition	Reference	Status	Date of Complaince	Approver	2019-20 Observation	Compliance Finding
Waste Generation and Management	E23	All waste materials removed from the site shall only be directed to a waste management facility lawfully permitted to accept the materials.	CEMP and OEMP	on-going	19/03/2013	Secretary	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 Mt Piper Power Station and routinely removed by EnergyAustralia NSW's waste contractors. No additional waste materials were generated during this reporting period.	**Compliant**
	E24	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.					No wastes generated outside the Lamberts North 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 wastes outside those that are allowed during routine operations	**Compliant**
	E25	The Proponent shall ensure that all liquid and / or non-liquid waste generated and / or stored on the site is assessed and classified in accordance with the Waste Classification Guidelines (DECC, 2008), or any future guideline that may supersede that document.					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.	**Compliant**
PART F - POST OPERATIONS								
Project Completion Management Plan	F1	No later than one month prior to the decommissioning of the project, or as otherwise agreed by the Director-General, the Proponent is to prepare a Project Completion Management Plan, in consultation with the SCA, for the approval of the Director- General. The Plan is to include but not necessarily be limited to:	Not Triggered	Pending	TBA	Secretary	The Project is still in operational phase.	**Not applicable**
	a)	identification of structures to be removed and how they will be removed;						
	b)	measures to reduce impacts on the environment and surrounding sensitive land uses;						
	c)	details of components to be recycled;						
	d)	details of rehabilitation and revegetation with reference to the biodiversity offset required under condition B6;						
	e)	groundwater assessment criteria including trigger levels for remedial measures;						
	f)	a groundwater monitoring program as per condition E15 for groundwater connectivity, water levels, groundwater flow and water quality over the short and long term that includes upstream and downstream locations. The program shall continue for a minimum of five years following final capping and landscaping;						
	g)	a contingency plan to address potential exceedances and mitigation measures in groundwater and groundwater quality impacts and if exceedances continue, implementation of further measures and groundwater monitoring to demonstrate compliance;						
	h)	surface water assessment criteria including trigger levels for remedial measures;						
	i)	available flow and water quality monitoring program for Neubecks Creek and Lamberts Gully Creek that includes discharge points, upstream and downstream locations as per condition E16 and limits for identified pollutants. The program shall continue for a minimum of five years following final capping and landscaping; and						
	j)	a contingency plan to address potential exceedances and mitigation measures in surface water and surface water quality impacts and if exceedances continue, implementation of further measures and surface water monitoring to demonstrate compliance.						

Appendix B Lamberts North Operational Noise Assessment – October 2019

Project: Mt Piper Power Station Ash Placement

Lamberts North – Operational Noise Assessment October 2019

Reference: 246493

Prepared for: EnergyAustralia NSW

Revision: 1

4 February 2020

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Approval			
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1 Introduction

1.1 Project Understanding

On 16 February 2012, Delta Electricity received Project Approval (09_0186) under delegation from the Minister of Planning for the Mt Piper Ash Placement Project (the Project) under Section 75J - *Environmental Planning and Assessment Act 1979*, to permit the continued disposal of ash generated by the Mt Piper Power Station into the Lamberts North area, which is an extension of the existing Mt Piper Ash Repository. The Project Approval was granted subject to Conditions of Approval. EnergyAustralia NSW acquired Mt Piper Power Station and associated land holdings and infrastructure from the state-owned Delta Electricity in September 2013. As such the project is now owned by EnergyAustralia NSW.

This report has been developed in accordance with the Lamberts North Ash Placement Project Condition of Approval (CoA) E11 and the mitigation measures specified in the Operational Environment Management Plan (OEMP May 2013). The OEMP outlines the requirements of the ongoing noise monitoring program and operational noise review in accordance with CoA's E7, E8, E9 and E11.

1.2 Background to the Project

Lamberts North Ash Repository is located immediately east of EnergyAustralia NSW's existing Mt Piper Ash Repository, which is described as Area 1 in the Environmental Assessment (EA) (SKM, 2010). Ash placement at Mt Piper Ash Repository is still currently being undertaken but alternates with ash placement at Lamberts North.

Both sites are located in an area characterised by both rural and industrial influences, with a number of coal mines in relatively close proximity. The project site is predominately surrounded by Ben Bullen State Forest, which lies to the north and south east of Mt Piper Power Station, together with open cut coal mines and coal washeries. Wallerawang Power Station which is also owned by EnergyAustralia NSW, lies to the south east of the project site, approximately 5 km away, but is no longer operational following the announcement in November 2014, that the power station would be closed.

Lamberts North ash repository is approximately 53 hectares.

Historically, the Lamberts North area has been highly disturbed as a result of extensive mining activities including underground working (from the 1950s to the early 1990s) and recent open-cut mining activities being carried out by Centennial Coal.

EnergyAustralia NSW has engaged a principal contractor (Lend Lease) to manage and operate both the Mt Piper (Area 1) and Lamberts North ash repositories. Operations at Lamberts North commenced on 2 September 2013.

1.3 Scope of Work

In accordance with CoA E11, the scope of works includes a noise assessment comprising of attended and unattended noise measurements at two sensitive receiver locations, to determine potential impacts arising from the operational activities at Lamberts North ash repository.

1.4 Sensitive Receivers

The sensitive receivers located within the vicinity of the Project and identified for noise impacts within the Operation Noise Management and Monitoring Plan (ONMMP), a sub plan of the OEMP, are described in Table 1 below. The two sensitive receivers closest to the site are located at Blackmans Flat approximately 1.4 km to the east of Lamberts North and at Wallerawang approximately 2.5 km south east of Lamberts North.

A third location 'Location 3' has been used as an additional location to measure the reference noise levels from operational activities. Measurements at location 3 / 3A are within the Lambert's North and Ash Repository sites and are used for reference only, and monitoring requirements at these locations are not covered in the ONMMP.

The positions of the measurement locations are shown in Figure 1.

Table 1 | Sensitive receivers nearest to Lamberts North

Location ID[a]	Description	Map Coordinates	Noise monitoring location	Distance from Lamberts North Ash Repository
1	Blackmans Flat	33.36468ºS 150.05904ºE	Located at the western end of Noon Street on the southern side of the road. Positioned at the boundary of the residential property 90 m from the Castlereagh Highway.	1.4 km east
2	Wallerawang	33.374001ºS 150.065370ºE	Situated on a rural property southeast of Lamberts North, and approximately 650m from Castlereagh Highway.	2.5 km south east
3	Ash Repository	33.355570ºS 150.045268ºE	Additional location within the Ash Sediment basin	300m west
3A	Lamberts North	33.357021ºS 150.049253ºE	Additional location at the north-western boundary of the Lamberts North site	Within the Lamberts North site

[a] Refer to Figure 1 for locations

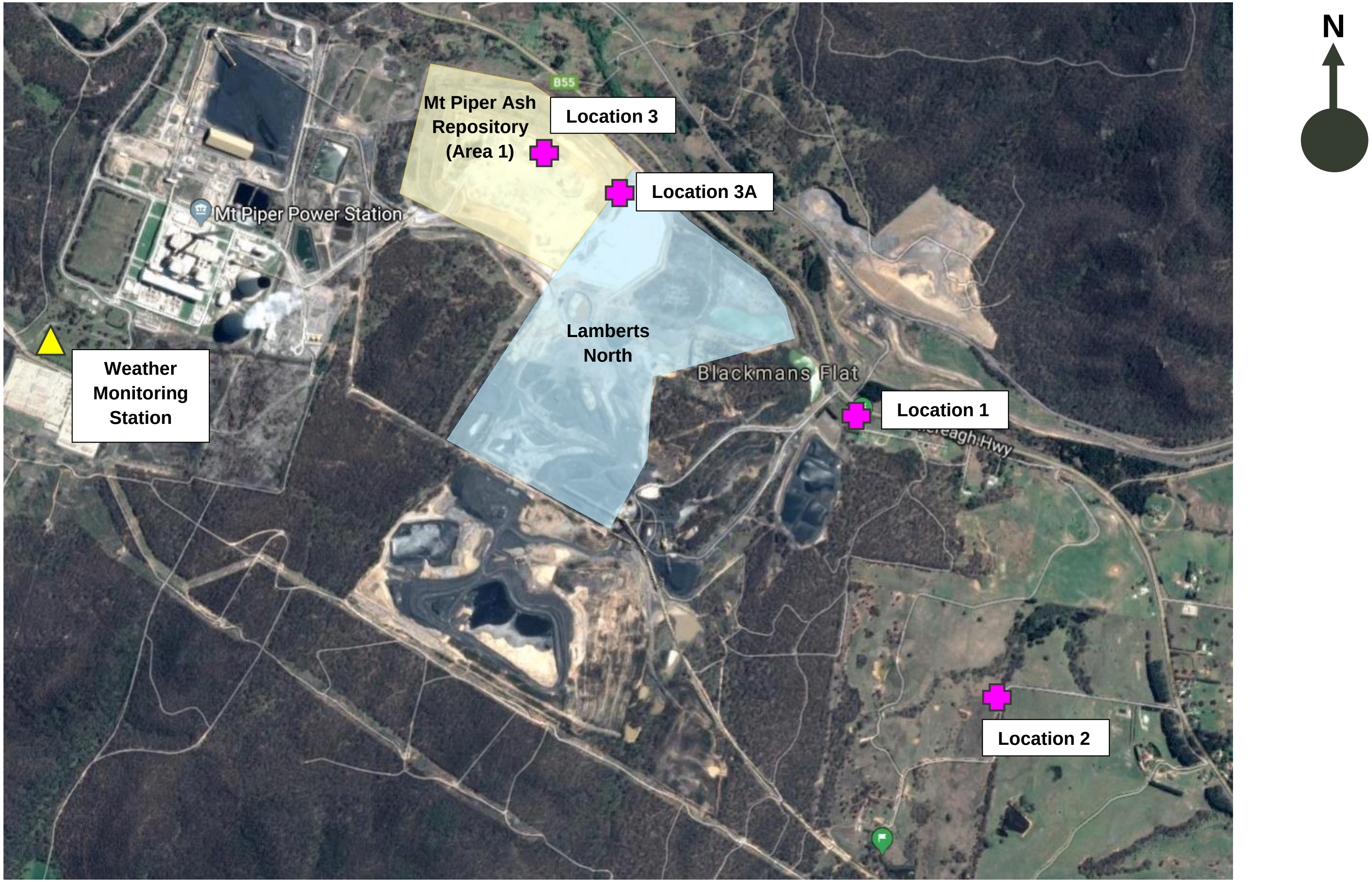


Figure 1 | Environmental noise monitoring locations

2 Site Operations

2.1 Operation Methodology

Key potential noise impacts during operational activities at Lamberts North and Mt Piper Ash Repository sites are listed below:

- Transporting fly ash and bottom ash to the ash repository using haulage trucks along the designated haul roads;
- Placing ash in stockpiles in designated areas before being spread out by a dozer;
- Compacting the ash using a dozer and roller;
- Maintenance on the haulage roads using a grader, roller, dozers and water carts;
- Dust suppression across the site using a series of techniques including but not limited to water carts and sprinkler systems;
- Developing and maintaining water management structures (containments, drains and sumps) using an excavator;
- Using various sized pumps on site to pump water from various water sources;
- Using light vehicles on occasion to inspect the ash repository and carry out environmental monitoring; and
- The machinery and plant generate noise from the engine and drive line, hydraulics and reverse warning devices.

2.2 Activities during Monitoring Period

The Mt Piper Ash Repository and Lamberts North sites are located adjacent to each other. Ash deposition at either site is dependent on several factors, typically decided on a weekly basis by the Lend Lease environmental manager.

During the site visit from 18th – 20th October 2019, ash placement operations were only occurring towards the western end Area 1 (within the ash sediment basin), with no ash placement activities occurring at the Lamberts North site (refer Appendix D).

Below is the summary of activities identified on site. Sound Power Levels (SWL) calculated from the measured reference noise levels are detailed in Table 2.

- The day activities started at 06:00 for a 06:15 start, which included the daily tool box talk and work-related discussions.
- The following plant/machinery was operational during the monitoring period,
  - 2 x Dump trucks were operating in total, being loaded with ash near the ash bins and transported to the ash sediment basin as illustrated in the figure below. Truck routes/access roads are also illustrated in the figure below.
  - 1 x dozer/crawler tractor, 2 x water cart/trucks and 1 x roller were operating in the ash sediment basin, with the dozer and water truck using the B1, B2 circuit and the roller using the B5, B6 circuit.
  - 1 x diesel generator operating at the south-east corner of Area 1.
  - No activities were being carried out in the southern part of the Lamberts North site.
- All activities ceased by 17:00. No activities occurred during the evening or night time periods (18:00 – 06:00).
- Please refer to Appendix B for site photographs.

Table 2 | Calculated Sound Power Levels of Noise Sources Operating during Site Visit

Plant	Quantity	Sound Power Level (SWL), dB(A)*
Dozer / Crawler Tractor*	1	107
Water Cart / truck*	2 (only 1 operating at a time, typically at 20min intervals)	101
Roller*	1	105
Dump Truck	2 (only 1 operating at a time, typically at 20min intervals)	101
Light commercial vehicles (e.g. Ute)	2 movements considered in a 15-minute interval	98
Generator[#]	1	88

*Sound Power Levels (SWL) calculated based on noise measurements at approx. 7-10m from operating plant, on the 18th and 19th October 2019.

#Generator (stationary plant) measurement conducted at 2m.

2.3 Description of the surrounding environment

Area 1 and Lamberts North sites are predominantly surrounded by Ben Bullen State Forest, with open cut coal mines and coal washeries also located to the north and east.

Activities at Springvale colliery, which is operated by Centennial Coal and lies to the south east of the site, primarily includes but is not limited to the transportation of coal via conveyors and operations of mobile and stationary plan. Noise impacts from these activities will contribute to the ambient noise measurements at locations 1 and 2.

Pine Dale coal mine is located to the north east of the site but is unlikely to contribute to the ambient environment at measurement locations as the mine is currently under care and maintenance (i.e. non-operational).

3 Noise Criteria

3.1 Conditions of Approval

The ONMMP seeks to address the specific requirements of the CoA attached to the Project Approval for Lamberts North, insofar as they relate to noise and vibration during operation.

CoA E7 and CoA D3a(ii) define the operational noise requirements for the project, to ensure noise emissions from operational activities do not exceed the criteria shown in Table 3 below.

Table 3 | Operational Noise Criteria

Location	Operational Noise Criteria, dB(A)$L_{eq(15min)}$		
	Day Time (7:00 – 18:00)	Evening Time (18:00 – 22:00)	Night Time (22:00 – 7:00)
All private receivers within the township of Blackmans Flat	42	38	35
All other residences	42	38	35

Note: These criteria do not apply where the Proponent and an affected landowner have reached a negotiated agreement regarding noise, and a copy of that agreement has been forwarded to the Director-General and the NSW EPA.

3.2 Operational Hours

In accordance with the CoA E1, operational activities associated with the project shall only be undertaken from 6:00am to 8:00pm Monday to Friday and 6:00am to 5:00pm Saturday and Sunday. Operations outside the hours stipulated above are only permitted in emergency situations.

4 Noise Survey

4.1 Methodology

Attended and unattended noise measurements were conducted from the 18th – 20th October 2019 at the boundary of the nearest residential properties (Location 1 and Location 2) likely to be exposed to noise from the ongoing ash placement operation.

- Unattended continuous monitoring was conducted using two Acoustic Research Laboratories type EL-316 noise monitors. The monitors were set to record continuously at 15-minute time intervals, in an A-weighted fast response mode. Both monitors were calibrated at the start and end of the monitoring period using a Brüel & Kjær type 4230 calibrator. No significant drift was noted.

- Attended noise measurements were conducted using a Brüel & Kjær Type 2270 Class 1 sound analyser, fitted with a type 4189 ½" microphone, set to record using 'A' frequency weighting in fast response mode. The sound analyser was also fitted with an approved windshield. A Brüel & Kjær Type 4230 calibrator was utilised to calibrate the sound level meter before and after each series of measurements. No significant calibration drift was noted. Measurements were undertaken for a period of 15-minutes at each of the selected measurement locations.

Measurements were typically taken at a height of 1.2 m and at least 3.5 m from any reflecting structure other than the ground. The weather during the noise survey period can be summarised as sunny conditions, with no rainfall and wind speeds were less than 5m/s at ground level. Measurements were generally taken in accordance with the Australian Standard *AS 1055.1 1997: Acoustics – Description and measurement of environmental noise*.

Table 4 | Noise Monitoring Equipment Calibration Information

Equipment/Measurement Location	Make	Serial	Last Calibration
Noise Monitor – Location 1	Acoustic Research Labs	15-203-504	November 2019
Noise Monitor – Location 2		15-203-506	November 2019
Sound Level Analyser – Location 3/3A.	Brüel & Kjær	3027570	February 2019

4.2 Weather Data

Weather data for the monitoring periods, as provided by the Mt Piper weather station (located within the Mt Piper Power Plant site), is shown in Appendix E. Noise measurement data with wind speeds higher than 5m/s was excluded from the assessment during that time.

As discussed in Section 2.2, there was no ash placement activity during the evening or night-time period (18:00 – 06:00). In accordance with the NSW Noise Policy for Industry (NPI), activities at the Lamberts North site during 06:00 – 07:00 are not considered as night time activity as this time period falls within the defined shoulder period[b].

[b] As per NSW Noise Policy for Industry Section 3.3 (Dealing with 'shoulder' periods): For early morning (5am-7am) operations, it may be unduly stringent to expect such operations to be assessed against the night time criteria-especially if existing background noise levels are steadily rising in during these early morning hours.

As per Appendix C (*Procedure of assessing noise increase due to temperature inversions*) of *NSW Noise Policy for Industry, "if the development does not operate at night, there is no potential for noise impact due to inversions, and no further consideration of these effects is required"*.

Below is the summary of weather conditions prevalent during the noise monitoring periods which complies with the CoA E7 and CoA D3a(ii):

- Wind speeds were less than 3 m/s at 10 m above ground level for most of the time.
- Stability Category F temperature inversion conditions were not prevalent during the operational activities.
- Stability Category G temperature inversion conditions were not prevalent during the operational activities.

4.3 Noise Measurement Results

During the monitoring works, both attended and unattended monitoring was undertaken.

- Unattended continuous monitoring was undertaken at Locations 1 and 2 from 10:00am on the 18th October 2019 to 11:00am on the 20th October 2019. Detailed results of continuous noise measurements over the monitoring period are shown in Appendix C and statistical noise levels measured over the day, evening and night-time monitoring periods are detailed in Table 5.

  As noted in Appendix D and E, wind speeds greater than 5 m/s were experienced at the weather station for a few hours. The measured noise data during these periods was excluded from the overall measurements to ensure compliance with conditions CoA E7 and CoA D3a(ii).

- Attended noise measurements were conducted at locations 3 and 3A. These 15-minute statistical noise levels are also detailed in Table 5.

Table 5 | Results of Ambient Noise Monitoring

Note: rows in grey are results of attended monitoring, rows in white are results of unattended monitoring

Location	Date	Time	Period	Measured Noise Level, dBA				Note
				L_{Aeq}	L_{A10}	$L_{A90,}$	L_{Amax}	
Location 1 *(Blackmans Flat)*	18/10/2019	10:13am	Day	51	50	42	75	Note 1
	20/010/2019	10:19am	Day	47	50	35	66	
	18/10/2019	7am-6pm	Day	48	51	38	62	
		6pm-10pm	Evening	48	52	29	60	
		10pm-7am	Night	50	54	27	67	
	19/10/2019	7am-6pm	Day	55	59	37	68	
		6pm-10pm	Evening	45	50	30	58	
		10pm-7am	Night	45	49	27	61	
Location 2 *(Wallerawang)*	18/10/2019	9:53am	Day	43	47	33	65	Note 2
	20/010/2019	9:40am	Day	40	39	32	68	
	18/10/2019	7am-6pm	Day	48	52	34	64	
		6pm-10pm	Evening	38	41	32	57	
		10pm-7am	Night	40	43	30	59	
	19/10/2019	7am-6pm	Day	**60**	**64**	**34**	**74**	Note 2a
		6pm-10pm	Evening	48	52	33	62	Note 2
		10pm-7am	Night	40	42	29	63	
Location 3	28/06/2019	11:30am	Day	69	71	67	72	Note 3
Location 3A		11:50am	Day	64	67	58	71	

4.4 Discussion of results

Only the attended daytime noise measurement on the 20th October at location 2, complies with the assessment criteron of 42 dB(A)$L_{eq(15min)}$. All other daytime measurements exceed this noise limit and is discussed in detail for each location in the following sections.

4.4.1 Note 1 (Location 1 – Blackmans Flat)

We have been advised by EA NSW that this site has been purchased by Centennial Coal and currently there are no residential receivers on the site. Regular noise monitoring as per OEMP May 2013 is being conducted at this site.

During our site attendance, ambient noise was dominated by traffic noise from Castlereagh Highway.

There was no audible noise from the westerly direction (i.e. Lamberts North or Ash Repository).

The maximum equivalent continuous noise level at Location 1 was measured at 55 dB(A)L_{eq}. Birds, insects and heavy vehicle (trucks/trailers) passbys contributed to maximum noise levels of 60 – 75 dB(A)L_{Max} in the day/ evening/ night time.

4.4.2 Note 2 (Location 2 – Wallerawang)

The ambient noise levels at this rural residential location is dominated by noise from birds/insects, low industrial hum from the western direction and distant traffic noise from Castlereagh Highway. Intermittent machinery/plant noise (tractors, pump/generator) was also faintly audible from the farm to the west/south-west.

Additionally, dirt bike activity was noted during the daytime period (initially at 10:00am and also at 2:30pm and 6:00pm) within the farm property to the south of the monitoring location. Elevated levels during this time period is a result of this activity, which can also be seen in the noise logging data attached in Appendix C.

Subjectively on site there was no evidence of noise originating from the north-westerly direction, thus indicating negligible noise contribution from ash repository sites to ambient noise levels at this location.

The maximum equivalent continuous noise level at Location 2 was measured at 48 dB(A)L_{eq}. Birds, insects and vehicle passby (local resident vehicles on dirt road) contributed to maximum noise levels of 57 – 68 dB(A)L_{Max} in the day/ evening/ night time.

4.4.2.1 Note 2a

Dirt bike activity was noted on the farmland to the west and south-west during the afternoon period on the 19th October 2019. This was first noted during the daytime period (approx. 10:00am) and also confirmed extending into the afternoon and evening periods (2:30pm – 7:30pm).

4.4.3 Location 3 & 3A

As part of the assessment of compliance against the CoA, additional reference measurements were undertaken at locations 3 and 3A based on the activities being undertaken on site.

- Location 3 – Measurements of dozer, roller and water cart operations, measured at the western edge of the ash sediment basin. Operational noise clearly audible at this location and included sources such as engine noise and reverse beeps.
- Location 3A – Measurement conducted at the western boundary of the Lamberts North site (between Area 1 and Lamberts North). Operational noise from dump trucks and water carts travelling along internal access road (to the ash sediment basin) clearly audible at this location. Generator noise (located near south-east corner of Area 1) also clearly audible at this location. Operational noise from dozer and roller in ash sediment basin barely perceptible at this location and not visible as a result of ash mound. Noise sources include engine noise (dump trucks and water carts) and generator motor.

4.5 Previous monitoring data

A summary of previous data collected by this office for Lamberts North is presented in Table 6 below.

Table 6 | Summary of previous Environmental Noise Monitoring Data

Location	Period	Measured Equivalent Sound Pressure Level, L_{Aeq} dBA						
		March 2016	October 2016	April 2017	November 2017	April 2018	September 2018	June 2019
Location 1 *(Blackmans Flat)*	Day	52	56	56	56	56	55	52
	Evening	49	53	52	51	51	51	52
	Night	47	51	50	48	49	49	46
Location 2 *(Wallerawang)*	Day	45	49	60	42	49	46	45
	Evening	45	46	46	40	44	42	46
	Night	43	51	44	44	43	49	49

- These receiver locations have not changed since 2016, with Aurecon endeavouring to install the noise monitors at approximately the same location during each visit.
- Noise levels are not expected to fluctuate greatly, which is evident from the historical data, as there has not been any major development in the immediate vicinity of these locations, to significantly impact on the existing ambient environment.
- Moreover, operations at Lamberts North have also been fairly consistent, with typical activities and associated plant/equipment only moving to different areas of the site. However, based on the distance of Lamberts North from these receiver locations and the existing terrain, this has had little to no impact on the measured noise levels. Fluctuations noted in the historical data is most likely a result of noise impacts associated with intermittent operations at the Springvale Coal Services site located to the west of Location 1 (1613 Castlereagh Highway), farm equipment and dirt bikes on adjoining farms and seasonal traffic variations along Castlereagh Highway. All these noise sources are significantly closer to the receiver locations than Lamberts North.
- The daytime equivalent sound pressure levels measured during this assessment period is consistent with the historical data presented above at both receiver locations.

5 Noise Assessment

The results of the measured ambient noise levels at the sensitive receivers stipulated in the CoA (Location 1 and Location 2) are detailed in

Table 5 above.

As discussed in Section 4.4, the ambient environment at both the receiver locations, was dominated by traffic noise, low industrial hum, noise from nearby coal mines and noise from birds/insects. It is impossible to accurately identify the industrial hum noted at location 1, given the location of several facilities in the westerly direction, i.e. Springvale mine, Pinedale mine, Lamberts South Centennial Coal site etc.

The measured equivalent sound pressure levels were in excess of the 42 dB(A)$L_{eq(15min)}$ daytime noise target as detailed in Table 5, however no discernible operational noise was noted at either location from ash placement works, during the monitoring period. Given the large buffer distances (at least 1.4km to location 1 and over 2.5km to location 2), intervening topography and based on the measured reference noise levels measured from ash sediment operations plant/equipment (refer Table 2), noise impacts at both receiver locations would be minimal or insignificant.

Aurecon undertook a desktop assessment to predict noise impacts from the measured operational activities, to validate this statement and this is described in more detail in the following section.

5.1 Predicted noise contribution

For the purpose of this assessment, we have assumed a worst-case scenario of the plant/machinery detailed in Table 2 operating in the northern part of the Lamberts North site (as opposed to Area 1). We were informed by Lend Lease that operations only occur in the northern part of Lamberts North site and no activities take place in the southern half. Additionally, we were also informed that no activities had taken place in the northern part of Lamberts North over last two months and no operations were proposed in the immediate future. The operational activities on site commenced each day from approximately 06:30 until 17:00, during our site visit. There were no operational activities between 17:00 and 06:00.

We note that the magnitude of operational noise impacts will depend on the number and intensity of machines operating, and the working location of the equipment. It is unlikely that all the plant and equipment will be running simultaneously in the same location. In addition, the nature of activities onsite is expected to vary from day to day.

The predicted noise levels were calculated (based on sound propagation through geometric spreading) at a distance based on worst case noise emission levels (i.e. maximum sound power levels) without considering any barrier effects from the undulating surrounding terrain. However due to intermittent operational characteristics and constant change of distance between the source-receiver, a 50% operational efficiency (equipment operational for 50% of the time during each 15-minute measurement period) for each equipment type in the calculation has been used. The results of this calculation are shown in Table 7.

It should be noted that the predicted levels in this section are based on a worst-case operational scenario at both assessment locations and include adjustments for annoying activities as outlined in the NSW Environment Protection Authority's (EPA) Interim Construction Noise Guideline (ICNG). The above prediction methodology takes into account the number of individual machines operating as well as the percentage in use during a 15-minute period, with all scheduled equipment operating at the minimum distance from the nearest sensitive receiver.

The predicted levels in Table 7 provide a theoretical maximum cumulative noise impact. The distances shown in Table 7 are considered minimum between the operational works and the respective receiver zones. The calculation also assumes that each item of equipment is operating at maximum capacity (i.e. maximum sound power level). In reality the mobile plant operates at much lower capacity during its operation and hence the levels shown in Table 7 are considered conservative and should be interpreted as indicative worst case only.

Table 7 | Predicted Noise Emissions

Equipment at Lamberts North	Sound Power Level (SWL), dBA	Predicted Noise Levels, dB(A)$L_{eq(15min)}$	
		Location 1 – Blackmans Flat (approx. 1.4km)	Location 2 – Wallerawang (approx. 2.5 km)
Dozer / Crawler	107	33	28
Water Truck x 2	101	27	22
Roller	105	31	26
Dump Truck x 2	101	28	23
Light commercial vehicles x 2	98	26	21
Generator	88	<20	<20
Cumulative predicted noise levels from the operation of the above equipment		**37**	**32**

Table 8 | Summary of Cumulative Noise Emissions against the Noise Criteria (dBA)

Location*	Description	Maximum theoretical predicted noise	Day limit 42 dBA (07:00-18:00)	Evening limit 38 dBA (18:00-22:00) ^	Night limit 35 dBA (22:00-07:00) ^
1	Blackmans Flat	37	✓	N/A	N/A
2	Wallerawang	32	✓	N/A	N/A

✓ Complies with the stipulated noise criteria

^ No operational activity during Evening or night time periods.

As shown in Table 8, results of our assessment revealed the following:

- Worst-case modelling predicted that noise levels would comply with the daytime and evening period noise criteria, at both Location 1 and Location 2.
- Worst case modelling indicates that the maximum predicted noise level will exceed the noise criteria during night time at Location 1. However, CoA E1 for Lamberts North restricts any activities after 20:00 on weekdays and 17:00 on weekends (refer to Section 3.2 for more details), and therefore any predicted night time exceedance is not relevant.

Additionally, the noise emission predictions correlate the on-site observations as the predicted emissions at Location 1 and Location 2 are greater than 10 dB below the ambient background noise levels measured on site and would thereby be subjectively inaudible.

6 Recommendations

6.1 Noise management measures

Should complaints from the community be received, the following noise control measures could be applied to minimise noise impacts;

- If possible, avoid the coincidence of noisy plant/machine working simultaneously.
- Construction trucks and other heavy machinery to use loop tracks as much as possible on the site to minimise the amount of reversing activities, i.e. managed through the Operational Traffic and Transport Management Plan.
- Consider the use of alternative warning system to the conventional single tone reversing alarm, such as squawkers and broadband sound reversing alarm (e.g. bbs-tek® White Sound® reverse alarms).
- Installation of silencer/mufflers on the engine exhaust, if plant/machinery operations are proposed along the eastern boundary of the Lamberts North site.

7 Conclusion

Aurecon conducted operational noise measurements of the ash placement operations associated with the Lamberts North Ash Placement Project, as required by the Condition of Approval (CoA) E11 and the mitigation measures specified in the Operational Environment Management Plan (OEMP May 2013). Noise measurements were carried out at the two nearest affected sensitive receiver locations (Blackmans Flat and Wallerawang) between 18th – 20th October 2019, in accordance with the project OEMP.

- *Location 1 – Blackmans Flat*

The ambient noise at Location 1 (i.e. Blackmans Flat) was relatively high and the maximum equivalent continuous sound pressure level over 15 minutes at Location 1 was measured at $L_{Aeq\ (15minute)}$ 55 dB(A). The measured noise levels were dominated by traffic noise from Castlereagh Highway. Attended measurements indicated that noise emissions from the Lamberts North site was subjectively inaudible at the Location 1 site.

The maximum predicted noise contribution resulting from the operation of equipment/ plant at the Lamberts North site at Location 1 was determined to be 37 dB(A)$L_{eq(15min)}$, as detailed in Table 7. This contribution is deemed to comply with the requirements of the CoA.

- *Location 2 – Wallerawang*

The ambient noise at Location 2 (i.e. Wallerawang) was dominated by noise from birds/insects, low hum from Mt Piper Power Station and distant traffic noise from Castlereagh Highway. Intermittent machinery/plant noise (tractors, pump/generator) was audible from the farm to the west/south-west. Additionally, dirt bike activity was noted during the daytime period (initially at 10:00am and also at 2:30pm and 6:00pm) within the farm property to the south of the monitoring location.

Subjectively there was no evidence of noise originating from the north-westerly direction at Location 2. This suggests that noise contribution from Lamberts North to the overall equivalent sound pressure level at this location, is negligible. Maximum equivalent continuous noise over 15 minutes at Location 2 was measured at $L_{Aeq\ (15minute)}$ 48 dB(A), ignoring Saturday (19 June) daytime dirt bike noise contributions.

The maximum predicted noise contribution resulting from the operation of equipment/ plant at the Lamberts North site at Location 2 was determined to be 32 dB(A)$L_{eq(15min)}$, as detailed in Table 7. This contribution is deemed to comply with the requirements of the CoA.

- *Summary*

The ambient noise levels measured at Locations 1 and 2 exceed the 42 dB(A) day time noise target. However, noise contributions from surrounding simultaneous noise sources and activities including coal mines, road traffic and local environment (birds, insects and dogs barking), were noted as the dominant contributors. Subjectively there was no evidence of noise originating from the Lamberts north site direction at either receiver location.

To validate this observation, a desktop assessment of the measured operational levels associated with the ash placement activities was also undertaken by this office. Based on the worst-case operating scenario (refer section 5.1), cumulative predicted noise levels from ash placement activities will comfortably comply with the *Lamberts North Ash Placement Project – Operational Environmental Management Plan (May 2013)*, at both the representative residential receiver locations 1 and 2.

8 References

The following documents were referenced as part of this assessment:

- Lamberts North Ash Placement Project – Operational Environmental Management Plan (OEMP) May 2013.
- Lamberts North Operational Noise Assessment June 2019 report, revision 2.
- *Delta Electricity Project Conditions of Approval for Mt Piper Power Station Ash Repository Extension Project (approved on 16 February 2012).*
- *Mt Piper Power Station Ash Placement Project – Lamberts North Construction Noise monitoring 14-15 January 2013 (Revision 2, dated 11 February 2013)*
- Australian Standard *AS 1055 1997: Acoustics – Description and measurement of environmental noise*.

Appendix A
Glossary of terms

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

Appendix B
Photos of noise monitored locations at Blackmans Flat and Wallerawang

Figure 2 | Photograph of Measurement Location 1 (Blackmans Flat) – 18th and 20th October 2019

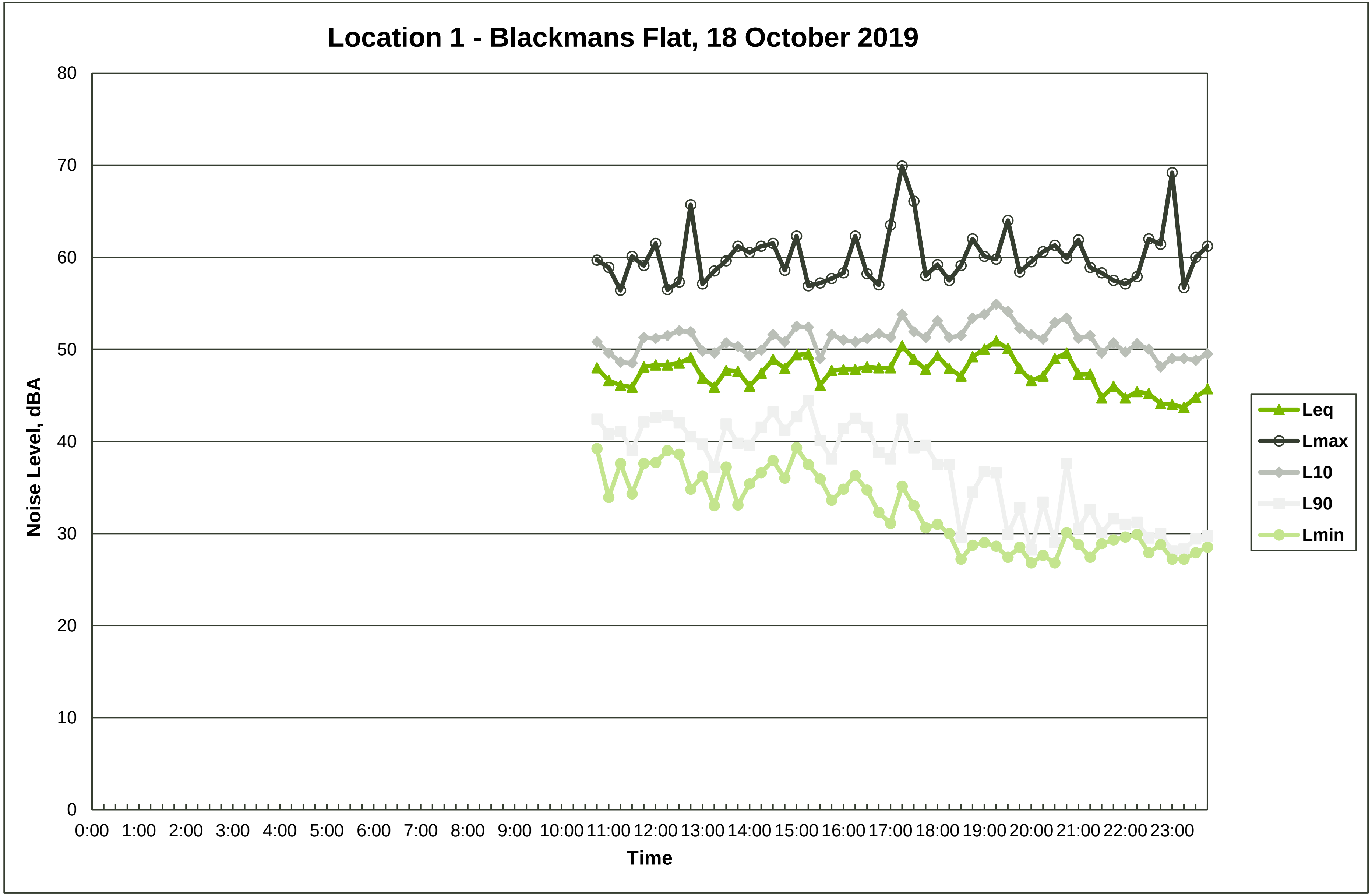
Figure 3 | Photograph of Springvale Coal Services site at 1613 Castlereagh Highway

Figure 4 | Photograph of Measurement Location 2 (Wallerawang) – 18th and 20th October 2019 looking west and north-west

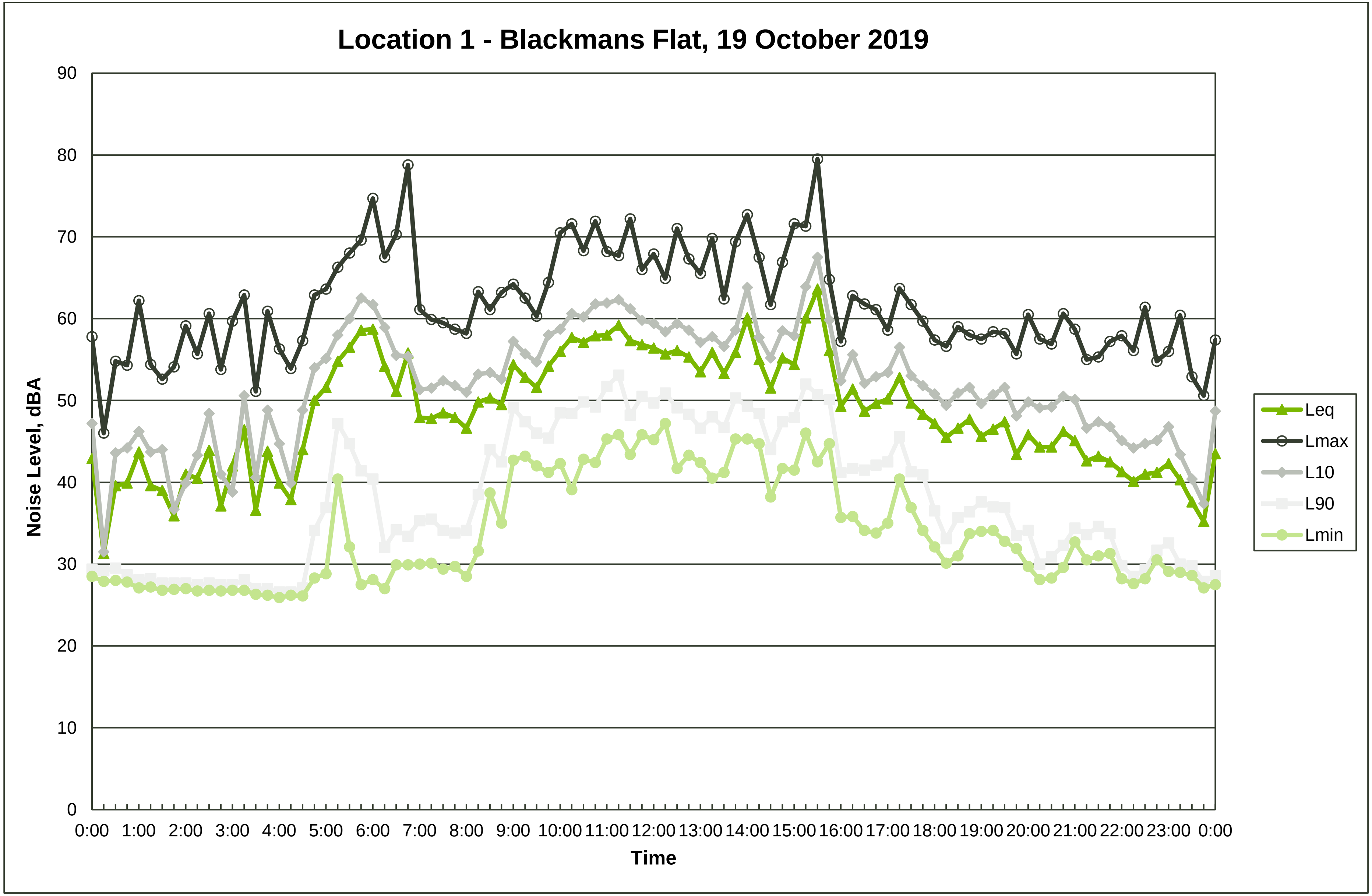
Figure 5a | Photograph of Machinery Operating in Area 1 and Ash Sediment Basin on the 18th and 19th October 2019

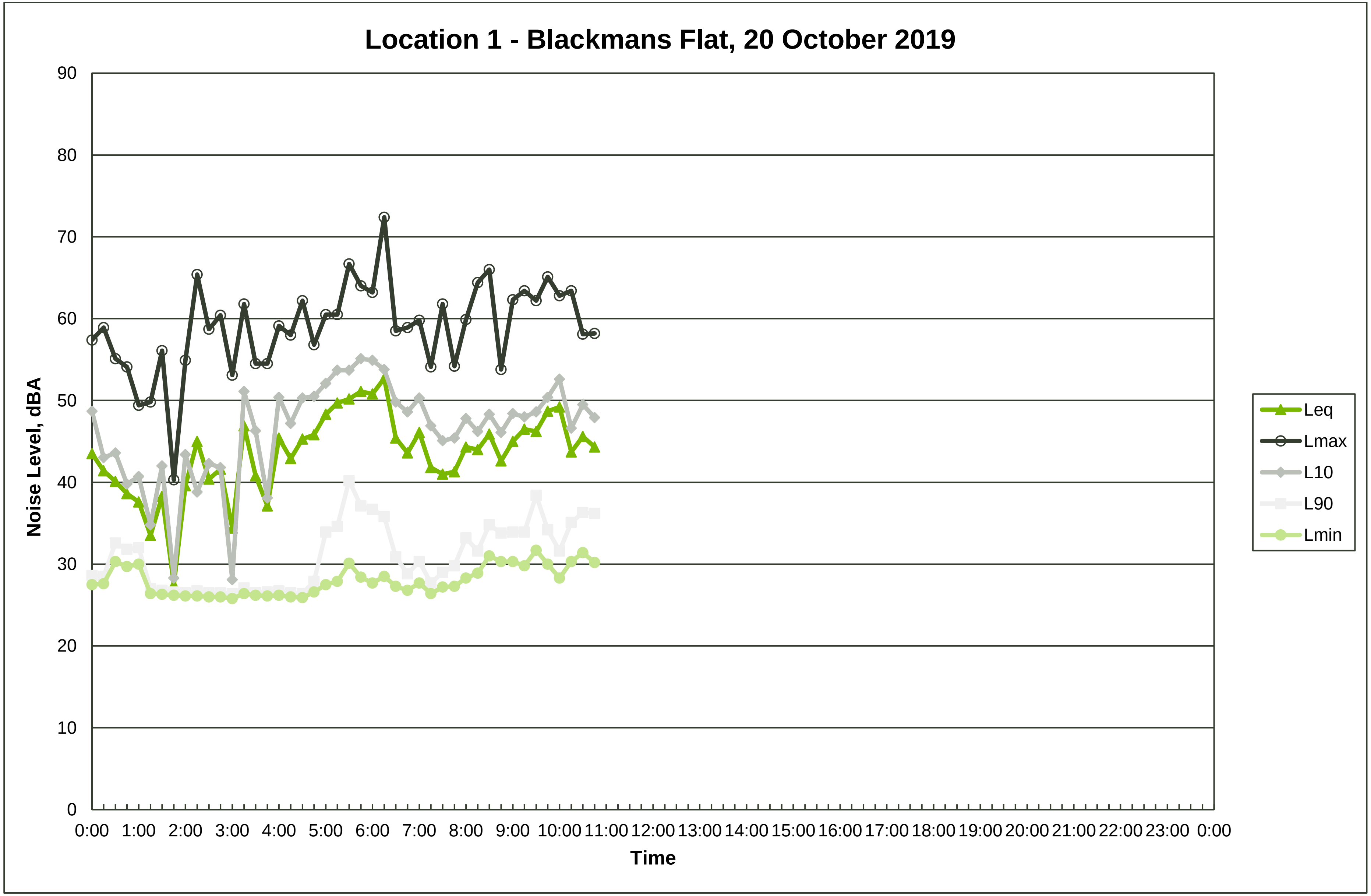
Figure 5b | Photograph of Machinery Operating in Area 1 and Ash Sediment Basin on the 18th and 19th October 2019

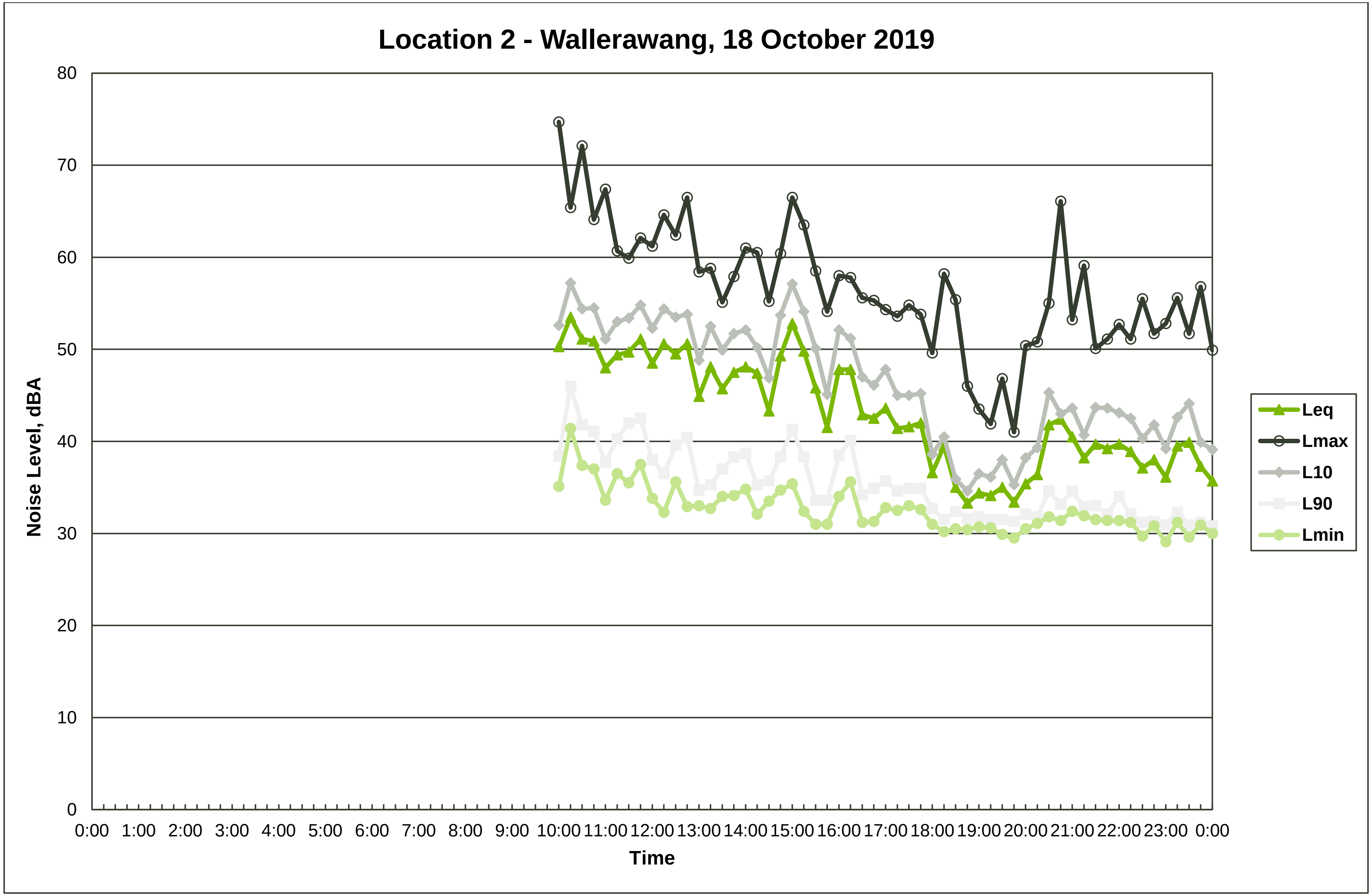
Appendix C
Noise Monitoring Graphs

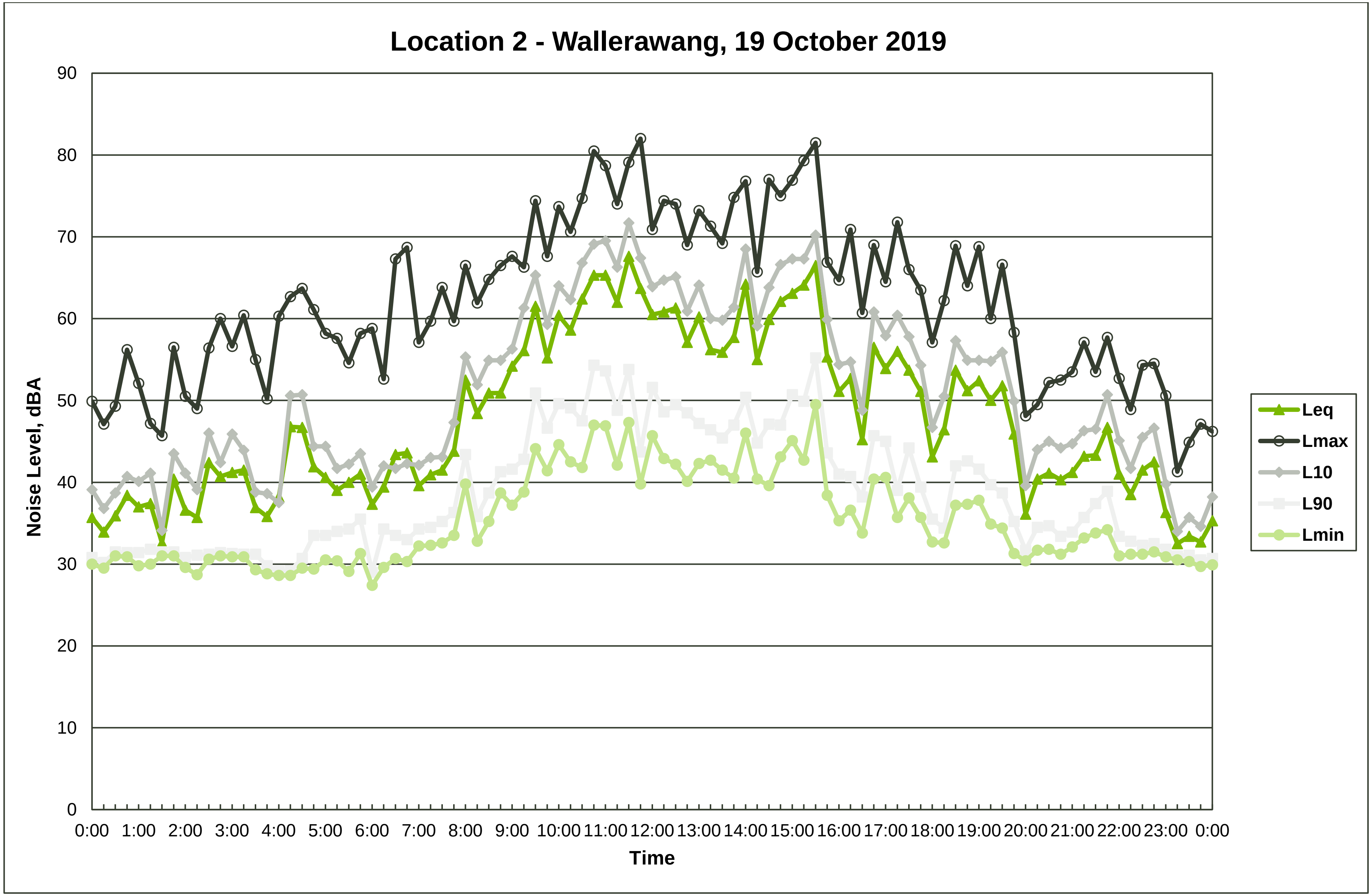


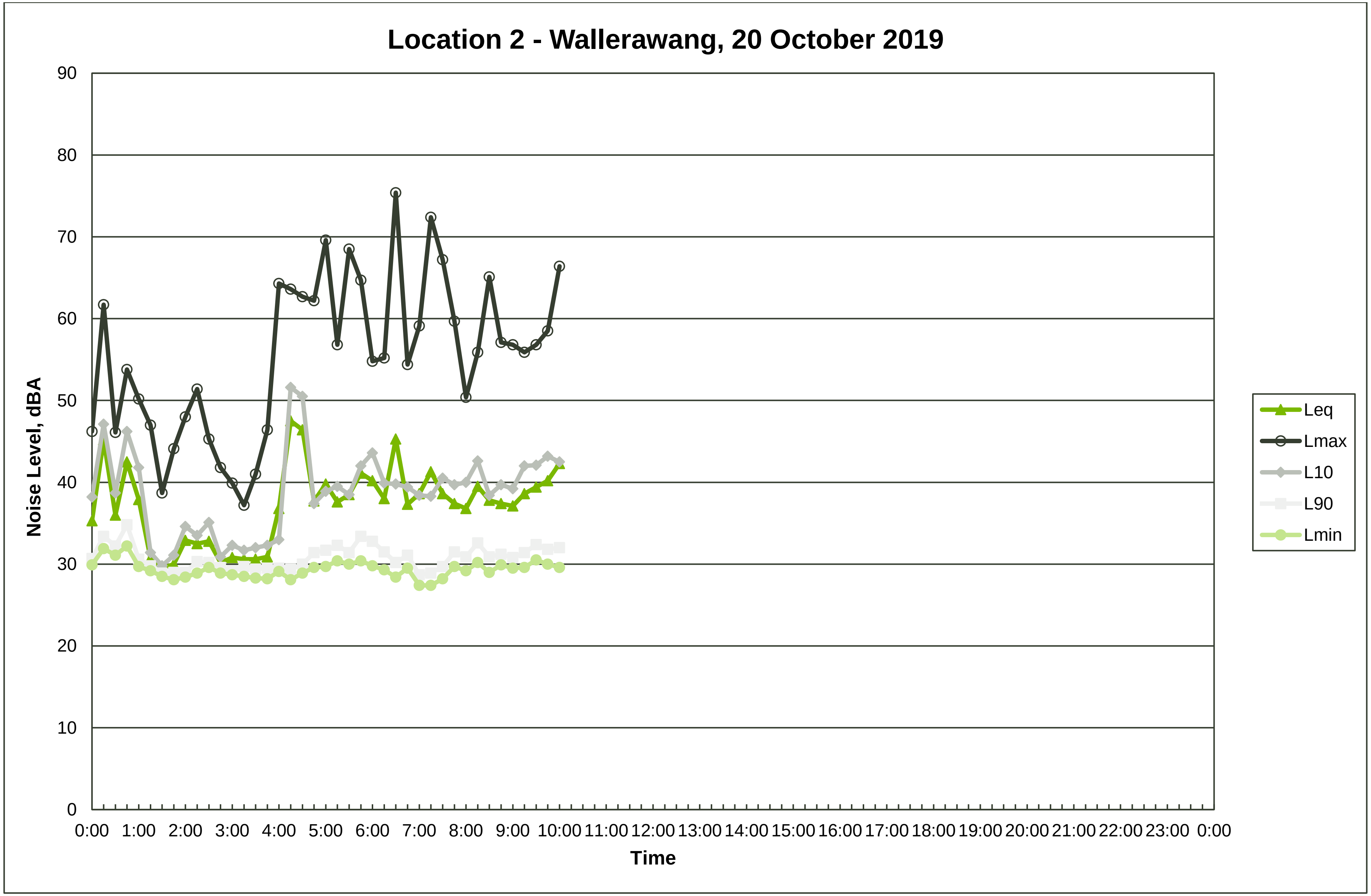
Location 1 - Blackmans Flat, 18 October 2019
80
70
60
50
40
30
20
10
0
Noise Level, dBA
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Leq
Lmax
L10
L90
Lmin


Location 1 - Blackmans Flat, 19 October 2019
Noise Level, dBA
90
80
70
60
50
40
30
20
10
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Time
Leq
Lmax
L10
L90
Lmin


Location 1 - Blackmans Flat, 20 October 2019
Noise Level, dBA
0
10
20
30
40
50
60
70
80
90
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Time
Leq
Lmax
L10
L90
Lmin


Location 2 - Wallerawang, 18 October 2019
Noise Level, dBA
80
70
60
50
40
30
20
10
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Time
Leq
Lmax
L10
L90
Lmin


Location 2 - Wallerawang, 19 October 2019
Noise Level, dBA
Time
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Leq
Lmax
L10
L90
Lmin


Location 2 - Wallerawang, 20 October 2019
Noise Level, dBA
0
10
20
30
40
50
60
70
80
90
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
Leq
Lmax
L10
L90
Lmin

Appendix D

Area 1 - Traffic Route and Machinery Operations during Monitoring Period


APPENDIX 1
IMPORTANT RULES FOR THE APA
1. DIRECTION OF TRAVEL ALONG ASH BIN LOOP CIRCUIT MAY VARY TO SUIT WIND DIRECTION AND ASH DRIFT - OBEY ALL SIGNS, DIRECTIONAL ARROWS AND CONTACT HAUL TRUCKS BEFORE PROCEEDING ALONG CIRCUIT
2. CAPPING TRUCKS TO YIELD TO ASH TRUCKS
3. LIGHT VEHICLES TO YIELD TO ALL HEAVY PLANT
See Document headings below that apply to this site:
4. MP-PC-733 APA ACCESS PROTOCOL
5. MP-PL-012 MT PIPER VEHICLE SITE MANAGEMENT PLAN
BLOWDOWN POND B
BLOWDOWN POND A
COTAMINATED WATER POND
TO POWER STATION
Bin Area
Dozer
Water Cart
Roller
CH3
LAMBERTS NORTH
MULTIQUIP AREA
N
0
125
250
SCALE 1:5000
PEDESTRIAN CROSSING
VARIABLE ONE WAY CIRCUIT WITH ARROW OR FIXED ONE WAY
HV
HEAVY VEHICLE ROAD
27
UHF CALL UP SIGN
STOP
NO ENTRY
GIVE WAY
AUTHORISED ACCESS ONLY
ASH HAUL ROAD (MARKED POSTS)
FBA HAUL ROAD (MARKED POSTS)
CAPPING HAUL ROAD
ACCESS ROAD
EARTH WINDROW
DEEP WATER
LAY DOWN AREA / SERVICE AREA
MONITORING BORE
DUST MONITOR OPERATIONAL
DUST MONITOR OUT OF SERVICE
VIBRATING WIRE PIEZOMETER PLUGIN
VWP LOCATION
WEATHER STATION
CHAIN WIRE FENCE
TO COAL SERVICES WM
TRAFFIC MANAGEMENT PLAN LAYOUT
MT PIPER ASH PLACEMENT AREA
lendlease
23/05/19

Appendix E
Weather summary

Note: Highlighted rows indicate periods with rainfall or wind speeds > 5m/s. Corresponding noise levels measured during these periods are excluded from this assessment.					
Date	**Time**	**Rainfall (mm)**	**Temperature (°C)**	**Wind Speed (m/s)**	**Wind Direction (deg.)**
18/10/2019	7:00:00 AM	0	9	3	216
18/10/2019	7:05:00 AM	0	9	3	209
18/10/2019	7:10:00 AM	0	9	3	204
18/10/2019	7:15:00 AM	0	9	3	219
18/10/2019	7:20:00 AM	0	10	3	218
18/10/2019	7:25:00 AM	0	10	2	228
18/10/2019	7:30:00 AM	0	10	3	240
18/10/2019	7:35:00 AM	0	10	5	254
18/10/2019	7:40:00 AM	0	10	5	253
18/10/2019	7:45:00 AM	0	10	5	254
18/10/2019	7:50:00 AM	0	10	5	250
18/10/2019	7:55:00 AM	0	10	4	251
18/10/2019	8:00:00 AM	0	11	4	245
18/10/2019	8:05:00 AM	0	11	4	242
18/10/2019	8:10:00 AM	0	11	5	252
18/10/2019	8:15:00 AM	0	11	5	258
18/10/2019	8:20:00 AM	0	11	5	233
18/10/2019	8:25:00 AM	0	11	4	243
18/10/2019	8:30:00 AM	0	11	3	227
18/10/2019	8:35:00 AM	0	12	3	225
18/10/2019	8:40:00 AM	0	12	3	265
18/10/2019	8:45:00 AM	0	12	3	243
18/10/2019	8:50:00 AM	0	12	4	251
18/10/2019	8:55:00 AM	0	12	3	208
18/10/2019	9:00:00 AM	0	12	3	229
18/10/2019	9:05:00 AM	0	13	4	227
18/10/2019	9:10:00 AM	0	13	4	215
18/10/2019	9:15:00 AM	0	13	3	218
18/10/2019	9:20:00 AM	0	14	3	259
18/10/2019	9:25:00 AM	0	13	3	246
18/10/2019	9:30:00 AM	0	13	4	252
18/10/2019	9:35:00 AM	0	13	5	233
18/10/2019	9:40:00 AM	0	14	4	229
18/10/2019	9:45:00 AM	0	14	4	230

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
18/10/2019	9:50:00 AM	0	14	4	251
18/10/2019	9:55:00 AM	0	14	3	216
18/10/2019	10:00:00 AM	0	15	3	202
18/10/2019	10:05:00 AM	0	16	4	211
18/10/2019	10:10:00 AM	0	16	4	225
18/10/2019	10:15:00 AM	0	16	3	212
18/10/2019	10:20:00 AM	0	16	3	199
18/10/2019	10:25:00 AM	0	17	3	210
18/10/2019	10:30:00 AM	0	16	4	235
18/10/2019	10:35:00 AM	0	17	5	214
18/10/2019	10:40:00 AM	0	16	4	220
18/10/2019	10:45:00 AM	0	16	4	229
18/10/2019	10:50:00 AM	0	17	4	234
18/10/2019	11:50:00 AM	0	16	2	227
18/10/2019	11:55:00 AM	0	16	3	264
18/10/2019	12:00:00 PM	0	17	3	200
18/10/2019	12:05:00 PM	0	17	5	246
18/10/2019	12:10:00 PM	0	17	4	228
18/10/2019	12:15:00 PM	0	18	4	243
18/10/2019	12:20:00 PM	0	18	4	227
18/10/2019	12:25:00 PM	0	18	5	234
18/10/2019	12:30:00 PM	0	18	5	219
18/10/2019	12:35:00 PM	0	18	6	272
18/10/2019	12:40:00 PM	0	18	5	235
18/10/2019	12:45:00 PM	0	18	4	255
18/10/2019	12:50:00 PM	0	18	4	258
18/10/2019	12:55:00 PM	0	18	4	282
18/10/2019	1:00:00 PM	0	18	4	263
18/10/2019	1:05:00 PM	0	18	4	261
18/10/2019	1:10:00 PM	0	18	5	269
18/10/2019	1:15:00 PM	0	18	4	270
18/10/2019	1:20:00 PM	0	17	5	291
18/10/2019	1:25:00 PM	0	17	6	285
18/10/2019	1:30:00 PM	0	18	5	261
18/10/2019	1:35:00 PM	0	18	6	275
18/10/2019	1:40:00 PM	0	18	4	272
18/10/2019	1:45:00 PM	0	18	5	261
18/10/2019	1:50:00 PM	0	18	4	259
18/10/2019	1:55:00 PM	0	19	5	278
18/10/2019	2:00:00 PM	0	18	4	280
18/10/2019	2:05:00 PM	0	19	4	262
18/10/2019	2:10:00 PM	0	19	4	253
18/10/2019	2:15:00 PM	0	18	4	274
18/10/2019	2:20:00 PM	0	19	4	274
18/10/2019	2:25:00 PM	0	18	5	258

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
18/10/2019	2:30:00 PM	0	18	5	273
18/10/2019	2:35:00 PM	0	19	5	260
18/10/2019	2:40:00 PM	0	18	4	263
18/10/2019	2:45:00 PM	0	19	4	272
18/10/2019	2:50:00 PM	0	18	5	275
18/10/2019	2:55:00 PM	0	19	5	261
18/10/2019	3:00:00 PM	0	18	5	281
18/10/2019	3:05:00 PM	0	19	4	283
18/10/2019	3:10:00 PM	0	19	2	264
18/10/2019	3:15:00 PM	0	19	5	284
18/10/2019	3:20:00 PM	0	19	4	270
18/10/2019	3:25:00 PM	0	19	5	277
18/10/2019	3:30:00 PM	0	19	3	275
18/10/2019	3:35:00 PM	0	19	4	289
18/10/2019	3:40:00 PM	0	20	4	259
18/10/2019	3:45:00 PM	0	20	4	257
18/10/2019	3:50:00 PM	0	20	5	261
18/10/2019	3:55:00 PM	0	19	6	255
18/10/2019	4:00:00 PM	0	19	4	251
18/10/2019	4:05:00 PM	0	19	4	244
18/10/2019	4:10:00 PM	0	19	3	267
18/10/2019	4:15:00 PM	0	19	3	284
18/10/2019	4:20:00 PM	0	20	4	258
18/10/2019	4:25:00 PM	0	19	3	276
18/10/2019	4:30:00 PM	0	20	3	275
18/10/2019	4:35:00 PM	0	19	3	286
18/10/2019	4:40:00 PM	0	19	4	254
18/10/2019	4:45:00 PM	0	20	4	258
18/10/2019	4:50:00 PM	0	20	3	278
18/10/2019	4:55:00 PM	0	19	4	255
18/10/2019	5:00:00 PM	0	20	5	267
18/10/2019	5:05:00 PM	0	19	5	256
18/10/2019	5:10:00 PM	0	19	4	285
18/10/2019	5:15:00 PM	0	19	4	262
18/10/2019	5:20:00 PM	0	19	4	264
18/10/2019	5:25:00 PM	0	19	5	255
18/10/2019	5:30:00 PM	0	19	3	254
18/10/2019	5:35:00 PM	0	19	4	244
18/10/2019	5:40:00 PM	0	19	4	259
18/10/2019	5:45:00 PM	0	19	4	249
18/10/2019	5:50:00 PM	0	19	4	253
18/10/2019	5:55:00 PM	0	19	5	252
18/10/2019	6:00:00 PM	0	18	4	251
18/10/2019	6:05:00 PM	0	18	3	266
18/10/2019	6:10:00 PM	0	18	4	255

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
18/10/2019	6:15:00 PM	0	18	3	257
18/10/2019	6:20:00 PM	0	18	3	248
18/10/2019	6:25:00 PM	0	18	3	258
18/10/2019	6:30:00 PM	0	18	3	257
18/10/2019	6:35:00 PM	0	18	2	251
18/10/2019	6:40:00 PM	0	18	2	254
18/10/2019	6:45:00 PM	0	17	2	252
18/10/2019	6:50:00 PM	0	16	2	258
18/10/2019	6:55:00 PM	0	16	2	259
18/10/2019	7:00:00 PM	0	15	2	262
18/10/2019	7:05:00 PM	0	15	2	256
18/10/2019	7:10:00 PM	0	15	2	247
18/10/2019	7:15:00 PM	0	14	2	243
18/10/2019	7:20:00 PM	0	13	2	241
18/10/2019	7:25:00 PM	0	13	1	248
18/10/2019	7:30:00 PM	0	12	1	274
18/10/2019	7:35:00 PM	0	12	1	264
18/10/2019	7:40:00 PM	0	11	1	234
18/10/2019	7:45:00 PM	0	11	1	246
18/10/2019	7:50:00 PM	0	10	1	259
18/10/2019	7:55:00 PM	0	10	1	262
18/10/2019	8:00:00 PM	0	10	1	241
18/10/2019	8:05:00 PM	0	10	1	219
18/10/2019	8:10:00 PM	0	9	1	217
18/10/2019	8:15:00 PM	0	9	1	231
18/10/2019	8:20:00 PM	0	8	1	240
18/10/2019	8:25:00 PM	0	8	1	251
18/10/2019	8:30:00 PM	0	8	1	223
18/10/2019	8:35:00 PM	0	7	1	205
18/10/2019	8:40:00 PM	0	7	1	222
18/10/2019	8:45:00 PM	0	7	1	62
18/10/2019	8:50:00 PM	0	7	1	91
18/10/2019	8:55:00 PM	0	7	1	46
18/10/2019	9:00:00 PM	0	7	1	60
18/10/2019	9:05:00 PM	0	6	1	51
18/10/2019	9:10:00 PM	0	6	1	77
18/10/2019	9:15:00 PM	0	6	1	63
18/10/2019	9:20:00 PM	0	6	1	95
18/10/2019	9:25:00 PM	0	6	1	226
18/10/2019	9:30:00 PM	0	5	1	240
18/10/2019	9:35:00 PM	0	6	2	246
18/10/2019	9:40:00 PM	0	6	1	236
18/10/2019	9:45:00 PM	0	5	1	261
18/10/2019	9:50:00 PM	0	5	1	254
18/10/2019	9:55:00 PM	0	5	1	256

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
18/10/2019	10:00:00 PM	0	5	1	250
18/10/2019	10:05:00 PM	0	5	1	263
18/10/2019	10:10:00 PM	0	4	1	256
18/10/2019	10:15:00 PM	0	4	1	243
18/10/2019	10:20:00 PM	0	4	1	236
18/10/2019	10:25:00 PM	0	4	1	204
18/10/2019	10:30:00 PM	0	4	1	202
18/10/2019	10:35:00 PM	0	4	1	208
18/10/2019	10:40:00 PM	0	4	1	247
18/10/2019	10:45:00 PM	0	4	1	227
18/10/2019	10:50:00 PM	0	4	0	128
18/10/2019	10:55:00 PM	0	4	0	142
18/10/2019	11:00:00 PM	0	4	0	161
18/10/2019	11:05:00 PM	0	4	0	109
18/10/2019	11:10:00 PM	0	4	0	161
18/10/2019	11:15:00 PM	0	4	0	195
18/10/2019	11:20:00 PM	0	3	1	245
18/10/2019	11:25:00 PM	0	3	0	263
18/10/2019	11:30:00 PM	0	3	0	134
18/10/2019	11:35:00 PM	0	3	0	89
18/10/2019	11:40:00 PM	0	3	1	197
18/10/2019	11:45:00 PM	0	3	1	237
18/10/2019	11:50:00 PM	0	3	1	247
18/10/2019	11:55:00 PM	0	4	2	256
18/10/2019	12:00:00 AM	0	4	2	258
18/10/2019	12:05:00 AM	0	4	1	270
18/10/2019	12:10:00 AM	0	4	1	191
18/10/2019	12:15:00 AM	0	4	1	41
18/10/2019	12:20:00 AM	0	3	1	62
18/10/2019	12:25:00 AM	0	3	1	158
18/10/2019	12:30:00 AM	0	3	1	121
18/10/2019	12:35:00 AM	0	3	0	288
18/10/2019	12:40:00 AM	0	3	0	298
18/10/2019	12:45:00 AM	0	3	1	160
18/10/2019	12:50:00 AM	0	3	1	50
19/10/2019	12:55:00 AM	0	3	1	39
19/10/2019	1:00:00 AM	0	3	1	254
19/10/2019	1:05:00 AM	0	2	0	244
19/10/2019	1:10:00 AM	0	2	0	94
19/10/2019	1:15:00 AM	0	2	0	52
19/10/2019	1:20:00 AM	0	2	0	115
19/10/2019	1:25:00 AM	0	2	1	230
19/10/2019	1:30:00 AM	0	2	1	238
19/10/2019	1:35:00 AM	0	2	1	245
19/10/2019	1:40:00 AM	0	2	1	233

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
19/10/2019	1:45:00 AM	0	2	1	260
19/10/2019	1:50:00 AM	0	2	1	269
19/10/2019	1:55:00 AM	0	2	1	260
19/10/2019	2:00:00 AM	0	2	1	251
19/10/2019	2:05:00 AM	0	2	1	242
19/10/2019	2:10:00 AM	0	2	1	243
19/10/2019	2:15:00 AM	0	2	1	247
19/10/2019	2:20:00 AM	0	2	1	232
19/10/2019	2:25:00 AM	0	2	1	241
19/10/2019	2:30:00 AM	0	2	1	249
19/10/2019	2:35:00 AM	0	2	1	279
19/10/2019	2:40:00 AM	0	2	1	265
19/10/2019	2:45:00 AM	0	2	1	107
19/10/2019	2:50:00 AM	0	2	1	38
19/10/2019	2:55:00 AM	0	2	1	37
19/10/2019	3:00:00 AM	0	2	1	101
19/10/2019	3:05:00 AM	0	2	1	303
19/10/2019	3:10:00 AM	0	1	1	303
19/10/2019	3:15:00 AM	0	1	1	298
19/10/2019	3:20:00 AM	0	2	1	293
19/10/2019	3:25:00 AM	0	2	1	296
19/10/2019	3:30:00 AM	0	2	1	291
19/10/2019	3:35:00 AM	0	2	1	291
19/10/2019	3:40:00 AM	0	2	1	288
19/10/2019	3:45:00 AM	0	3	2	282
19/10/2019	3:50:00 AM	0	4	2	286
19/10/2019	3:55:00 AM	0	5	2	299
19/10/2019	4:00:00 AM	0	6	2	296
19/10/2019	4:05:00 AM	0	7	1	292
19/10/2019	4:10:00 AM	0	6	1	288
19/10/2019	4:15:00 AM	0	6	1	290
19/10/2019	4:20:00 AM	0	7	2	304
19/10/2019	4:25:00 AM	0	7	2	310
19/10/2019	4:30:00 AM	0	7	2	303
19/10/2019	4:35:00 AM	0	8	2	303
19/10/2019	4:40:00 AM	0	6	1	297
19/10/2019	4:45:00 AM	0	6	2	293
19/10/2019	4:50:00 AM	0	6	2	287
19/10/2019	4:55:00 AM	0	5	2	287
19/10/2019	5:00:00 AM	0	5	2	275
19/10/2019	5:05:00 AM	0	5	2	283
19/10/2019	5:10:00 AM	0	5	2	290
19/10/2019	5:15:00 AM	0	5	2	268
19/10/2019	5:20:00 AM	0	5	1	290
19/10/2019	5:25:00 AM	0	5	1	274

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
19/10/2019	5:30:00 AM	0	4	2	282
19/10/2019	5:35:00 AM	0	4	2	291
19/10/2019	5:40:00 AM	0	5	2	253
19/10/2019	5:45:00 AM	0	5	2	267
19/10/2019	5:50:00 AM	0	6	2	279
19/10/2019	5:55:00 AM	0	6	2	282
19/10/2019	6:00:00 AM	0	5	2	309
19/10/2019	6:05:00 AM	0	5	2	256
19/10/2019	6:10:00 AM	0	5	2	290
19/10/2019	6:15:00 AM	0	5	2	278
19/10/2019	6:20:00 AM	0	4	2	289
19/10/2019	6:25:00 AM	0	4	2	290
19/10/2019	6:30:00 AM	0	4	2	298
19/10/2019	6:35:00 AM	0	4	2	282
19/10/2019	6:40:00 AM	0	5	2	275
19/10/2019	6:45:00 AM	0	5	2	291
19/10/2019	6:50:00 AM	0	5	1	294
19/10/2019	6:55:00 AM	0	6	1	303
19/10/2019	7:00:00 AM	0	6	1	239
19/10/2019	7:05:00 AM	0	6	1	279
19/10/2019	7:10:00 AM	0	7	1	246
19/10/2019	7:15:00 AM	0	8	1	263
19/10/2019	7:20:00 AM	0	9	1	220
19/10/2019	7:25:00 AM	0	10	2	285
19/10/2019	7:30:00 AM	0	11	2	309
19/10/2019	7:35:00 AM	0	11	2	247
19/10/2019	7:40:00 AM	0	12	2	300
19/10/2019	7:45:00 AM	0	12	2	297
19/10/2019	7:50:00 AM	0	13	2	292
19/10/2019	7:55:00 AM	0	13	2	275
19/10/2019	8:00:00 AM	0	13	1	228
19/10/2019	8:05:00 AM	0	14	2	141
19/10/2019	8:10:00 AM	0	14	2	270
19/10/2019	8:15:00 AM	0	14	2	215
19/10/2019	8:20:00 AM	0	15	2	198
19/10/2019	8:25:00 AM	0	15	2	278
19/10/2019	8:30:00 AM	0	15	2	246
19/10/2019	8:35:00 AM	0	15	2	270
19/10/2019	8:40:00 AM	0	15	3	288
19/10/2019	8:45:00 AM	0	15	4	272
19/10/2019	8:50:00 AM	0	15	3	242
19/10/2019	8:55:00 AM	0	16	3	258
19/10/2019	9:00:00 AM	0	16	5	260
19/10/2019	9:05:00 AM	0	16	4	269
19/10/2019	9:10:00 AM	0	15	6	260

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
19/10/2019	9:15:00 AM	0	16	6	262
19/10/2019	9:20:00 AM	0	16	5	265
19/10/2019	9:25:00 AM	0	16	5	270
19/10/2019	9:30:00 AM	0	16	5	262
19/10/2019	9:35:00 AM	0	16	5	254
19/10/2019	9:40:00 AM	0	16	7	262
19/10/2019	9:45:00 AM	0	16	7	251
19/10/2019	9:50:00 AM	0	17	6	255
19/10/2019	9:55:00 AM	0	17	8	258
19/10/2019	10:00:00 AM	0	17	6	258
19/10/2019	10:05:00 AM	0	17	5	281
19/10/2019	10:10:00 AM	0	17	6	284
19/10/2019	10:15:00 AM	0	17	6	255
19/10/2019	10:20:00 AM	0	17	6	260
19/10/2019	10:25:00 AM	0	17	6	256
19/10/2019	10:30:00 AM	0	18	5	263
19/10/2019	10:35:00 AM	0	17	7	274
19/10/2019	10:40:00 AM	0	18	6	253
19/10/2019	10:45:00 AM	0	17	6	258
19/10/2019	10:50:00 AM	0	18	6	253
19/10/2019	10:55:00 AM	0	18	7	246
19/10/2019	11:00:00 AM	0	18	5	252
19/10/2019	11:05:00 AM	0	18	6	262
19/10/2019	11:10:00 AM	0	18	6	276
19/10/2019	11:15:00 AM	0	18	6	276
19/10/2019	11:20:00 AM	0	19	5	261
19/10/2019	11:25:00 AM	0	19	6	272
19/10/2019	11:30:00 AM	0	19	8	269
19/10/2019	11:35:00 AM	0	19	8	256
19/10/2019	11:40:00 AM	0	19	5	263
19/10/2019	11:45:00 AM	0	19	7	260
19/10/2019	11:50:00 AM	0	19	7	264
19/10/2019	11:55:00 AM	0	20	6	260
19/10/2019	12:00:00 PM	0	20	6	262
19/10/2019	12:05:00 PM	0	20	8	261
19/10/2019	12:10:00 PM	0	19	8	257
19/10/2019	12:15:00 PM	0	19	7	260
19/10/2019	12:20:00 PM	0	19	7	265
19/10/2019	12:25:00 PM	0	19	7	266
19/10/2019	12:30:00 PM	0	20	7	260
19/10/2019	12:35:00 PM	0	20	8	252
19/10/2019	12:40:00 PM	0	19	6	269
19/10/2019	12:45:00 PM	0	19	7	264
19/10/2019	12:50:00 PM	0	19	5	265
19/10/2019	12:55:00 PM	0	19	6	255

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
19/10/2019	1:00:00 PM	0	19	6	268
19/10/2019	1:05:00 PM	0	19	6	261
19/10/2019	1:10:00 PM	0	20	7	259
19/10/2019	1:15:00 PM	0	20	7	274
19/10/2019	1:20:00 PM	0	19	7	279
19/10/2019	1:25:00 PM	0	19	7	263
19/10/2019	1:30:00 PM	0	19	7	253
19/10/2019	1:35:00 PM	0	20	6	274
19/10/2019	1:40:00 PM	0	20	6	273
19/10/2019	1:45:00 PM	0	20	5	253
19/10/2019	1:50:00 PM	0	19	6	260
19/10/2019	1:55:00 PM	0	19	6	262
19/10/2019	2:00:00 PM	0	19	8	248
19/10/2019	2:05:00 PM	0	19	5	252
19/10/2019	2:10:00 PM	0	18	7	276
19/10/2019	2:15:00 PM	0	19	6	273
19/10/2019	2:20:00 PM	0	19	6	287
19/10/2019	2:25:00 PM	0	19	5	297
19/10/2019	2:30:00 PM	0	19	7	274
19/10/2019	2:35:00 PM	0	19	6	284
19/10/2019	2:40:00 PM	0	20	6	293
19/10/2019	2:45:00 PM	0	20	8	275
19/10/2019	2:50:00 PM	0	19	7	268
19/10/2019	2:55:00 PM	0	18	7	261
19/10/2019	3:00:00 PM	0	18	4	285
19/10/2019	3:05:00 PM	0	18	6	300
19/10/2019	3:10:00 PM	0	18	4	305
19/10/2019	3:15:00 PM	0	19	4	284
19/10/2019	3:20:00 PM	0	18	5	263
19/10/2019	3:25:00 PM	0	18	6	269
19/10/2019	3:30:00 PM	0	18	7	270
19/10/2019	3:35:00 PM	0	18	7	279
19/10/2019	3:40:00 PM	0	17	5	297
19/10/2019	3:45:00 PM	0	17	4	285
19/10/2019	3:50:00 PM	0	18	5	251
19/10/2019	3:55:00 PM	0	19	7	246
19/10/2019	4:00:00 PM	0	18	7	247
19/10/2019	4:05:00 PM	0	18	7	250
19/10/2019	4:10:00 PM	0	17	7	240
19/10/2019	4:15:00 PM	0	17	6	260
19/10/2019	4:20:00 PM	0	16	9	259
19/10/2019	4:25:00 PM	0	15	7	243
19/10/2019	4:30:00 PM	0	15	8	260
19/10/2019	4:35:00 PM	0	16	6	274
19/10/2019	4:40:00 PM	0	16	6	250

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
19/10/2019	4:45:00 PM	0	16	6	254
19/10/2019	4:50:00 PM	0	17	5	254
19/10/2019	4:55:00 PM	0	17	4	255
19/10/2019	5:00:00 PM	0	16	6	269
19/10/2019	5:05:00 PM	0	17	5	265
19/10/2019	5:10:00 PM	0	17	5	283
19/10/2019	5:15:00 PM	0	16	4	286
19/10/2019	5:20:00 PM	0	16	4	269
19/10/2019	5:25:00 PM	0	16	5	277
19/10/2019	5:30:00 PM	0	16	4	262
19/10/2019	5:35:00 PM	0	16	4	273
19/10/2019	5:40:00 PM	0	16	4	262
19/10/2019	5:45:00 PM	0	16	6	257
19/10/2019	5:50:00 PM	0	15	5	245
19/10/2019	5:55:00 PM	0	15	5	260
19/10/2019	6:00:00 PM	0	15	5	256
19/10/2019	6:05:00 PM	0	15	6	258
19/10/2019	6:10:00 PM	0	15	7	256
19/10/2019	6:15:00 PM	0	15	6	259
19/10/2019	6:20:00 PM	0	15	4	256
19/10/2019	6:25:00 PM	0	15	5	252
19/10/2019	6:30:00 PM	0	15	5	254
19/10/2019	6:35:00 PM	0	15	4	246
19/10/2019	6:40:00 PM	0	14	4	239
19/10/2019	6:45:00 PM	0	14	4	256
19/10/2019	6:50:00 PM	0	14	4	245
19/10/2019	6:55:00 PM	0	14	4	252
19/10/2019	7:00:00 PM	0	13	4	254
19/10/2019	7:05:00 PM	0	13	3	248
19/10/2019	7:10:00 PM	0	13	4	248
19/10/2019	7:15:00 PM	0	13	5	253
19/10/2019	7:20:00 PM	0	13	5	252
19/10/2019	7:25:00 PM	0	13	6	249
19/10/2019	7:30:00 PM	0	13	5	254
19/10/2019	7:35:00 PM	0	13	6	248
19/10/2019	7:40:00 PM	0	12	4	251
19/10/2019	7:45:00 PM	0	12	4	253
19/10/2019	7:50:00 PM	0	12	5	249
19/10/2019	7:55:00 PM	0	12	4	246
19/10/2019	8:00:00 PM	0	12	5	249
19/10/2019	8:05:00 PM	0	12	4	250
19/10/2019	8:10:00 PM	0	12	4	252
19/10/2019	8:15:00 PM	0	12	5	244
19/10/2019	8:20:00 PM	0	12	5	241
19/10/2019	8:25:00 PM	0	11	4	249

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
19/10/2019	8:30:00 PM	0	11	4	246
19/10/2019	8:35:00 PM	0	11	4	247
19/10/2019	8:40:00 PM	0	11	3	245
19/10/2019	8:45:00 PM	0	11	3	240
19/10/2019	8:50:00 PM	0	11	4	243
19/10/2019	8:55:00 PM	0	11	2	231
19/10/2019	9:00:00 PM	0	11	3	224
19/10/2019	9:05:00 PM	0	11	2	210
19/10/2019	9:10:00 PM	0	10	3	215
19/10/2019	9:15:00 PM	0	10	3	208
19/10/2019	9:20:00 PM	0	10	2	192
19/10/2019	9:25:00 PM	0	10	2	219
19/10/2019	9:30:00 PM	0	10	3	220
19/10/2019	9:35:00 PM	0	10	3	229
19/10/2019	9:40:00 PM	0	10	3	234
19/10/2019	9:45:00 PM	0	9	2	241
19/10/2019	9:50:00 PM	0	9	3	238
19/10/2019	9:55:00 PM	0	9	3	242
19/10/2019	10:00:00 PM	0	9	3	237
19/10/2019	10:05:00 PM	0	9	3	242
19/10/2019	10:10:00 PM	0	9	3	241
19/10/2019	10:15:00 PM	0	9	2	240
19/10/2019	10:20:00 PM	0	9	3	240
19/10/2019	10:25:00 PM	0	9	3	233
19/10/2019	10:30:00 PM	0	9	3	240
19/10/2019	10:35:00 PM	0	9	3	235
19/10/2019	10:40:00 PM	0	9	4	228
19/10/2019	10:45:00 PM	0	9	4	225
19/10/2019	10:50:00 PM	0	9	3	222
19/10/2019	10:55:00 PM	0	9	3	213
19/10/2019	11:00:00 PM	0	9	3	208
19/10/2019	11:05:00 PM	0	8	4	216
19/10/2019	11:10:00 PM	0	8	3	218
19/10/2019	11:15:00 PM	0	8	4	230
19/10/2019	11:20:00 PM	0	8	4	231
19/10/2019	11:25:00 PM	0	8	5	230
19/10/2019	11:30:00 PM	0	8	5	229
19/10/2019	11:35:00 PM	0	8	5	227
19/10/2019	11:40:00 PM	0	8	5	232
19/10/2019	11:45:00 PM	0	8	5	230
19/10/2019	11:50:00 PM	0	8	6	228
19/10/2019	11:55:00 PM	0	8	5	225
19/10/2019	12:00:00 AM	0	8	4	209
19/10/2019	12:05:00 AM	0	8	3	207
19/10/2019	12:10:00 AM	0	8	2	196

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
19/10/2019	12:15:00 AM	0	8	3	205
19/10/2019	12:20:00 AM	0	8	2	204
19/10/2019	12:25:00 AM	0	8	3	204
19/10/2019	12:30:00 AM	0	8	3	196
19/10/2019	12:35:00 AM	0	8	3	176
19/10/2019	12:40:00 AM	0	7	3	174
19/10/2019	12:45:00 AM	0	7	3	158
19/10/2019	12:50:00 AM	0	7	3	184
20/10/2019	12:55:00 AM	0	7	2	177
20/10/2019	1:00:00 AM	0	7	3	175
20/10/2019	1:05:00 AM	0	7	4	175
20/10/2019	1:10:00 AM	0	7	5	160
20/10/2019	1:15:00 AM	0	7	3	136
20/10/2019	1:20:00 AM	0	7	2	131
20/10/2019	1:25:00 AM	0	7	2	136
20/10/2019	1:30:00 AM	0	7	2	139
20/10/2019	1:35:00 AM	0	7	3	143
20/10/2019	1:40:00 AM	0	6	2	141
20/10/2019	1:45:00 AM	0	6	2	130
20/10/2019	1:50:00 AM	0	6	2	141
20/10/2019	1:55:00 AM	0	6	2	144
20/10/2019	2:00:00 AM	0	6	1	248
20/10/2019	2:05:00 AM	0	5	1	274
20/10/2019	2:10:00 AM	0	5	1	275
20/10/2019	2:15:00 AM	0	4	1	277
20/10/2019	2:20:00 AM	0	4	1	236
20/10/2019	2:25:00 AM	0	4	1	56
20/10/2019	2:30:00 AM	0	3	1	78
20/10/2019	2:35:00 AM	0	3	1	131
20/10/2019	2:40:00 AM	0	3	1	145
20/10/2019	2:45:00 AM	0	3	1	111
20/10/2019	2:50:00 AM	0	2	1	122
20/10/2019	2:55:00 AM	0	2	1	116
20/10/2019	3:00:00 AM	0	2	1	169
20/10/2019	3:05:00 AM	0	2	1	182
20/10/2019	3:10:00 AM	0	2	1	142
20/10/2019	3:15:00 AM	0	2	1	176
20/10/2019	3:20:00 AM	0	2	2	158
20/10/2019	3:25:00 AM	0	2	2	150
20/10/2019	3:30:00 AM	0	3	2	156
20/10/2019	3:35:00 AM	0	3	2	203
20/10/2019	3:40:00 AM	0	2	1	197
20/10/2019	3:45:00 AM	0	2	2	183
20/10/2019	3:50:00 AM	0	2	2	208
20/10/2019	3:55:00 AM	0	3	3	220

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
20/10/2019	4:00:00 AM	0	3	2	223
20/10/2019	4:05:00 AM	0	3	2	210
20/10/2019	4:10:00 AM	0	3	1	203
20/10/2019	4:15:00 AM	0	3	1	215
20/10/2019	4:20:00 AM	0	3	1	193
20/10/2019	4:25:00 AM	0	3	1	153
20/10/2019	4:30:00 AM	0	3	1	85
20/10/2019	4:35:00 AM	0	2	1	135
20/10/2019	4:40:00 AM	0	2	1	239
20/10/2019	4:45:00 AM	0	1	2	267
20/10/2019	4:50:00 AM	0	2	2	226
20/10/2019	4:55:00 AM	0	2	2	235
20/10/2019	5:00:00 AM	0	3	2	231
20/10/2019	5:05:00 AM	0	3	2	224
20/10/2019	5:10:00 AM	0	2	1	220
20/10/2019	5:15:00 AM	0	2	1	197
20/10/2019	5:20:00 AM	0	2	1	213
20/10/2019	5:25:00 AM	0	1	1	180
20/10/2019	5:30:00 AM	0	1	1	193
20/10/2019	5:35:00 AM	0	1	1	165
20/10/2019	5:40:00 AM	0	1	1	155
20/10/2019	5:45:00 AM	0	1	1	234
20/10/2019	5:50:00 AM	0	0	2	253
20/10/2019	5:55:00 AM	0	0	2	190
20/10/2019	6:00:00 AM	0	1	1	176
20/10/2019	6:05:00 AM	0	0	2	167
20/10/2019	6:10:00 AM	0	0	2	207
20/10/2019	6:15:00 AM	0	1	2	194
20/10/2019	6:20:00 AM	0	2	1	174
20/10/2019	6:25:00 AM	0	2	1	179
20/10/2019	6:30:00 AM	0	2	2	170
20/10/2019	6:35:00 AM	0	3	2	154
20/10/2019	6:40:00 AM	0	4	2	169
20/10/2019	6:45:00 AM	0	4	2	169
20/10/2019	6:50:00 AM	0	4	2	187
20/10/2019	6:55:00 AM	0	5	2	199
20/10/2019	7:00:00 AM	0	5	2	208
20/10/2019	7:05:00 AM	0	5	1	188
20/10/2019	7:10:00 AM	0	5	1	151
20/10/2019	7:15:00 AM	0	6	2	144
20/10/2019	7:20:00 AM	0	6	2	157
20/10/2019	7:25:00 AM	0	6	3	155
20/10/2019	7:30:00 AM	0	6	1	143
20/10/2019	7:35:00 AM	0	6	1	131
20/10/2019	7:40:00 AM	0	7	2	156

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
20/10/2019	7:45:00 AM	0	7	1	169
20/10/2019	7:50:00 AM	0	7	1	218
20/10/2019	7:55:00 AM	0	8	1	187
20/10/2019	8:00:00 AM	0	8	2	207
20/10/2019	8:05:00 AM	0	9	2	203
20/10/2019	8:10:00 AM	0	9	2	224
20/10/2019	8:15:00 AM	0	9	1	208
20/10/2019	8:20:00 AM	0	9	1	227
20/10/2019	8:25:00 AM	0	10	1	208
20/10/2019	8:30:00 AM	0	10	2	214
20/10/2019	8:35:00 AM	0	10	3	192
20/10/2019	8:40:00 AM	0	11	3	190
20/10/2019	8:45:00 AM	0	11	3	204
20/10/2019	8:50:00 AM	0	11	3	219
20/10/2019	8:55:00 AM	0	11	3	222
20/10/2019	9:00:00 AM	0	11	3	241
20/10/2019	9:05:00 AM	0	11	3	237
20/10/2019	9:10:00 AM	0	11	4	211
20/10/2019	9:15:00 AM	0	11	3	202
20/10/2019	9:20:00 AM	0	11	3	199
20/10/2019	9:25:00 AM	0	12	3	203
20/10/2019	9:30:00 AM	0	12	3	232
20/10/2019	9:35:00 AM	0	11	4	229
20/10/2019	9:40:00 AM	0	12	3	212
20/10/2019	9:45:00 AM	0	12	3	166
20/10/2019	9:50:00 AM	0	12	3	169
20/10/2019	9:55:00 AM	0	13	3	164
20/10/2019	10:00:00 AM	0	13	3	208
20/10/2019	10:05:00 AM	0	12	2	245
20/10/2019	10:10:00 AM	0	12	2	193
20/10/2019	10:15:00 AM	0	13	3	234
20/10/2019	10:20:00 AM	0	13	2	227
20/10/2019	10:25:00 AM	0	13	2	196
20/10/2019	10:30:00 AM	0	12	2	276
20/10/2019	10:35:00 AM	0	13	2	194
20/10/2019	10:40:00 AM	0	13	3	261
20/10/2019	10:45:00 AM	0	13	2	262
20/10/2019	10:50:00 AM	0	14	3	240
20/10/2019	10:55:00 AM	0	13	2	257
20/10/2019	11:00:00 AM	0	14	2	226
20/10/2019	11:05:00 AM	0	14	2	127
20/10/2019	11:10:00 AM	0	15	1	136
20/10/2019	11:15:00 AM	0	14	2	239
20/10/2019	11:20:00 AM	0	15	2	196
20/10/2019	11:25:00 AM	0	15	2	187

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
20/10/2019	11:30:00 AM	0	16	3	211
20/10/2019	11:35:00 AM	0	15	3	219
20/10/2019	11:40:00 AM	0	14	2	258
20/10/2019	11:45:00 AM	0	15	4	189
20/10/2019	11:50:00 AM	0	16	2	167
20/10/2019	11:55:00 AM	0	16	3	236
20/10/2019	12:00:00 PM	0	15	4	269
20/10/2019	12:05:00 PM	0	15	2	209
20/10/2019	12:10:00 PM	0	15	2	221
20/10/2019	12:15:00 PM	0	16	2	232
20/10/2019	12:20:00 PM	0	16	4	223
20/10/2019	12:25:00 PM	0	16	3	245
20/10/2019	12:30:00 PM	0	16	3	214
20/10/2019	12:35:00 PM	0	16	2	209
20/10/2019	12:40:00 PM	0	16	3	219
20/10/2019	12:45:00 PM	0	17	3	164
20/10/2019	12:50:00 PM	0	16	2	234
20/10/2019	12:55:00 PM	0	17	3	244
20/10/2019	1:00:00 PM	0	16	3	246
20/10/2019	1:05:00 PM	0	15	2	253
20/10/2019	1:10:00 PM	0	16	3	237
20/10/2019	1:15:00 PM	0	16	3	260
20/10/2019	1:20:00 PM	0	17	1	192
20/10/2019	1:25:00 PM	0	17	3	260
20/10/2019	1:30:00 PM	0	17	4	258
20/10/2019	1:35:00 PM	0	16	3	269
20/10/2019	1:40:00 PM	0	17	2	286
20/10/2019	1:45:00 PM	0	17	2	163
20/10/2019	1:50:00 PM	0	17	3	305
20/10/2019	1:55:00 PM	0	17	3	270
20/10/2019	2:00:00 PM	0	17	4	226
20/10/2019	2:05:00 PM	0	17	1	134
20/10/2019	2:10:00 PM	0	17	1	188
20/10/2019	2:15:00 PM	0	17	2	232
20/10/2019	2:20:00 PM	0	17	3	272
20/10/2019	2:25:00 PM	0	17	2	275
20/10/2019	2:30:00 PM	0	17	2	236
20/10/2019	2:35:00 PM	0	17	3	240
20/10/2019	2:40:00 PM	0	18	3	202
20/10/2019	2:45:00 PM	0	18	2	176
20/10/2019	2:50:00 PM	0	18	2	133
20/10/2019	2:55:00 PM	0	18	4	237
20/10/2019	3:00:00 PM	0	18	3	260
20/10/2019	3:05:00 PM	0	18	3	247
20/10/2019	3:10:00 PM	0	18	1	153

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
20/10/2019	3:15:00 PM	0	19	3	200
20/10/2019	3:20:00 PM	0	19	3	218
20/10/2019	3:25:00 PM	0	19	3	217
20/10/2019	3:30:00 PM	0	20	3	200
20/10/2019	3:35:00 PM	0	19	4	208
20/10/2019	3:40:00 PM	0	19	3	202
20/10/2019	3:45:00 PM	0	19	3	218
20/10/2019	3:50:00 PM	0	19	3	185
20/10/2019	3:55:00 PM	0	19	2	201
20/10/2019	4:00:00 PM	0	20	2	251
20/10/2019	4:05:00 PM	0	19	1	111
20/10/2019	4:10:00 PM	0	18	1	167
20/10/2019	4:15:00 PM	0	19	3	240
20/10/2019	4:20:00 PM	0	19	3	255
20/10/2019	4:25:00 PM	0	19	4	246
20/10/2019	4:30:00 PM	0	18	3	258
20/10/2019	4:35:00 PM	0	18	1	274
20/10/2019	4:40:00 PM	0	19	3	219
20/10/2019	4:45:00 PM	0	19	4	239
20/10/2019	4:50:00 PM	0	19	3	238
20/10/2019	4:55:00 PM	0	19	3	246
20/10/2019	5:00:00 PM	0	19	2	214
20/10/2019	5:05:00 PM	0	19	3	238
20/10/2019	5:10:00 PM	0	19	4	242
20/10/2019	5:15:00 PM	0	19	3	240
20/10/2019	5:20:00 PM	0	19	2	231
20/10/2019	5:25:00 PM	0	19	3	210
20/10/2019	5:30:00 PM	0	19	3	234
20/10/2019	5:35:00 PM	0	19	2	245
20/10/2019	5:40:00 PM	0	18	4	236
20/10/2019	5:45:00 PM	0	19	3	235
20/10/2019	5:50:00 PM	0	19	3	242
20/10/2019	5:55:00 PM	0	18	3	235
20/10/2019	6:00:00 PM	0	19	4	231
20/10/2019	6:05:00 PM	0	19	3	224
20/10/2019	6:10:00 PM	0	18	3	235
20/10/2019	6:15:00 PM	0	18	3	223
20/10/2019	6:20:00 PM	0	18	3	227
20/10/2019	6:25:00 PM	0	18	3	238
20/10/2019	6:30:00 PM	0	18	3	232
20/10/2019	6:35:00 PM	0	17	3	237
20/10/2019	6:40:00 PM	0	17	3	233
20/10/2019	6:45:00 PM	0	17	2	234
20/10/2019	6:50:00 PM	0	16	2	230
20/10/2019	6:55:00 PM	0	16	3	232

Date	Time	Rainfall (mm)	Temperature (°C)	Wind Speed (m/s)	Wind Direction (deg.)
20/10/2019	7:00:00 PM	0	15	3	231
20/10/2019	7:05:00 PM	0	15	2	228
20/10/2019	7:10:00 PM	0	14	2	234
20/10/2019	7:15:00 PM	0	14	2	236
20/10/2019	7:20:00 PM	0	14	2	238
20/10/2019	7:25:00 PM	0	14	2	238
20/10/2019	7:30:00 PM	0	14	2	234
20/10/2019	7:35:00 PM	0	13	2	232
20/10/2019	7:40:00 PM	0	13	2	243
20/10/2019	7:45:00 PM	0	13	2	247
20/10/2019	7:50:00 PM	0	13	2	225
20/10/2019	7:55:00 PM	0	12	2	216
20/10/2019	8:00:00 PM	0	12	2	223
20/10/2019	8:05:00 PM	0	11	1	212
20/10/2019	8:10:00 PM	0	11	1	200
20/10/2019	8:15:00 PM	0	11	1	150
20/10/2019	8:20:00 PM	0	10	1	120
20/10/2019	8:25:00 PM	0	10	1	122
20/10/2019	8:30:00 PM	0	9	1	139
20/10/2019	8:35:00 PM	0	9	2	146
20/10/2019	8:40:00 PM	0	8	2	251
20/10/2019	8:45:00 PM	0	9	1	225
20/10/2019	8:50:00 PM	0	9	1	233
20/10/2019	8:55:00 PM	0	9	2	243
20/10/2019	9:00:00 PM	0	9	1	250
20/10/2019	9:05:00 PM	0	9	1	258
20/10/2019	9:10:00 PM	0	9	1	261
20/10/2019	9:15:00 PM	0	8	1	262
20/10/2019	9:20:00 PM	0	8	1	247
20/10/2019	9:25:00 PM	0	7	2	236
20/10/2019	9:30:00 PM	0	7	2	258
20/10/2019	9:35:00 PM	0	7	1	254
20/10/2019	9:40:00 PM	0	7	1	256
20/10/2019	9:45:00 PM	0	7	1	252
20/10/2019	9:50:00 PM	0	7	1	257
20/10/2019	43758.91319	0	7	1	251
20/10/2019	43758.91667	0	7	1	190

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Appendix C Lamberts North Operational Noise Assessment –May 2020

Project: Mt Piper Power Station Ash Placement

Lamberts North – Operational Noise Assessment May 2020

Reference: 246493

Prepared for: EnergyAustralia NSW

Revision: 1

21 July 2020

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

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1 Introduction

1.1 Project Understanding

On 16 February 2012, Delta Electricity received Project Approval (09_0186) under delegation from the Minister of Planning for the Mt Piper Ash Placement Project (the Project) under Section 75J - *Environmental Planning and Assessment Act 1979*, to permit the continued disposal of ash generated by the Mt Piper Power Station into the Lamberts North area, which is an extension of the existing Mt Piper Ash Repository. The Project Approval was granted subject to Conditions of Approval. EnergyAustralia NSW acquired Mt Piper Power Station and associated land holdings and infrastructure from the state-owned Delta Electricity in September 2013. As such the project is now owned by EnergyAustralia NSW.

This report has been developed in accordance with the Lamberts North Ash Placement Project Condition of Approval (CoA) E11 and the mitigation measures specified in the Operational Environment Management Plan (OEMP May 2013). The OEMP outlines the requirements of the ongoing noise monitoring program and operational noise review in accordance with CoA's E7, E8, E9 and E11.

1.2 Background to the Project

Lamberts North Ash Repository is located immediately east of EnergyAustralia NSW's existing Mt Piper Ash Repository, which is described as Area 1 in the Environmental Assessment (EA) (SKM, 2010). Ash placement at Mt Piper Ash Repository is still currently being undertaken but alternates with ash placement at Lamberts North.

Both sites are located in an area characterised by both rural and industrial influences, with a number of coal mines in relatively close proximity. The project site is predominately surrounded by Ben Bullen State Forest, which lies to the north and south east of Mt Piper Power Station, together with open cut coal mines and coal washeries. Wallerawang Power Station which is also owned by EnergyAustralia NSW, lies to the south east of the project site, approximately 5 km away, but is no longer operational following the announcement in November 2014, that the power station would be closed.

Lamberts North ash repository is approximately 53 hectares.

Historically, the Lamberts North area has been highly disturbed as a result of extensive mining activities including underground working (from the 1950s to the early 1990s) and recent open-cut mining activities being carried out by Centennial Coal.

EnergyAustralia NSW has engaged a principal contractor (Lend Lease) to manage and operate both the Mt Piper (Area 1) and Lamberts North ash repositories. Operations at Lamberts North commenced on 2 September 2013.

1.3 Scope of Work

In accordance with CoA E11, the scope of works includes a noise assessment comprising of attended and unattended noise measurements at two sensitive receiver locations, to determine potential impacts arising from the operational activities at Lamberts North ash repository.

1.4 Sensitive Receivers

The sensitive receivers located within the vicinity of the Project and identified for noise impacts within the Operation Noise Management and Monitoring Plan (ONMMP), a sub plan of the OEMP, are described in Table 1 below. The two sensitive receivers closest to the site are located at Blackmans Flat approximately 1.4 km to the east of Lamberts North and at Wallerawang approximately 2.5 km south east of Lamberts North.

A third location 'Location 3' has been used as an additional location to measure the reference noise levels from operational activities. Measurements at location 3 / 3A are within the Lambert's North and Ash Repository sites and are used for reference only, and monitoring requirements at these locations are not covered in the ONMMP.

The positions of the measurement locations are shown in Figure 1.

Table 1 | Sensitive receivers nearest to Lamberts North

Location ID[a]	Description	Map Coordinates	Noise monitoring location	Distance from Lamberts North Ash Repository
1	Blackmans Flat	33.36468ºS 150.05904ºE	Located at the western end of Noon Street on the southern side of the road. Positioned at the boundary of the residential property 90 m from the Castlereagh Highway.	1.4 km east
2	Wallerawang	33.374001ºS 150.065370ºE	Situated on a rural property southeast of Lamberts North, and approximately 650m from Castlereagh Highway.	2.5 km south east
3	Ash Repository	33.355570ºS 150.045268ºE	Additional location within the Ash Sediment basin	300m west
3A	Lamberts North	33.357021ºS 150.049253ºE	Additional location at the north-western boundary of the Lamberts North site	Within the Lamberts North site

[a] Refer to Figure 1 for locations

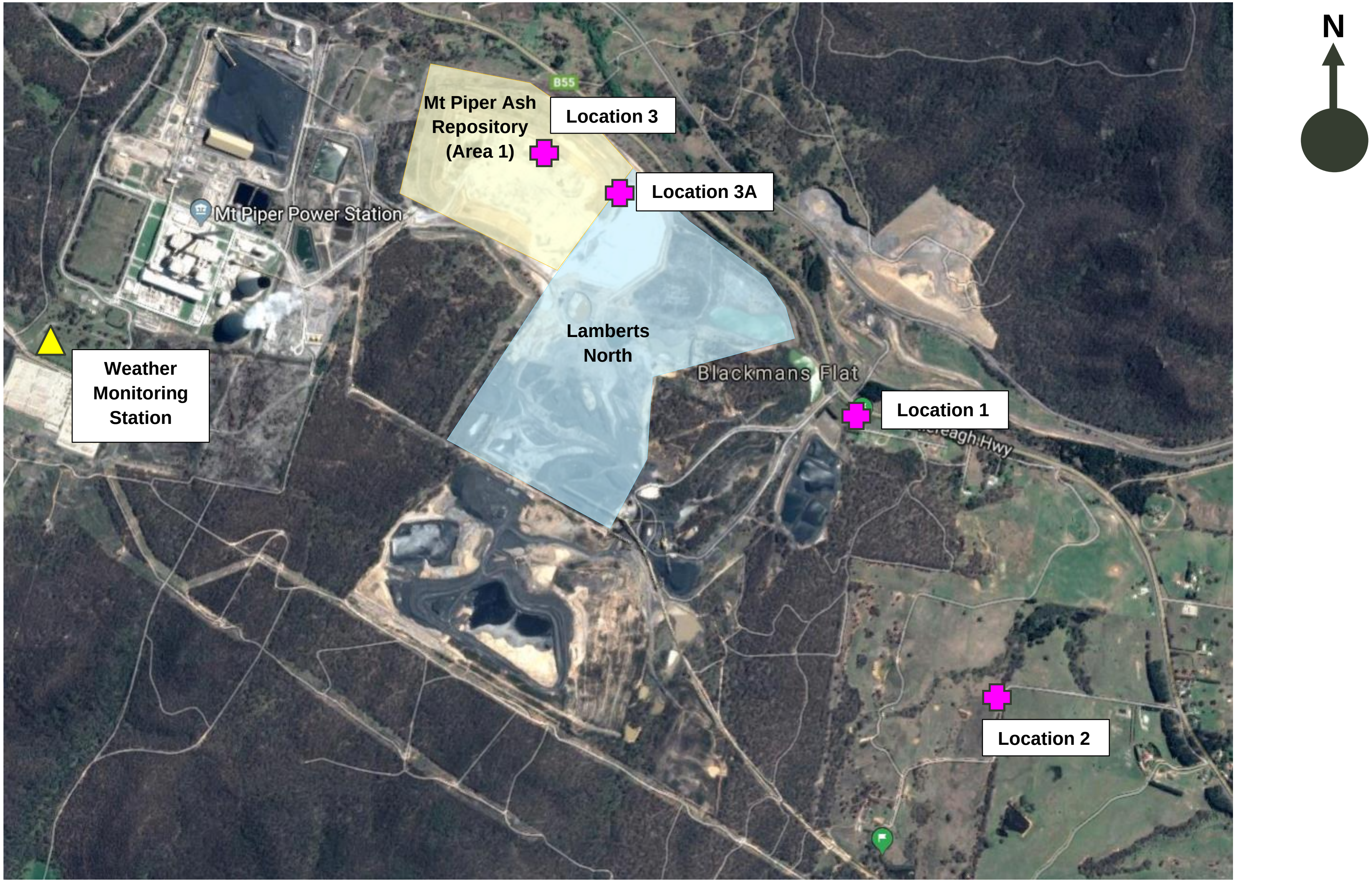


Figure 1 | Environmental noise monitoring locations

2 Site Operations

2.1 Operation Methodology

Key potential noise impacts during operational activities at Lamberts North and Mt Piper Ash Repository sites are listed below:

- Transporting fly ash and bottom ash to the ash repository using haulage trucks along the designated haul roads;
- Placing ash in stockpiles in designated areas before being spread out by a dozer;
- Compacting the ash using a dozer and roller;
- Maintenance on the haulage roads using a grader, roller, dozers and water carts;
- Dust suppression across the site using a series of techniques including but not limited to water carts and sprinkler systems;
- Developing and maintaining water management structures (containments, drains and sumps) using an excavator;
- Using various sized pumps on site to pump water from various water sources;
- Using light vehicles on occasion to inspect the ash repository and carry out environmental monitoring; and
- The machinery and plant generate noise from the engine and drive line, hydraulics and reverse warning devices.

2.2 Activities during Monitoring Period

The Mt Piper Ash Repository and Lamberts North sites are located adjacent to each other. Ash deposition at either site is dependent on several factors, typically decided on a weekly basis by the Lend Lease environmental manager.

During the site visit from 29th to 31st May 2020, ash placement operations were only occurring towards the western end Area 1 (within the ash sediment basin), with no ash placement activities occurring at the Lamberts North site (refer Appendix D).

Below is the summary of activities identified on site. Sound Power Levels (SWL) calculated from the measured reference noise levels are detailed in Table 2.

- The day activities started at 06:00 for a 06:15 start, which included the daily tool box talk and work-related discussions.
- The following plant/machinery was operational during the monitoring period,
  - 4 x Dump trucks were operating in total, being loaded with ash near the ash bins and transported to the ash sediment basin as illustrated in the figure below. Truck routes/access roads are also illustrated in the figure below.
  - 1 x dozer/crawler tractor, 2 x water cart/trucks and 1 x roller were operating in the ash sediment basin, with the dozer and water truck using the B1, B2 circuit and the roller using the B5, B6 circuit.
  - No activities were being carried out in the southern part of the Lamberts North site.
- All activities ceased by 17:00. No activities occurred during the evening or night time periods (18:00 – 06:00).
- Please refer to Appendix B for site photographs.

Table 2 | Calculated Sound Power Levels of Noise Sources Operating during Site Visit

Plant	Quantity	Sound Power Level (SWL), dB(A)*
Dozer / Crawler Tractor*	1	105
Water Cart / truck*	2 (only 1 operating at a time, typically at 20min intervals)	100
Roller*	1	96
Dump Truck*	2 (only 1 operating at a time, typically at 20min intervals)	100
Light commercial vehicles (e.g. Ute)	2 movements considered in a 15-minute interval	98

*Sound Power Levels (SWL) calculated based on noise measurements at approx. 7-10m from operating plant, on the 29th and 30th May 2020.

2.3 Description of the surrounding environment

Area 1 and Lamberts North sites are predominantly surrounded by Ben Bullen State Forest, with open cut coal mines and coal washeries also located to the north and east.

Activities at Springvale colliery, which is operated by Centennial Coal and lies to the south east of the site, primarily includes but is not limited to the transportation of coal via conveyors and operations of mobile and stationary plan. Noise impacts from these activities will contribute to the ambient noise measurements at locations 1 and 2.

Pine Dale coal mine is located to the north east of the site but is unlikely to contribute to the ambient environment at measurement locations as the mine is currently under care and maintenance (i.e. non-operational).

3 Noise Criteria

3.1 Conditions of Approval

The ONMMP seeks to address the specific requirements of the CoA attached to the Project Approval for Lamberts North, insofar as they relate to noise and vibration during operation.

CoA E7 and CoA D3a(ii) define the operational noise requirements for the project, to ensure noise emissions from operational activities do not exceed the criteria shown in Table 3 below.

Table 3 | **Operational Noise Criteria**

Location	Operational Noise Criteria, dB(A)$L_{eq(15min)}$		
	Day Time (7:00 – 18:00)	Evening Time (18:00 – 22:00)	Night Time (22:00 – 7:00)
All private receivers within the township of Blackmans Flat	42	38	35
All other residences	42	38	35

Note: These criteria do not apply where the Proponent and an affected landowner have reached a negotiated agreement regarding noise, and a copy of that agreement has been forwarded to the Director-General and the NSW EPA.

3.2 Operational Hours

In accordance with the CoA E1, operational activities associated with the project shall only be undertaken from 6:00am to 8:00pm Monday to Friday and 6:00am to 5:00pm Saturday and Sunday. Operations outside the hours stipulated above are only permitted in emergency situations.

4 Noise Survey

4.1 Methodology

Attended and unattended noise measurements were conducted from the 29th to 31st May 2020 at the boundary of the nearest residential properties (Location 1 and Location 2) likely to be exposed to noise from the ongoing ash placement operation.

- Unattended continuous monitoring was conducted using two Acoustic Research Laboratories type EL-316 noise monitors. The monitors were set to record continuously at 15-minute time intervals, in an A-weighted fast response mode. Both monitors were calibrated at the start and end of the monitoring period using a Brüel & Kjær type 4230 calibrator. No significant drift was noted.

- Attended noise measurements were conducted using a Brüel & Kjær Type 2270 Class 1 sound analyser, fitted with a type 4189 ½" microphone, set to record using 'A' frequency weighting in fast response mode. The sound analyser was also fitted with an approved windshield. A Brüel & Kjær Type 4230 calibrator was utilised to calibrate the sound level meter before and after each series of measurements. No significant calibration drift was noted. Measurements were undertaken for a period of 15-minutes at each of the selected measurement locations.

Measurements were typically taken at a height of 1.2 m and at least 3.5 m from any reflecting structure other than the ground. The weather during the noise survey period can be summarised as sunny conditions, with no rainfall and wind speeds were less than 5m/s at ground level. Measurements were generally taken in accordance with the Australian Standard *AS 1055.1 1997: Acoustics – Description and measurement of environmental noise*.

Table 4 | Noise Monitoring Equipment Calibration Information

Equipment/Measurement Location	Make	Serial	Last Calibration
Noise Monitor – Location 1	Acoustic Research Labs	15-203-506	November 2019
Noise Monitor – Location 2		15-203-504	November 2019
Sound Level Analyser – Location 3/3A.	Brüel & Kjær	3027570	February 2019

4.2 Weather Data

The weather conditions applicable to the noise survey period are based on meteorological data provided by EnergyAustralia for the Mt Piper weather station (located within the Mt Piper Power Plant site). No data was available for the monitoring period. However, statistical data available on the Bureau of Meteorology website for Lithgow (Cooerwull; station 063226) and Lidsdale (Maddox Lane; station 063132) indicates no rain and calm wind speeds (<4km/hr) during the monitoring period.

4.3 Noise Measurement Results

During the monitoring works, both attended and unattended monitoring was undertaken.

- Unattended continuous monitoring was undertaken at Locations 1 and 2 from 10:30am on the 29th May 2020 to 10:30am on the 31st May 2020. Detailed results of continuous noise measurements over the monitoring period are shown in Appendix C and statistical noise levels measured over the day, evening and night-time monitoring periods are detailed in Table 5.

- Attended noise measurements were conducted at locations 3 and 3A on the 29th May 2020. These 15-minute statistical noise levels are also detailed in Table 5.

Table 5 | Results of Ambient Noise Monitoring

Note: rows in grey are results of attended monitoring, rows in white are results of unattended monitoring

Location	Date	Time	Period	Measured Noise Level, dBA				Note
				L_{Aeq}	L_{A10}	L_{A90},	L_{Amax}	
Location 1 *(Blackmans Flat)*	29/05/2020	10:23am	Day	48	51	36	76	Note 1
	30/05/2020	10:38am	Day	53	55	46	81	
	29/05/2020	7am-6pm	Day	52	55	37	66	
		6pm-10pm	Evening	51	55	36	63	
		10pm-7am	Night	48	49	33	69	
	30/05/2020	7am-6pm	Day	50	54	36	64	
		6pm-10pm	Evening	51	55	33	66	
		10pm-7am	Night	46	49	33	64	
Location 2 *(Wallerawang)*	29/05/2020	10:02am	Day	38	39	32	62	Note 2
	30/05/2020	10:23am	Day	48	50	41	68	
	29/05/2020	7am-6pm	Day	49	43	33	68	
		6pm-10pm	Evening	43	45	37	60	
		10pm-7am	Night	41	43	32	58	
	30/05/2020	7am-6pm	Day	43	45	35	63	
		6pm-10pm	Evening	41	44	33	55	
		10pm-7am	Night	40	42	35	52	
Location 3	29/05/2020	11:30am	Day	66	72	60	76	Note 3
Location 3A		11:50am	Day	60	61	59	62	

4.4 Discussion of results

Only the attended daytime noise measurement on the 29th May 2020 at location 2, complies with the assessment criterion of 42 dB(A)$L_{eq(15min)}$. All other daytime measurements exceed this noise limit and is discussed in detail for each location in the following sections.

4.4.1 Note 1 (Location 1 – Blackmans Flat)

We have been advised by EA NSW that this site has been purchased by Centennial Coal and currently there are no residential receivers on the site. Regular noise monitoring as per OEMP May 2013 is being conducted at this site.

During our site attendance, ambient noise was dominated by traffic noise from Castlereagh Highway.

There was no audible noise from the westerly direction (i.e. Lamberts North or Ash Repository).

The maximum equivalent continuous noise level at Location 1 was measured at 53 dB(A)L_{eq}. Birds, insects and heavy vehicle (trucks/trailers) passbys contributed to maximum noise levels of 63 – 81 dB(A)L_{Max}.

4.4.2 Note 2 (Location 2 – Wallerawang)

The ambient noise levels at this rural residential location is dominated by noise from birds/insects, low industrial hum from the western direction and distant traffic noise from Castlereagh Highway. Continuous machinery/plant noise was noted during unattended noise monitor setup and attended noise measurement period, on the 29th May 2020. This noise was audible from the east.

Subjectively on site there was no evidence of noise originating from the north-westerly direction, thus indicating negligible noise contribution from ash repository sites to ambient noise levels at this location.

The maximum equivalent continuous noise level at Location 2 was measured at 49 dB(A)L_{eq}. Birds, insects and vehicle passby (local resident vehicles on dirt road) contributed to maximum noise levels of 52 – 68 dB(A)L_{Max}.

4.4.3 Location 3 & 3A

As part of the assessment of compliance against the CoA, additional reference measurements were undertaken at locations 3 and 3A based on the activities being undertaken on site.

- Location 3 – Measurements of dozer, roller and water cart operations, measured at the western edge of the ash sediment basin. Operational noise clearly audible at this location and included sources such as engine noise and reverse beeps.
- Location 3A – Measurement conducted at the western boundary of the Lamberts North site (between Area 1 and Lamberts North). Operational noise from dump trucks and water carts travelling along internal access road (to the ash sediment basin) clearly audible at this location. Noise sources include engine noise (dump trucks and water carts) and generator motor.

4.5 Previous monitoring data

A summary of previous data collected by this office for Lamberts North is presented in Table 6 below.

Table 6 | Summary of previous Environmental Noise Monitoring Data

Location	Period	Measured Equivalent Sound Pressure Level, L_{Aeq} dBA						
		October 2016	April 2017	November 2017	April 2018	September 2018	June 2019	October 2019
Location 1 *(Blackmans Flat)*	Day	56	56	56	56	55	52	55
	Evening	53	52	51	51	51	52	48
	Night	51	50	48	49	49	46	50
Location 2 *(Wallerawang)*	Day	49	60	42	49	46	45	48
	Evening	46	46	40	44	42	46	48
	Night	51	44	44	43	49	49	40

- These receiver locations have not changed since 2016, with Aurecon endeavouring to install the noise monitors at approximately the same location during each visit.
- Noise levels are not expected to fluctuate greatly, which is evident from the historical data, as there has not been any major development in the immediate vicinity of these locations, to significantly impact on the existing ambient environment.

- Moreover, operations at Lamberts North have also been fairly consistent, with typical activities and associated plant/equipment only moving to different areas of the site. However, based on the distance of Lamberts North from these receiver locations and the existing terrain, this has had little to no impact on the measured noise levels. Fluctuations noted in the historical data is most likely a result of noise impacts associated with intermittent operations at the Springvale Coal Services site located to the west of Location 1 (1613 Castlereagh Highway), farm equipment and dirt bikes on adjoining farms and seasonal traffic variations along Castlereagh Highway. All these noise sources are significantly closer to the receiver locations than Lamberts North.
- The daytime equivalent sound pressure levels measured during this assessment period is consistent with the historical data presented above at both receiver locations.

5 Noise Assessment

The results of the measured ambient noise levels at the sensitive receivers stipulated in the CoA (Location 1 and Location 2) are detailed in Table 5 above.

As discussed in Section 4.4, the ambient environment at both the receiver locations, was dominated by traffic noise, low industrial hum, noise from nearby coal mines and noise from birds/insects. It is impossible to accurately identify the industrial hum noted at location 1, given the location of several facilities in the westerly direction, i.e. Springvale mine, Pinedale mine, Lamberts South Centennial Coal site etc.

The measured equivalent sound pressure levels were in excess of the 42 dB(A)$L_{eq(15min)}$ daytime noise target as detailed in Table 5, however no discernible operational noise was noted at either location from ash placement works, during the monitoring period. Given the large buffer distances (at least 1.4km to location 1 and over 2.5km to location 2), intervening topography and based on the measured reference noise levels measured from ash sediment operations plant/equipment (refer Table 2), noise impacts at both receiver locations would be minimal or insignificant.

Aurecon undertook a desktop assessment to predict noise impacts from the measured operational activities, to validate this statement and this is described in more detail in the following section.

5.1 Predicted noise contribution

For the purpose of this assessment, we have assumed a worst-case scenario of the plant/machinery detailed in Table 2 operating in the northern part of the Lamberts North site (as opposed to Area 1). We were informed by Lend Lease that operations only occur in the northern part of Lamberts North site and no activities take place in the southern half. Additionally, we were also informed that no activities had taken place in the northern part of Lamberts North over last two months and no operations were proposed in the immediate future. The operational activities on site commenced each day from approximately 06:30 until 17:00, during our site visit. There were no operational activities between 17:00 and 06:00.

We note that the magnitude of operational noise impacts will depend on the number and intensity of machines operating, and the working location of the equipment. It is unlikely that all the plant and equipment will be running simultaneously in the same location. In addition, the nature of activities onsite is expected to vary from day to day.

The predicted noise levels were calculated (based on sound propagation through geometric spreading) at a distance based on worst case noise emission levels (i.e. maximum sound power levels) without considering any barrier effects from the undulating surrounding terrain. However due to intermittent operational characteristics and constant change of distance between the source-receiver, a 50% operational efficiency (equipment operational for 50% of the time during each 15-minute measurement period) for each equipment type in the calculation has been used. The results of this calculation are shown in Table 7.

It should be noted that the predicted levels in this section are based on a worst-case operational scenario at both assessment locations and include adjustments for annoying activities as outlined in the NSW Environment Protection Authority's (EPA) Interim Construction Noise Guideline (ICNG). The above prediction methodology takes into account the number of individual machines operating as well as the percentage in use during a 15-minute period, with all scheduled equipment operating at the minimum distance from the nearest sensitive receiver.

The predicted levels in Table 7 provide a theoretical maximum cumulative noise impact. The distances shown in Table 7 are considered minimum between the operational works and the respective receiver zones. The calculation also assumes that each item of equipment is operating at maximum capacity (i.e. maximum sound power level). In reality the mobile plant operates at much lower capacity during its operation and hence the levels shown in Table 7 are considered conservative and should be interpreted as indicative worst case only.

Table 7 | Predicted Noise Emissions

Equipment at Lamberts North	Sound Power Level (SWL), dBA	Predicted Noise Levels, dB(A)$L_{eq(15min)}$	
		Location 1 – Blackmans Flat (approx. 1.4km)	Location 2 – Wallerawang (approx. 2.5 km)
Dozer / Crawler	105	31	26
Water Truck x 2	100	26	21
Roller	96	22	< 20
Dump Truck x 4	100	30	25
Light commercial vehicles x 2	98	26	21
Cumulative predicted noise levels from the operation of the above equipment		**35**	**30**

Table 8 | Summary of Cumulative Noise Emissions against the Noise Criteria (dBA)

Location*	Description	Maximum theoretical predicted noise	Day limit 42 dBA (07:00-18:00)	Evening limit 38 dBA (18:00-22:00) ^	Night limit 35 dBA (22:00-07:00) ^
1	Blackmans Flat	35	✓	N/A	N/A
2	Wallerawang	30	✓	N/A	N/A

✓ Complies with the stipulated noise criteria

^ No operational activity during Evening or night time periods.

As shown in Table 8, results of our assessment revealed the following:

- Worst-case modelling predicted that noise levels would comply with the daytime and evening period noise criteria, at both Location 1 and Location 2.
- Worst case modelling indicates that the maximum predicted noise level will exceed the noise criteria during night time at Location 1. However, CoA E1 for Lamberts North restricts any activities after 20:00 on weekdays and 17:00 on weekends (refer to Section 3.2 for more details), and therefore any predicted night time exceedance is not relevant.

Additionally, the noise emission predictions correlate the on-site observations as the predicted emissions at Location 1 and Location 2 are greater than 10 dB below the ambient background noise levels measured on site and would thereby be subjectively inaudible.

6 Recommendations

6.1 Noise management measures

Should complaints from the community be received, the following noise control measures could be applied to minimise noise impacts;

- If possible, avoid the coincidence of noisy plant/machine working simultaneously.
- Construction trucks and other heavy machinery to use loop tracks as much as possible on the site to minimise the amount of reversing activities, i.e. managed through the Operational Traffic and Transport Management Plan.
- Consider the use of alternative warning system to the conventional single tone reversing alarm, such as squawkers and broadband sound reversing alarm (e.g. bbs-tek® White Sound® reverse alarms).
- Installation of silencer/mufflers on the engine exhaust, if plant/machinery operations are proposed along the eastern boundary of the Lamberts North site.

7 Conclusion

Aurecon conducted operational noise measurements of the ash placement operations associated with the Lamberts North Ash Placement Project, as required by the Condition of Approval (CoA) E11 and the mitigation measures specified in the Operational Environment Management Plan (OEMP May 2013). Noise measurements were carried out at the two nearest affected sensitive receiver locations (Blackmans Flat and Wallerawang) between 29th to 31st May 2020, in accordance with the project OEMP.

- *Location 1 – Blackmans Flat*

The ambient noise at Location 1 (i.e. Blackmans Flat) was relatively high and the maximum equivalent continuous sound pressure level over 15 minutes at Location 1 was measured at $L_{Aeq\ (15minute)}$ 53 dB(A). The measured noise levels were dominated by traffic noise from Castlereagh Highway. Attended measurements indicated that noise emissions from the Lamberts North site was subjectively inaudible at the Location 1 site.

The maximum predicted noise contribution resulting from the operation of equipment/ plant at the Lamberts North site at Location 1 was determined to be 35 dB(A)$L_{eq(15min)}$, as detailed in Table 7. This contribution is deemed to comply with the requirements of the CoA.

- *Location 2 – Wallerawang*

The ambient noise at Location 2 (i.e. Wallerawang) was dominated by noise from birds/insects, low hum from Mt Piper Power Station and distant traffic noise from Castlereagh Highway. Continuous machinery/plant noise was noted during unattended noise monitor setup and attended noise measurement period, on the 29th May 2020. This noise was audible from the east.

Subjectively there was no evidence of noise originating from the north-westerly direction at Location 2. This suggests that noise contribution from Lamberts North to the overall equivalent sound pressure level at this location, is negligible. Maximum equivalent continuous noise over 15 minutes at Location 2 was measured at $L_{Aeq\ (15minute)}$ 49 dB(A).

The maximum predicted noise contribution resulting from the operation of equipment/ plant at the Lamberts North site at Location 2 was determined to be 30 dB(A)$L_{eq(15min)}$, as detailed in Table 7. This contribution is deemed to comply with the requirements of the CoA.

- *Summary*

The ambient noise levels measured at Locations 1 and 2 exceed the 42 dB(A) daytime noise target. However, noise contributions from surrounding simultaneous noise sources and activities including coal mines, road traffic and local environment (birds, insects and dogs barking), were noted as the dominant contributors. Subjectively there was no evidence of noise originating from the Lamberts north site direction at either receiver location.

To validate this observation, a desktop assessment of the measured operational levels associated with the ash placement activities was also undertaken by this office. Based on the worst-case operating scenario (refer section 5.1), cumulative predicted noise levels from ash placement activities will comfortably comply with the *Lamberts North Ash Placement Project – Operational Environmental Management Plan (May 2013)*, at both the representative residential receiver locations 1 and 2.

8 References

The following documents were referenced as part of this assessment:

- Lamberts North Ash Placement Project – Operational Environmental Management Plan (OEMP) May 2013.
- Lamberts North Operational Noise Assessment June 2019 report, revision 2.
- *Delta Electricity Project Conditions of Approval for Mt Piper Power Station Ash Repository Extension Project (approved on 16 February 2012).*
- *Mt Piper Power Station Ash Placement Project – Lamberts North Construction Noise monitoring 14-15 January 2013 (Revision 2, dated 11 February 2013)*
- Australian Standard *AS 1055 1997: Acoustics – Description and measurement of environmental noise*.

Appendix A
Glossary of terms

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

Appendix B
Photos of noise monitored locations at Blackmans Flat and Wallerawang

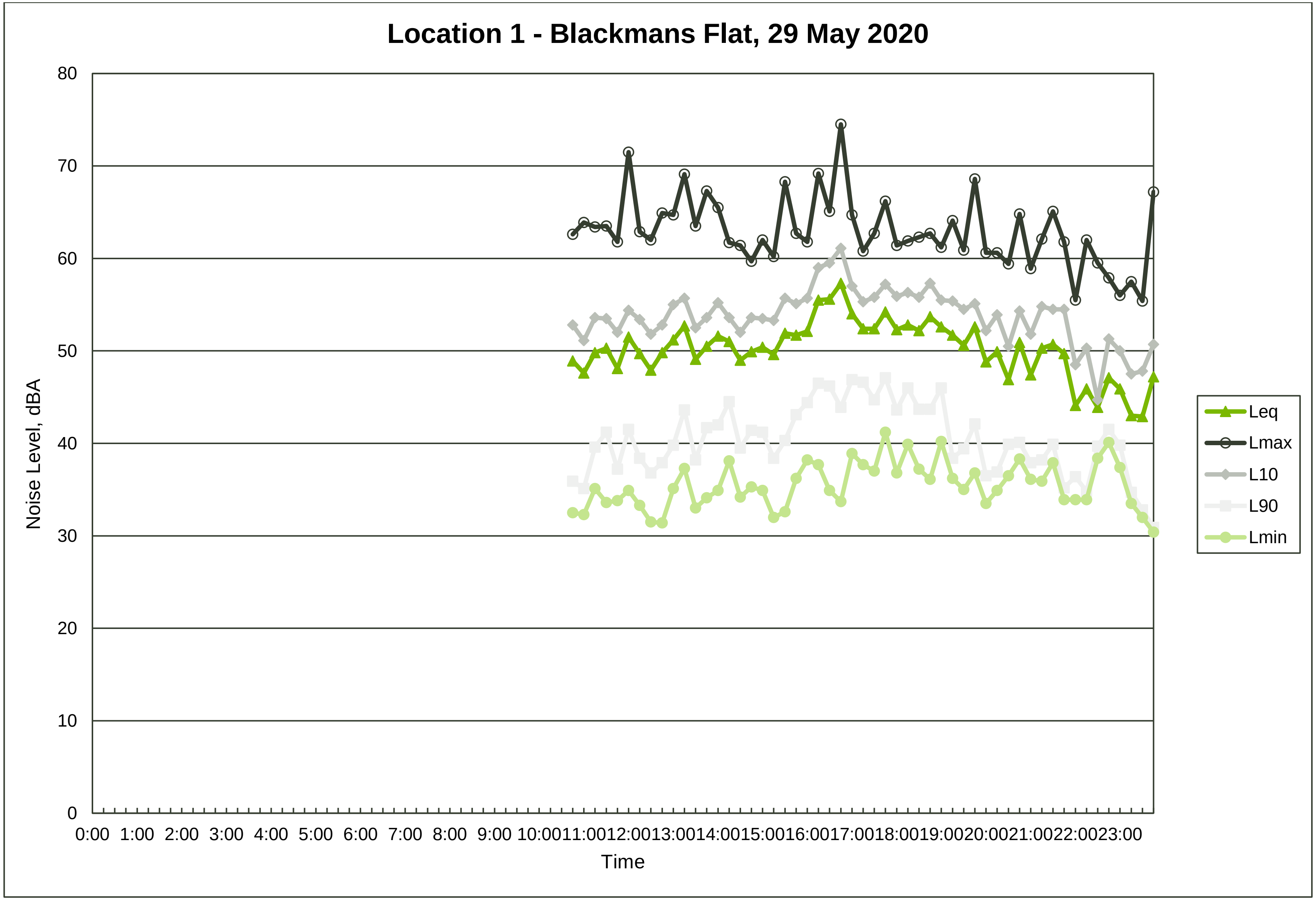
Figure 2 | Photograph of Measurement Location 1 (Blackmans Flat)

Figure 3 | Photograph of Measurement Location 2 (Wallerawang)

Figure 4a | Photograph of Machinery Operating in Area 1 and Ash Sediment Basin

Figure 4b | Photograph of Machinery Operating in Area 1 and Ash Sediment Basin

Appendix C
Noise Monitoring Graphs



Location 1 - Blackmans Flat, 29 May 2020
Noise Level, dBA
80
70
60
50
40
30
20
10
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
Time
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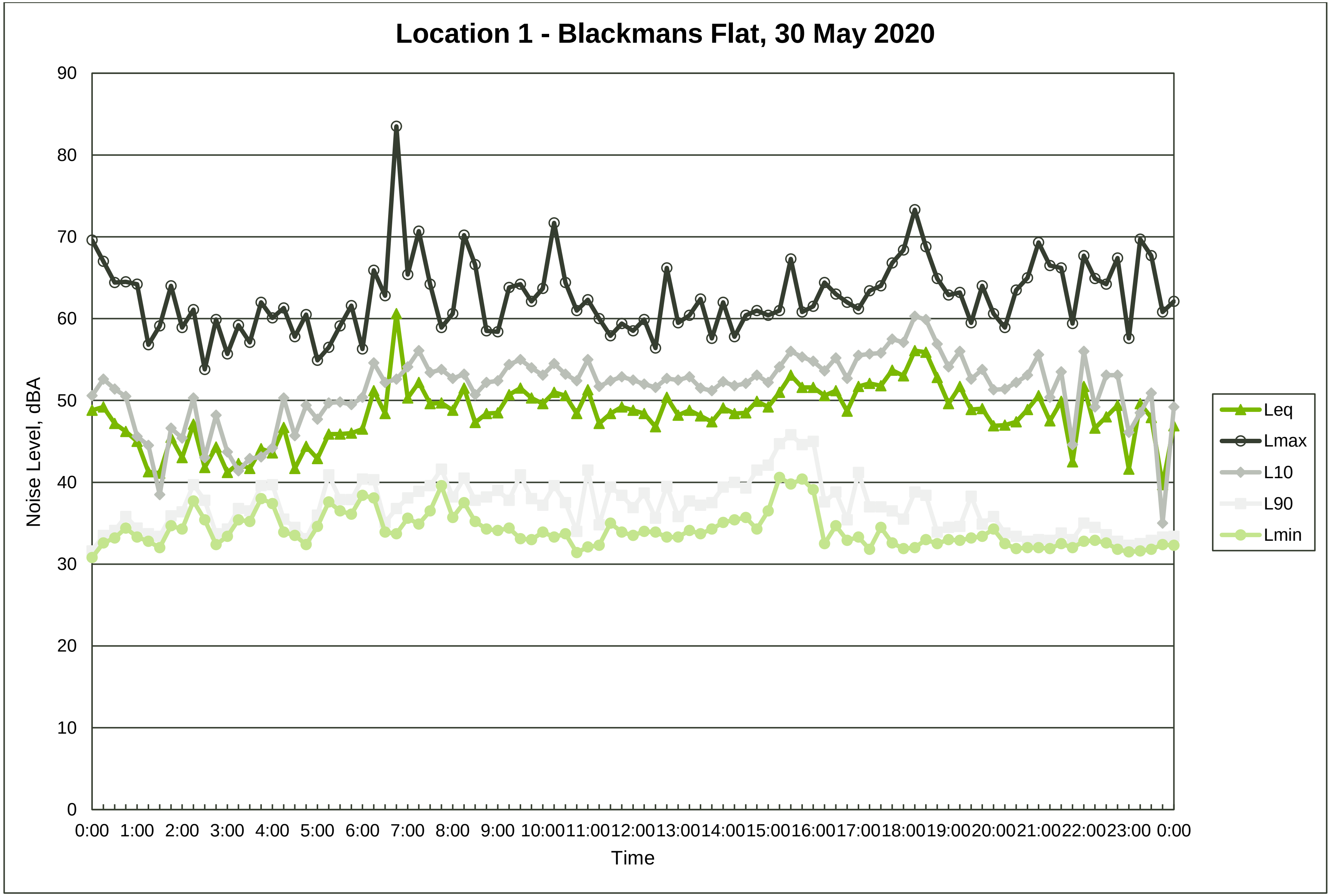
Lmax
L10
L90
Lmin



Location 1 - Blackmans Flat, 30 May 2020
Noise Level, dBA
0
10
20
30
40
50
60
70
80
90
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
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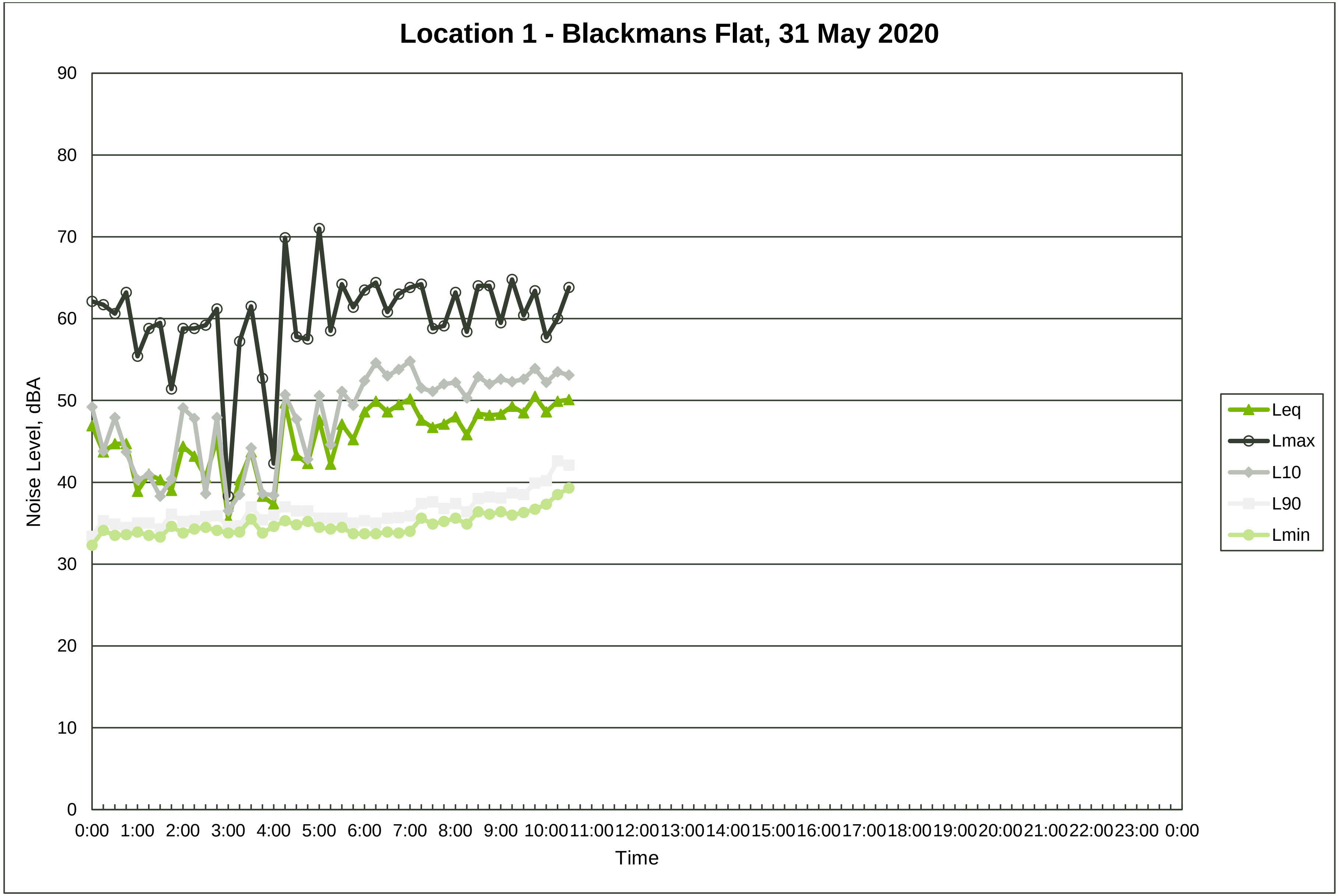

Location 1 - Blackmans Flat, 31 May 2020
Noise Level, dBA
90
80
70
60
50
40
30
20
10
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
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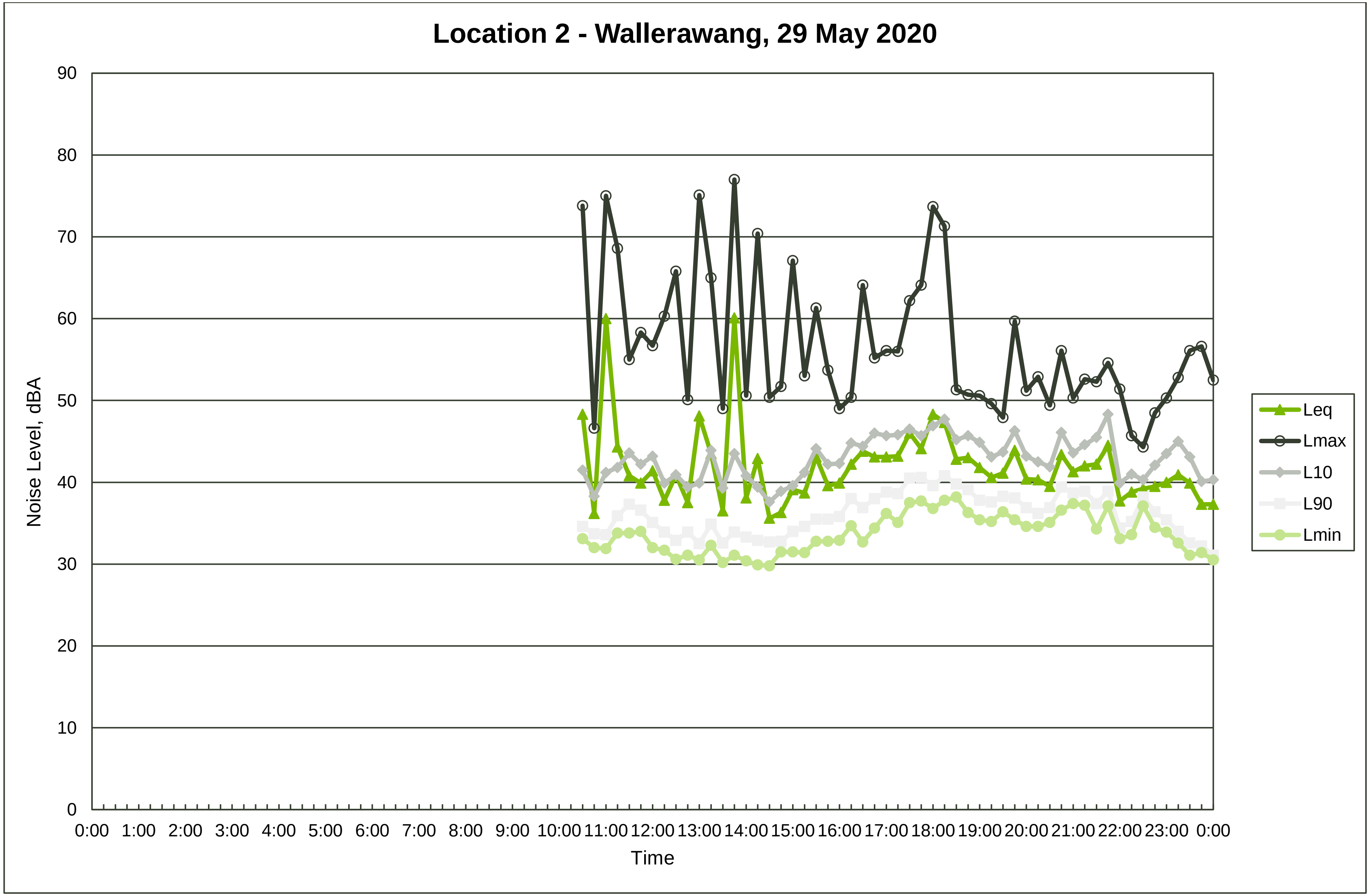

Location 2 - Wallerawang, 29 May 2020
Noise Level, dBA
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80
70
60
50
40
30
20
10
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0:00
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2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
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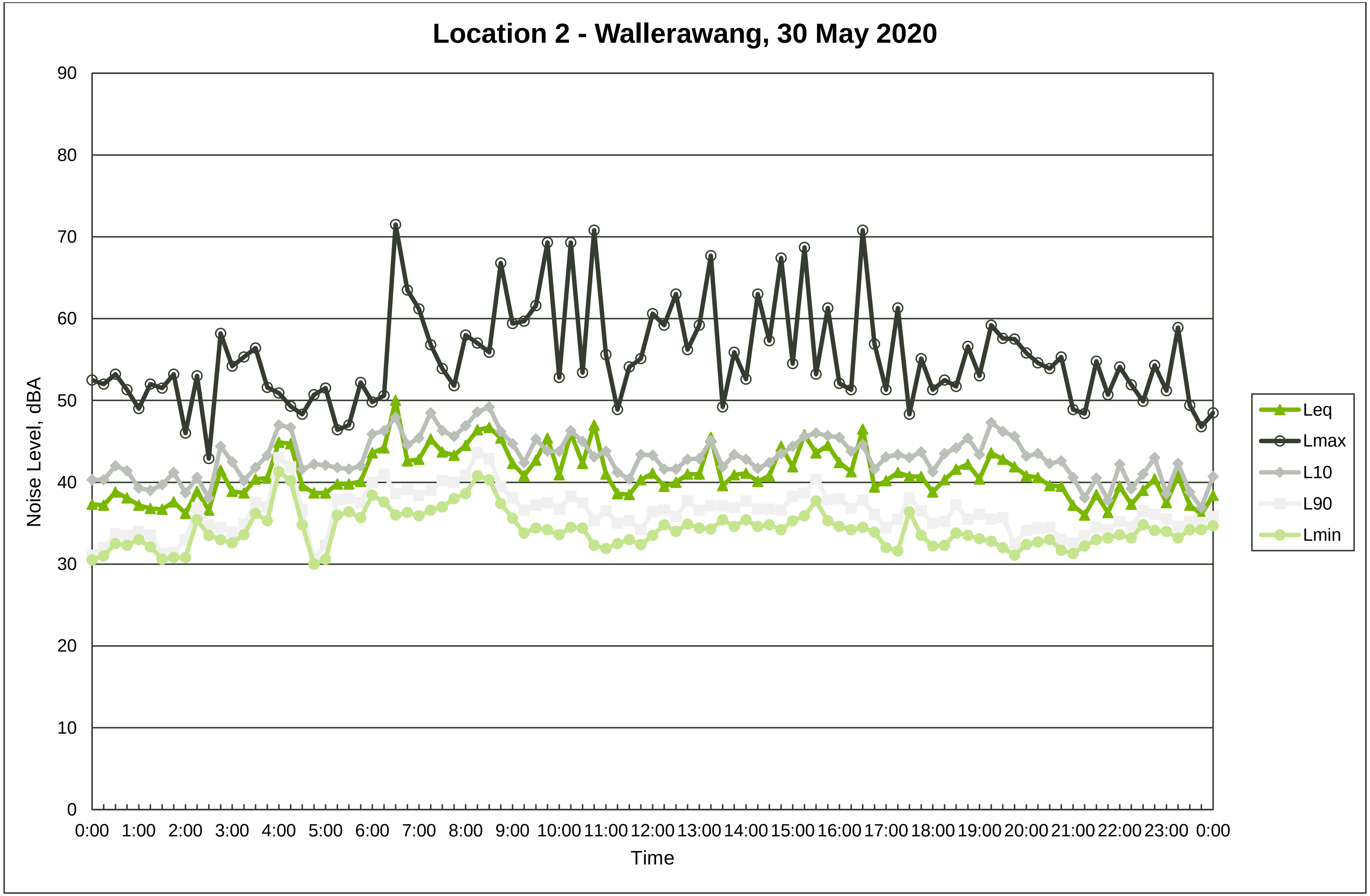
Location 2 - Wallerawang, 30 May 2020
Noise Level, dBA
Time
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10
20
30
40
50
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70
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90
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2:00
3:00
4:00
5:00
6:00
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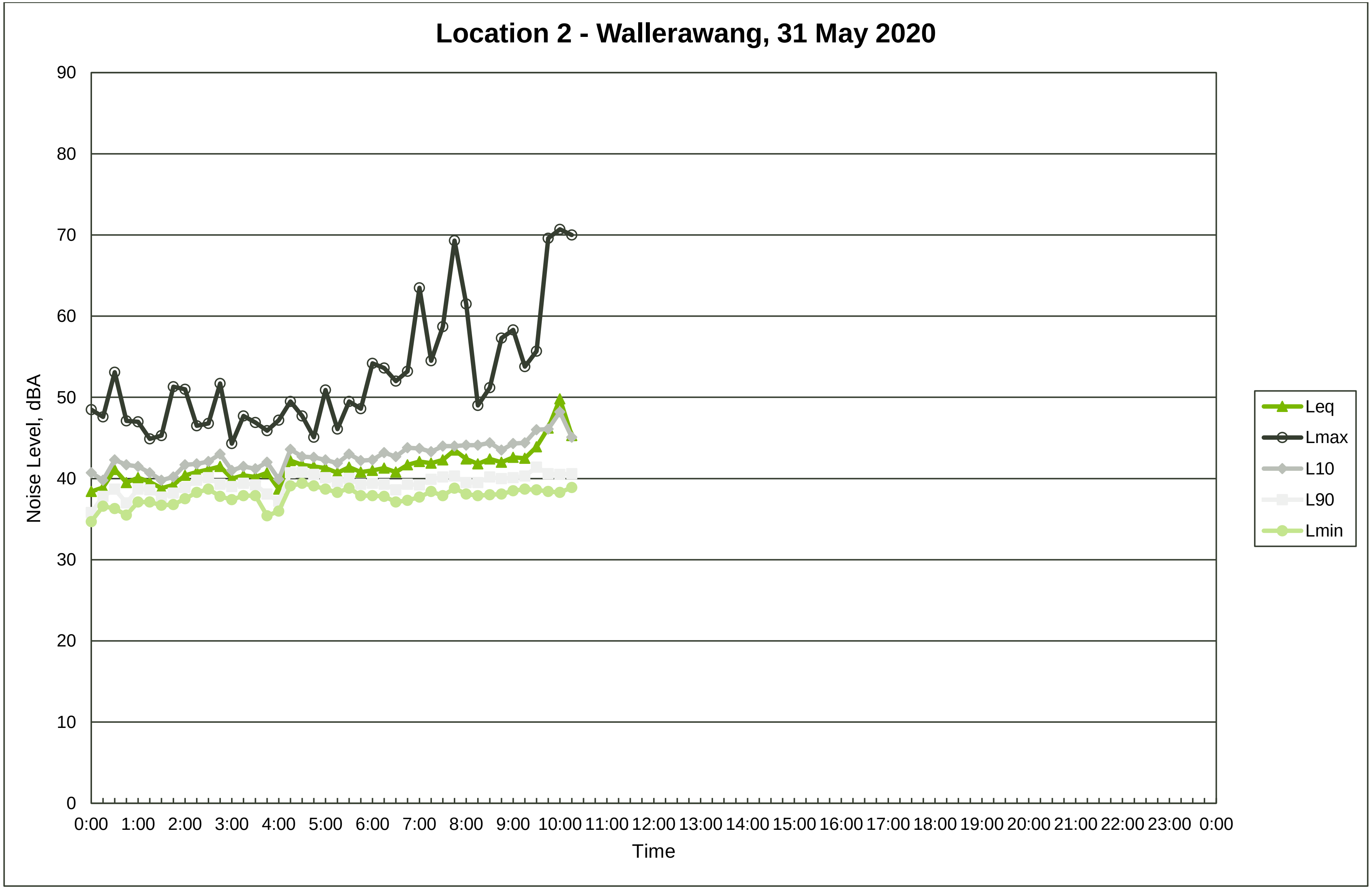

Location 2 - Wallerawang, 31 May 2020
Noise Level, dBA
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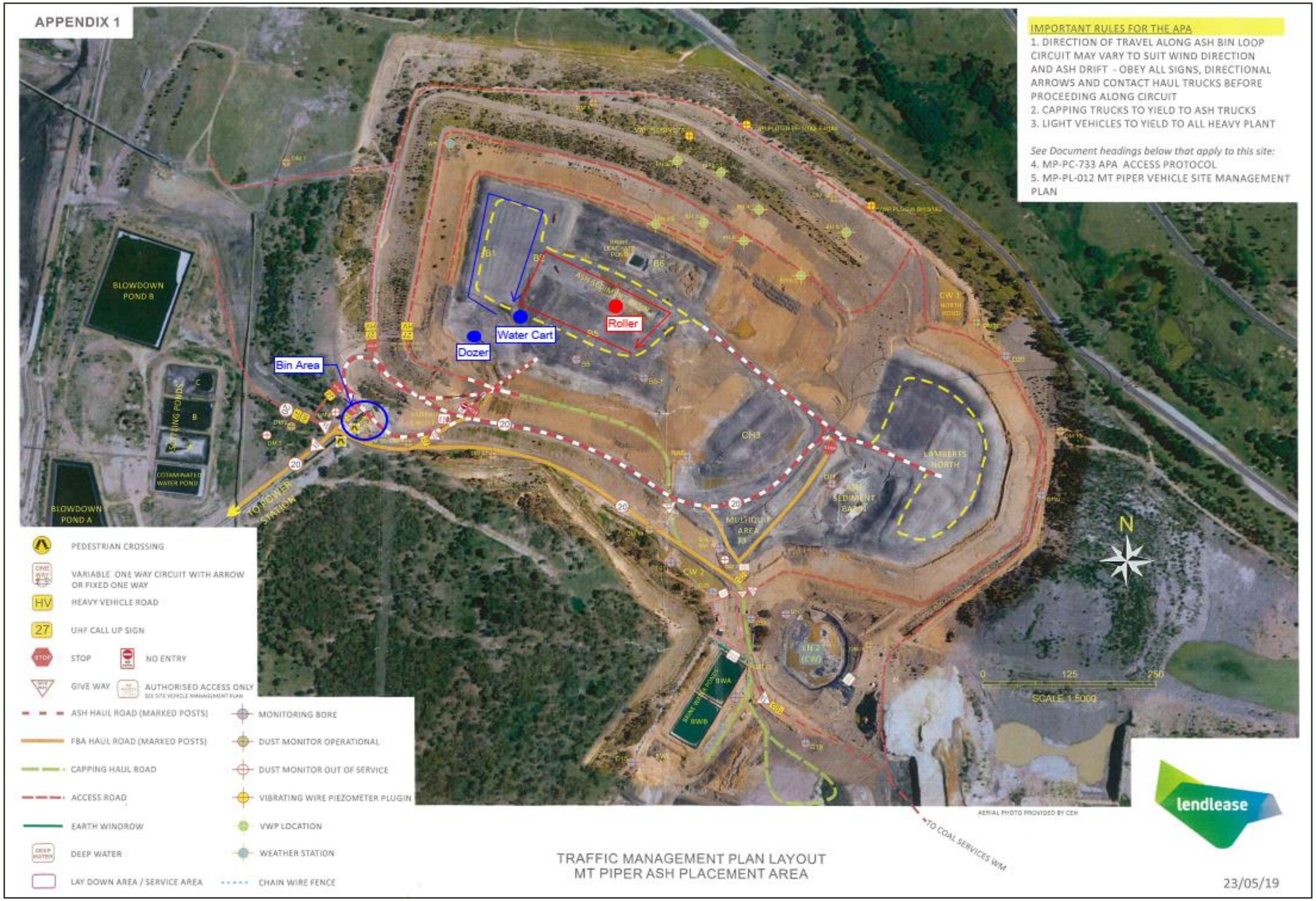
80
70
60
50
40
30
20
10
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Time
Leq
Lmax
L10
L90
Lmin

Appendix D

Area 1 - Traffic Route and Machinery Operations during Monitoring Period


APPENDIX 1
IMPORTANT RULES FOR THE APA
1. DIRECTION OF TRAVEL ALONG ASH BIN LOOP CIRCUIT MAY VARY TO SUIT WIND DIRECTION AND ASH DRIFT - OBEY ALL SIGNS, DIRECTIONAL ARROWS AND CONTACT HAUL TRUCKS BEFORE PROCEEDING ALONG CIRCUIT
2. CAPPING TRUCKS TO YIELD TO ASH TRUCKS
3. LIGHT VEHICLES TO YIELD TO ALL HEAVY PLANT
See Document headings below that apply to this site:
4. MP-PC-733 APA ACCESS PROTOCOL
5. MP-PL-012 MT PIPER VEHICLE SITE MANAGEMENT PLAN
BLOWDOWN POND B
BLOWDOWN POND A
SETTLING PONDS
CONTAMINATED WATER POND
TO POWER STATION
Bin Area
Dozer
Water Cart
Roller
CH3
LAMBERTS NORTH
ASH SEDIMENT BASIN
MULTIQUIP AREA
BWA
BWB
TO COAL SERVICES WM
N
0
125
250
SCALE 1:5000
PEDESTRIAN CROSSING
VARIABLE ONE WAY CIRCUIT WITH ARROW OR FIXED ONE WAY
HEAVY VEHICLE ROAD
UHF CALL UP SIGN
STOP
NO ENTRY
GIVE WAY
AUTHORISED ACCESS ONLY
ASH HAUL ROAD (MARKED POSTS)
FBA HAUL ROAD (MARKED POSTS)
CAPPING HAUL ROAD
ACCESS ROAD
EARTH WINDROW
DEEP WATER
LAY DOWN AREA / SERVICE AREA
MONITORING BORE
DUST MONITOR OPERATIONAL
DUST MONITOR OUT OF SERVICE
VIBRATING WIRE PIEZOMETER PLUGIN
VWP LOCATION
WEATHER STATION
CHAIN WIRE FENCE
TRAFFIC MANAGEMENT PLAN LAYOUT
MT PIPER ASH PLACEMENT AREA
lendlease
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Appendix D Lamberts North Ash Repository Water Quality Report 2019– 2020

Lamberts North Ash Placement Project

Annual Water Quality Monitoring Report 2019/20

9 November 2020

Project No.: 0553983_R02_F01

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Signature Page

9 November 2020

Lamberts North Ash Placement Project

Annual Water Quality Monitoring Report 2019/20

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Acronyms and Abbreviations

Name	Description
AEMR	Annual Environmental Monitoring Report
AHD	Australian Height Datum
ANZECC	Australia and New Zealand Environment Conservation Council
ARI	Average Recurrence Interval
BCA	brine conditioned ash
CCC	Community Consultation Committee
DPIE	NSW Department of Planning, Industry and Environment
EC	Electrical Conductivity
EPA	Environmental Protection Authority
EPL	Environmental Protection Licence
ERM	Environmental Resources Management
GCB	Groundwater Collection Basin
GMMP	Groundwater Management and Monitoring Plan
ha	hectares
LCC	Lithgow City Council
LLI	Lendlease Infrastructure
LNAR	Lamberts North Ash Repository
m	metre
mg/L	milligrams per litre
mm	millimetre
ML	Megalitre
MPAR	Mt Piper Ash Repository
MPPS	Mt Piper Power Station
NSW	New South Wales
OEMP	Operation Environmental Management Plan
PEA	Preliminary Environmental Assessment
QAQC	Quality Assurance Quality Control
REF	Review of Environmental Factors
RL	Relative Level
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
WAL	Water Access Licence
WCA	water conditioned ash
µg/L	micrograms per litre
µS/cm	microSiemens per centimetre

1. INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by EnergyAustralia NSW Pty Limited (EnergyAustralia) to prepare an Annual Water Quality Monitoring Report (this report) for the Lamberts North Ash Repository (LNAR) at the Mt Piper Power Station (MPPS) facility located at 350 Boulder Road, Portland, New South Wales (the site). Refer to Figure 1, Appendix A showing the location and setting of the site.

This report presents the results of water quality monitoring conducted in accordance with the Lamberts North Ash Placement Project Operation Environmental Management Plan (the OEMP) (EnergyAustralia, 2019) over the period of 1 September 2019 to 31 August 2020. Results from the monitoring program are reported to key stakeholders including WaterNSW, NSW Environment Protection Authority (EPA), Lithgow City Council (LCC) and NSW Department of Planning, Industry and Environment (DPIE).

This report has been prepared in accordance with Conditions E15 and E16 of project approval 09_0186 granted under the Environmental Planning and Assessment Act 1979 (NSW) on 16 February 2012 (the Project Approval).

This report should be read in conjunction with the Statement of Limitations presented Section 9.

1.1 Project Background

EnergyAustralia owns and operates the MPPS, including the LNAR; both are located approximately 18 km north-west of Lithgow. The LNAR is located adjacent to and to the east of the Mt Piper Brine in Ash Co-Placement Project Area at the Mt Piper Ash Repository (MPAR). Together the LNAR and the MPAR are referred to as the Ash Repositories. This report is limited to the LNAR as required by the Project Approval. The water quality monitoring conducted in relation to the MPAR is separately reported on in line with the separate development consents which apply to the MPAR. Refer to Figure 2, Appendix A for a plan showing relevant site features.

In 2009, a Preliminary Environmental Assessment (PEA) was prepared in support of the Concept Application (CA) for the future development of four (4) proposed ash placement sites at the MPPS including Lamberts North, Lamberts South, Neubecks Creek and Ivanhoe No. 4 (SKM, 2009). The Lamberts North and Lamberts South sites were noted as being historical coal workings including both underground and open-cut coal mining. Centennial Coal undertook coal mining and washery operations at the Lamberts North site prior to 2012 (CDM Smith, 2012), and some of these operations continue in the south of the Lamberts North area.

To facilitate an increase in the MPPS power generation capacity, and therefore an increase in the associated ash generation, development of a new ash placement facility in Lamberts North was first proposed by Delta Electricity in 2009. The intention of the new ash placement facility was to provide placement capacity for the ongoing operation of the MPPS beyond 2015 (SKM, 2009).

The Project Approval granted to Delta Electricity on 16 February 2012 authorised the "…construction and operation of new ash placement areas at the Lamberts South and Lamberts North sites to cater for the ash generated from the existing Mt Piper Power Station and the proposed Mt Piper Power Station Extension" subject to conditions. EnergyAustralia acquired the MPPS in 2013.

The approved area for the LNAR is approximately 53 hectares (ha) and ash placement has occurred under the Project Approval at the LNAR since 2013. No brine conditioned ash (BCA) has been emplaced in the LNAR. The LNAR has received only water conditioned ash (WCA) to date. Although authorised, the Lamberts South Ash Repository has not been constructed to date.

The conditions of the Project Approval relevantly operate to require:

- Implementation of the OEMP which contains a detailed environmental management framework, and practices and procedures to be adopted as part of operations at the LNAR. This includes a Groundwater Management Plan and a Surface Water Management Plan; and
- The carrying out of groundwater and surface water monitoring programs as specified in the OEMP.

No changes to the Project Approval were noted during the 2019/20 reporting period. While the OEMP was updated in September 2019, there were no changes to the surface water or groundwater monitoring programs.

1.2 Scope of Works

The following works have been implemented through the completion of this report:

- Review of monitoring data at the three existing surface water quality monitoring sites (the Final Holding Pond (LMP01) and in Wangcol Creek[1] at NC01 and WX22) (Appendix B);
- Assessment and reporting of groundwater quality and depth of the water table at all monitoring sites for the year of monitoring, presented in Appendix C and Appendix D, respectively;
- Comparison of data with the predictions in the OEMP;
- Assessment of trends in surface water and groundwater quality (comparison between years), presented in Appendix E and Appendix F respectively; and
- Preparation of this report to present the results of the surface water and groundwater quality monitoring required under the Lamberts North Project Approval, including
  - Interpretation and discussion of results,
  - A list of occasions in the twelve month reporting period when the Environmental Goals were not achieved, and
  - An update on the contingency measures currently being implemented in accordance with the OEMP.

1.3 Documentation Reviewed

Information provided in the reports listed below has been reviewed as part of this report, and that information has been relied upon:

- The Project Approval conditions;
- Sinclair Knight Merz, September 2009. Mt Piper Power Station Ash Placement Project, Project Description and Preliminary Environmental Assessment;
- Sinclair Knight Merz, August 2010, Mt Piper Power Station Ash Placement Project Environmental Assessment;
- Sinclair Knight Merz, March 2011, Mt Piper Power Station Ash Placement Project Submissions Report;
- CDM Smith, December 2012, Delta Electricity, Lamberts North Ash Placement Project Plan, Construction Environmental Management Plan (CEMP);
- EnergyAustralia NSW Pty Ltd (EnergyAustralia) (2019), Lamberts North Ash Placement Project – Operational Environmental Management Plan (the LNAR OEMP), Revision 5, 2 September 2019;
- ERM, March 2019. Lamberts North Ash Placement Water Quality Monitoring, Annual Water Quality Monitoring Report 2017/2018. Final Version 02, 15 March 2019;
- ERM, November 2019. Lamberts North Ash Placement Water Quality Monitoring, Annual Water Quality Monitoring Report 2018/2019. Final Version, 13 November 2019;
- Local climate data from Mt Piper Weather Station, obtained from EnergyAustralia (Appendix G); and
- Gauging data, presented as hydrographs, for groundwater bores supplied by EnergyAustralia for the reporting period (Appendix D).

In addition to the above, the information presented in this report was prepared with input by EnergyAustralia.

[1] Wangcol Creek is referred to as "Neubecks Creek" in the OEMP. However, WaterNSW has clarified that the creek is properly named "Wangcol Creek". Accordingly, this report refers to the monitored creek as Wangcol Creek.

2. OPERATIONS SUMMARY

All ash placement operations for Mt Piper Power Station, including within the LNAR authorised by the Project Approval, are undertaken by a specialist ash placement contractor. Lend Lease Infrastructure (LLI) is the current service provider for EnergyAustralia in relation to all aspects of ash placement and dust management at the MPPS.

A summary of operations at the LNAR area for the 2019/20 reporting period is presented in Table 1. No ash was placed at LNAR during the 2019/20 reporting period. Figure 2 and Figure 3 provide the layout of site features and the current ash placement plan.

Table 1 Lamberts North Ash Repository – Operations Summary

Activity	Previous Reporting Period (2018/19)	This Reporting Period (2019/20)
Ash delivered to site (T)	153,217	0[1]
Volume of water co-placed (ML)	Unknown	0[1]
Total LNAR ash footprint (ha)	19.8	16.77
Area of LNAR capped (ha)	0	1.29

[1] No ash was placed at LNAR during the 2019/20 reporting period.

2.1 Ash Placement and Geometry

This subsection presents a summary of the intended ash placement procedure and geometry, as summarised from the OEMP.

The LNAR is built to the south of an embankment of compacted mine spoil which was constructed in the northern end of Huon Gully to retain ash from the MPPS. The LNAR repository has approval for the placement of BCA (under specific conditions) or WCA (including furnace bottom ash) from the MPPS. However, EnergyAustralia have advised that only WCA and furnace bottom ash has been handled and placed within the LNAR since operations commenced. EnergyAustralia have also indicated that the water that is used to condition the ash is sourced from the cooling towers at the MPPS. The conditioning of the ash occurs at the MPPS. From there, the WCA is transferred via trucks to the LNAR for placement.

In accordance with the Project Approval, the OEMP states that brine conditioned ash is to be placed only above an RL of 946 m AHD. However, as noted above, no brine conditioned ash has been emplaced within the LNAR to date, and the Mt Piper Ash Placement Survey (reflected in Figure 3) indicates that this elevation was not reached in the LNAR during the 2019/20 monitoring period. Consistent with the OEMP, ash placement at the LNAR occurs in 0.5 m to 1 m lifts. The lifts are conducted in pads, using materials that have been conditioned with water to achieve design elevation contours. Ash placement occurred initially in the most northerly part of the site, continuing towards the eastern and southern parts of Lamberts North.

The ash deposited at the LNAR is treated to achieve an average compaction of 95%, relative to its maximum standard compaction, through the controlled combination of water addition and mechanical compaction with the use of rollers and rubber-tyred vehicles. The ash is deposited in layers and stepped to produce an overall batter slope of an approximate measurement of 1(V):4(H), with benches added to every 10 m in change of the height vertically.

Figure 3 identifies that the current placement height of the LNAR is approximately 940 to 945 m AHD, below the maximum limit for ash placement. Once the LNAR has reached its maximum RL of 960 m AHD it will be covered in accordance with the Project Approval. No ash was placed at the LNAR during the 2019/20 reporting period. Appendix H presents ash placement and elevation plans.

3. ENVIRONMENTAL SETTING

Details of the environmental site setting are presented in the following sections to provide some context to the surface water and groundwater assessments (Sections 5 and 6 respectively).

3.1 Climate

The climate data below was provided by EnergyAustralia and is sourced from a weather station at MPPS. A summary of the climate data is presented in Table 2 and a copy of the data is presented in Appendix G.

Table 2 Local Climate Data for 2019/20

Month	Rainfall Total (mm)	Min. Temperature (°C)	Max. Temperature (°C)
September 2019	51.2	-4.7	24.7
October2019	9.8	-0.2	29.6
November 2019	14.4	2.1	34.2
December 2019	0.0	5.6	38.7
January 2020	59.0	10.2	39.5
February 2020	120.4	5.9	38.6
March 2020	109.6	5.2	30.7
April 2020	90.0	1.1	24.0
May 2020	14.8	-4.0	19.0
June 2020	17.5	-4.0	16.0
July 2020	5.9	-3.7	14.1
August 2020	8	-4.6	17.5
TOTAL/MIN/MAX	500.6	-4.7	39.5

Data from MPPS Weather Station

The results show the total rainfall for the reporting period was 500.6 mm. This is lower than the total reported rainfall for the 2018/19 reporting period of 788.4 mm (ERM, 2019) and is lower than the average annual rainfall between 2012 and 2017 which was reported by Aurecon (2017) to be 756.5 mm.

The 2019-20 monitoring period was characterised by a bushfire season that was unprecedented in its extent and intensity, including the Gospers Mountain fire in the immediate vicinity of the site.

3.2 Geology

The LNAR is adjacent to the MPAR and is located in the western area of the Sydney geological basin, in the Illawarra Coal Measures. The coal measures are on the order of 40 m thick, underlain by the Shoalhaven Group which comprises sandstone and siltstone (SKM 2010). The geology in the vicinity of the MPPS, from surface to depth, is summarised below (from SKM 2010):

- Lidsdale Seam (1-1.5 m) – interbedded high ash coal and shale;
- Blackmans Flat Conglomerate (up to 20 m) - coarse sandstone and conglomerate;
- Lithgow Seam (2-3 m) - coal;
- Marrangaroo Conglomerate (about 20 m) - massive sandstone and conglomerate, with some boulders; and
- Shoalhaven Group (>20 m) - marine sandstone, siltstone and mudstone, sulfide-bearing and acid-generating in places.

3.3 Hydrogeology

The coal measures are considered to act as semi-confined aquifers compared to surrounding lithologies and hydraulic conductivities (SKM 2010).

Groundwater elevation contours indicate primary groundwater flow directions from the LNAR to the east and north-east, towards Wangcol Creek. The groundwater flow directions have remained relatively consistent throughout the monitoring period based on groundwater contour plans prepared for each season (refer to Figure 5 series).

Historically, groundwater seepage from beneath the MPAR would have been collected in the former Groundwater Collection Basin (GCB) located to the east of the MPAR (SKM, 2010). In 2012, the GCB was filled in as part of the construction of the LNAR. Aurecon (2017) noted that prior to the placement of ash in the footprint of the former GCB, the former void (Huons Void) was filled and compacted to a maximum level of 917 m AHD, with ash placed above this elevation.

3.4 Hydrology

The LNAR is within the Upper Coxs River Catchment. The main surface water course in the vicinity of the LNAR is Wangcol Creek, which is a tributary of the Coxs River. Wangcol Creek is located to the north of the LNAR and flows from the north-west towards the south-east. The MPPS and associated ash storage areas are within the catchment of Wangol Creek. At its closest, Wangcol Creek is located approximately 150 m north-east of the LNAR; it joins the Coxs River approximately 3.2 km east of the LNAR.

The Coxs River makes up part of the Warragamba water catchment, the largest of Sydney's five drinking water catchments (WaterNSW, 2020). The Coxs River catchment supports cattle and sheep grazing as its primary land use; however, consistent with the prior history of the MPPS and Ash Repositories, extractive industries such as coal mining are also present.

4. ENVIRONMENTAL GOALS

4.1 Surface Water Environmental Goals

In order to assess for potential effects on surface water quality in receiving surface waters adjacent to the LNAR, Surface Water Environmental Goals have been set out in the OEMP. The Surface Water Environmental Goals apply to the following surface water monitoring sites: the Final Holding Pond Weir (LMP01); Upstream Neubecks Creek (NC01); and Neubecks Creek (WX22), as shown on Figure 4.

The Surface Water Environmental Goals take into consideration local baseline surface water conditions in Wangcol Creek prior to the commencement of ash placement in the Stage I area (western side) of the MPAR (referred to as pre-placement). Baseline conditions were specifically established based on the 90th percentiles of the water quality dataset from monitoring site WX22 in Neubecks Creek.

Aurecon (2017) also presented a set of additional baseline values for copper and nickel which were developed based on the dataset from October 2012 to August 2013 at WX22, to capture potential changes which have occurred to the surface water environment since the operation of the MPAR, but prior to the commencement of operation of the LNAR.

The Surface Water Environmental Goals adopted for this assessment are as per the OEMP and are presented alongside the surface water data in Appendix B.

4.2 Groundwater Environmental Goals

In order to assess for potential effects on groundwater which may potentially discharge to nearby surface waters adjacent to the ash repository site, Groundwater Environmental Goals have been set out in the OEMP.

The Groundwater Environmental Goals are generally based on the ANZECC (2000) water quality guidelines, which are applicable to receiving waters rather than directly to groundwater. The Groundwater Environmental Goals have therefore been applied to the groundwater monitoring sites located cross-gradient/south of the LNAR (D15, D16, D17, D18) , up-gradient/adjacent the LNAR (D10 and D11 - down-gradient of the MPAR), down-gradient/adjacent to the LNAR and adjacent to Wangcol Creek (D1, D9, D8 and D19) with the objective of identifying where impacts above the Groundwater Environmental Goals exist.

Similar to the surface water approach, the Groundwater Environmental Goals also consider local baseline groundwater conditions in the former Groundwater Collection Basin (GCB), also known as the Huon Gully mine void, prior to the backfilling of this basin in 2012 as part of the construction of the LNAR. Baseline conditions (in pre-2000) were specifically established based on the 90th percentiles of the water quality dataset from monitoring undertaken at this location, as presented in the OEMP.

Aurecon (2017) also presented a set of additional baseline values for copper, iron and manganese which were developed based on the dataset from October 2012 to August 2013 at MPGM4/D9, to capture potential changes that had occurred in the underlying aquifer since the operation of the MPAR, but prior to the commencement of operation of the LNAR.

The Groundwater Environmental Goals adopted for this assessment are presented alongside the groundwater data in Appendix C.

4.3 Early Warning Assessment

In addition to comparing results with the Environmental Goals for surface water and groundwater, EnergyAustralia conduct an early warning assessment of the groundwater and surface water monitoring data. The early warning assessment includes assessment of concentration trends through time at each location, and comparison data (50th percentile) from the current monitoring period against the 90th percentile pre-placement data.

4.4 Operational Environmental Management Plan (OEMP)

The OEMP outlines the framework to manage environmental aspects associated with the operation of the LNAR. With respect to the management of surface water and groundwater at the site, the plan outlines the following sub-plans:

- Section 6.4 (of OEMP): Groundwater Management and Monitoring Plan (GMMP), to address Conditions D3 (b and j), B2, E15 and E17 of the Project Approval; and
- Section 6.5 (of OEMP): Soil and Surface Water Management Plan to address Conditions D3 (c) and E16 of the Project Approval.

4.5 Groundwater Model Predictions

Groundwater modelling that was prepared by CDM Smith (2012) for outlined the following:

- Ash placement was considered highly unlikely to adversely affect the two aquifers underlying the LNAR. The project design was modified to reduce the likelihood of groundwater contamination resulting from the LNAR, including provision of a sufficient separation distance between maximum groundwater level and the base of ash placement (CDM Smith, 2013);
- Groundwater modelling demonstrated that the water present in the former GCB and Huon Gully is largely groundwater from the intersection of Huon Void with the water table (CDM Smith, 2013);
- The maximum modelled groundwater level in the southern end of the LNAR was identified as 912.5 m AHD, 2.5 m above the nominal or normal RL 910 m AHD (CDM Smith, 2012);
- The model suggested that groundwater levels across the site were at maximum levels during monitoring due to wet weather patterns at the time. Accordingly the model suggests that groundwater will not rise any further than predicted and will therefore remain at least 4 m below the base of the LNAR under a 1 in 100 year Average Recurrence Interval (ARI) event and steady state normal conditions (CDM Smith, 2012);
- The model indicated that no impact on normal groundwater and surface water quality parameters was expected (CDM Smith, 2012); and
- Preliminary predictions based on sulfate and total dissolved solids (TDS) concentrations indicated that impacts from the LNAR associated with compounds such as boron, manganese, nickel, zinc, molybdenum, copper, arsenic and barium were unlikely (CDM Smith, 2012).

4.6 Independent Investigation

It is noted that a separate and broader independent investigation of groundwater and surface water conditions in the vicinity of the Ash Repositories, including the MPAR, is currently being completed (the independent investigation). Potential measures to manage potential impacts to groundwater and surface water are currently being evaluated as part of the independent investigation including the Mt Piper Groundwater Interception Project (described in Section 4.6.1 below).

The OEMP and the associated monitoring and reporting requirements will be revised following completion of the independent investigation to reflect the key findings and provide further detail on the contingency measures proposed.

4.6.1 Mt Piper Groundwater Interception Project

The Mt Piper Groundwater Interception Project is currently being progressed as a mitigation measure in response to routine monitoring which have indicated that BCA placement activities in the separately approved MPAR are influencing groundwater conditions in the vicinity of the MPAR. The objective of the Mt Piper Groundwater Interception Project is to mitigate groundwater impacts and to improve the water quality in Wangcol Creek, adjacent to the MPAR.

The Mt Piper Groundwater Interception Project proposes to extract water from former mine workings within the base of Wangcol Creek and groundwater from the vicinity of Wangcol Creek. The extracted groundwater would then be transferred back to the Ash Repositories for storage prior to being treated in the existing water management infrastructure at the MPPS. The Mt Piper Groundwater Interception Project has been, and continues to be, subject to discussion with regulatory stakeholders.

EnergyAustralia presented an overview of the Mt Piper Groundwater Interception Project to regulatory stakeholders on 29 April 2020 and 31 July 2020, and further engagement by EnergyAustralia with regulatory stakeholders and the Community Consultation Committee (CCC) is planned.

A Review of Environmental Factors (REF) is currently being developed in support of the applications for the approvals required to implement the Mt Piper Groundwater Interception Project. It is currently anticipated that the REF will be finalised in coming months and, pending relevant approvals, the Mt Piper Groundwater Interception Project will be implemented in 2021.

5. Surface Water Assessment

5.1 Objective

The objective of the surface water monitoring program is to monitor the impacts of ash placement activities occurring under the Project Approval on the surface water quality in Wangcol Creek.

5.2 Surface Water Monitoring Locations and Frequency

The condition of the surface water downstream of the LNAR is compared to upstream surface water quality conditions to assess for potential changes in water quality. A summary of the surface water monitoring site locations is presented in Table 3 and Figure 4.

Table 3 Surface Water Monitoring Site Network and Frequency

Site ID	Location Description	Frequency[1]	No. of Samples in 2019/20
LMP01	Final Holding Pond Weir - Licence discharge/monitoring point is located northwest of the MPAR. This monitoring site is located in an upstream position relative to the Lamberts North Ash Placement Area.	Quarterly	36
NC01	Located in Wangcol Creek. This monitoring site is located upstream to the LNAR and to the north of the MPAR. NC01 is also an aquatic life background monitoring site.	Quarterly	4
WX22	Located in Wangcol Creek at a stream gauge to the east and downstream of the Ash Repositories and downstream from all groundwater monitoring locations contained in the OEMP.	Quarterly	9

[1] *Frequency specified in the OEMP*

It is noted that the frequency of monitoring was affected during the reporting period due to constraints associated with necessary measures to respond to the COVID-19 pandemic, and the bushfires which occurred over summer 2019/20 and restricted access to MPPS.

5.3 Surface Water Monitoring Methodology

Surface water quality monitoring was undertaken by Nalco Water – Ecolab (Nalco) on behalf of EnergyAustralia. It is understood that the sampling methodology applied by Nalco was in accordance with that outlined in the OEMP.

5.4 Surface Water Quality Dataset

Samples were obtained by Nalco for either field or laboratory analysis in accordance with the following monitoring and analysis schedule:

- pH - laboratory measurement (LMP01 only) and field measurement;
- Electrical Conductivity (EC) - field measurement (WX22, LMP01 and NC01) and laboratory measurement at LMP01;
- Dissolved Oxygen (DO) - field measurement;
- TDS - laboratory analysis;
- Temperature (°C) - field measurement (WX22 only);
- Total Suspended Solids (TSS) - laboratory analysis (LMP01 only);
- Major anions including chloride, fluoride and alkalinity – laboratory analysis;

- Sulfate (as SO_4) – laboratory analysis
- Major cations including calcium, potassium, magnesium, sodium – laboratory analysis;
- Nutrients including nitrate, nitrite, nitrogen and phosphorus (and on occasion ammonia for LDP01) – laboratory analysis; and
- Metals (including Al, As, Ba, Be, B, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sr, V and Zn) – laboratory analysis.

Analysis for trace metals was undertaken on unfiltered surface water samples, except for aluminium, copper, iron, manganese, vanadium, and zinc where both filtered and unfiltered samples were analysed.

Data Quality Assurance and Quality Control (QA/QC) checks for compliance are performed by EnergyAustralia prior to the publishing of the surface water data online.

Evidence of the collection of field QC samples (i.e. rinsate, trip blanks or trip spikes) during the field based programs was not provided. Further, results of laboratory QC measures including laboratory duplicate, triplicate, internal RPDs, method blanks or spike data were not presented for review.

5.5 Surface Water Results

A summary of the surface water analytical results obtained for the 2019/20 reporting period against the Environmental Goals for surface water is presented in Table 4.

Tabulated results along with summary statistics for each monitoring point (minimum, maximum, 50th percentile and 90th percentile) are presented in Appendix B and Figure 6a.

Table 4 Surface Water Monitoring Results – 2019/20

Analyte/Location	Surface Water Concentration Range			Screening Criteria	
	Wangcol Creek (WX22)	Final Holding Pond Weir (LMP01)	Lamberts North Upstream Background (NC01)	Wangcol Creek at WX22 Pre-placement 90th Percentile	Surface Water Environmental Goal
pH (field)	6.48 – 7.34	7.18 – 8.86	6.88 – 7.04	6.7-7.8	6.5 – 8.0^k
pH (laboratory)	NA	7.38 – 9.4	7.43	6.7-7.8	6.5 – 8.0^k
Electrical Conductivity (µS/cm)	387 - **3040**	363 - 590	371 - 559	894	2,200^c
TDS, Major and Minor Ions (mg/L)					
TDS	266 - **2680**	14 - 446	220 - 363	580	1,500^d
Sulfate (as SO_4)	<215 - **1350**	52 - 270	32.2 - 140	332	1,000^e
Chloride	<42.9 - 212	6 - 55	7.72 – 22.8	22	350^f
Fluoride	<0.1 – <0.5	0.112–0.301	0.139 – **1.56**	0.338	1.5^g
Trace Metals (µg/L)					
Arsenic	<1	2 - 6	<1 - 2	<1	24b
Barium	14 - 81	19 - 42	19 - 51	29	700g
Beryllium	NA	<1	<1	<1	100i
Boron	60 - 47	70 - 110	50 - 90	90	370b
Cadmium	<0.1	<0.1 – 0.4	<0.1	<1	0.85h
Chromium (total)	<1	<1 – 4	<1	<1	2 h
Copper	<1 - 3	5 - 16	<1 - 5	<1	3.5 h / 5 m
Iron (filtered)^l	80 - 596	26 - 212	154 - 238	281	300f

Analyte/Location	Surface Water Concentration Range			Screening Criteria	
	Wangcol Creek (WX22)	Final Holding Pond Weir (LMP01)	Lamberts North Upstream Background (NC01)	Wangcol Creek at WX22 Pre-placement 90th Percentile	Surface Water Environmental Goal
Iron	179 - **1050**	292 - ***3480***	**763 - *3560***	281	300[f]
Mercury	<0.04 - 0.04	<0.04	<0.04	-	0.06[b]
Manganese (filtered)[l]	151 - **8620**	10 - 33	59 - 248	720	1,900[b]
Molybdenum	<1 - 1	4 - **23**	1 - 7	<1	10[i]
Nickel	15 - ***195***	4 - **17**	3 - 10	5	17[b] / 15[m]
Lead	<1	<1 - **8**	<1 - 2	<1	5[b]
Selenium	<0.2 – 0.4	0.5 – 0.9	<0.2 – 0.6	<1	5[b]
Silver	<1	<1	<1	-	0.05[b]
Zinc	10 - **142**	17 - 79	6 - 74	116	116[j]

Notes:

NA Not Available
All metals concentrations presented are from unfiltered samples, as per the OEMP
Shaded cell indicates value is equal to or exceeds the Environmental Goal
Bold indicates result is 1 - <10 times the Environmental Goal
Bold and italicised indicates result is >10 times the Environmental Goal
a. Values adopted from OEMP
b. ANZECC 2000 for Freshwater Slightly-Moderately disturbed aquatic ecosystems (B 90th, Pb 90th, Ni 80th, Se 90th, Ag 90th)
c. ANZECC 2000 – Conductivity range for lowland rivers in slightly disturbed ecosystems in south-east Australia is 125-2200 µS/cm
d. 1,500 mg/L based on a conversion factor of 0.68 and an EC of 2200 µS/cm lowland river conductivity for slightly disturbed ecosystems
e. ANZECC (2000) Livestock
f. ANZECC (2000) Irrigation for moderately tolerant crops
g. ANZECC (2000) Drinking water guidelines
h. Concentrations of cadmium, chromium and copper modified due to consideration of water hardness. Cd from 0.001 mg/L to 0.00085 mg/L; Cr from 0.001 mg/L to 0.002 mg/L and Cu from 0.0025 mg/L to 0.0035 mg/L
i. ANZECC (2000) Irrigation LTV
j. Local guideline based on 90th percentile pre-brine placement
k. ANZECC (2000) pH values presented are for groundwater systems and based on aesthetic considerations such as corrosion and fouling of pumping, irrigation and stock watering systems) for primary industries
l. Concentrations of iron and manganese are filtered
m. Lamberts North pre-placement 90th percentile baseline data from October 2012 to August, 2013 and Wangcol Creek at WX22 as presented in Aurecon (2017).

5.6 Discussion

Review of the surface water data presented in Appendix B and Figure 6 series indicates that, for specific analytes, concentrations at WX22 were generally higher than those reported at upstream locations LMP01 and NC01. Concentrations of chloride, sulfate, manganese, nickel and zinc in surface water from WX22 were generally higher than in samples from the upstream monitoring locations. However, these results are not considered to be due to ash placement activities occurring at LNAR. As reported in the Annual Environmental Monitoring Report – Water Management and Monitoring for the Mt Piper Power Station Brine Conditioned Fly Ash Co-Placement Project (the AEMR) (ERM, 2020), the results are considered likely to be related to BCA placement activities at the MPAR (refer to Section 6.6 for further details).

Higher concentrations for a range of analytes including TDS, EC, chloride, sulfate, boron, copper, manganese, nickel and zinc were reported in the same sample collected during January 2020 sampling at WX22. The elevated concentrations of parameters in surface water at this downstream monitoring location are considered to be related to groundwater inputs to Wangcol Creek, particularly during the summer period, when the region typically experiences the lowest rainfall (ERM, 2020).

Comparisons with water quality at LMP01 and NC01 was not possible as sampling did not occur at these locations during January 2020. However, results from the sample collected from LMP01 during the February sampling event were higher than those from the previous sampling events at that location.

The elevated concentrations of copper, barium, boron and iron in surface water from Wangcol Creek during the 2019/20 reporting period are considered to be related to the background surface water quality in the area, based on the surface water results from LMP01 and NC01 which are located upstream of the Ash Repositories.

5.7 Early Warning Assessment

A summary of the surface water analytical results (50th percentile) for the 2019/20 reporting period compared with the pre-placement 90th percentile in Wangcol Creek is presented in Table 5 and shown on Figure 6b. A requirement of the OEMP, this early warning assessment serves to provide an early indication of changes in surface water quality as part of contingency planning. Contingency planning is currently being implemented via the independent investigation and mitigation measures outlined at Section 4.6.

Table 5 Surface Water Concentrations (50th Percentile) – 2019/20

Analyte/Location	Surface Water Concentrations (50th percentile) 2019/20			Wangcol Creek at WX22 Pre-placement 90th Percentile [a]
	WX22	NC01	LMP01	
pH	6.95	7.04	7.25	6.7-7.8
Conductivity (µS/cm)	850	401	398	894
TDS and Major Ions				
TDS (mg/L)	652	253.5	266	580
Sulfate (as SO_4) (mg/L)	514	86	110	332
Chloride (mg/L)	101	13.2	14	22
Fluoride (mg/L)	0.136	0.223	0.138	0.338
Trace Metals				
Arsenic (µg/L)	<1	**1.5**	**4**	<1
Barium (µg/L)	**33.5**	**34**	27.5	29
Beryllium (µg/L)	NA	<1	<1	<1
Boron (µg/L)	**130**	65	**90**	90
Cadmium (µg/L)	<0.1	<0.1	0.3	<1
Chromium (total) (µg/L)	<1	<1	**3**	<1
Copper (µg/L)	**2**	**4**	**13.5**	<1
Iron (µg/L)[b]	**674**	**1055**	**1182**	281
Iron (µg/L)[c]	95	174	110	281
Manganese (µg/L) [b]	**1680**	312	121	720
Manganese (µg/L) [c]	**1620**	111	22	720
Molybdenum (µg/L)	**1**	**3**	**9.5**	<1
Nickel (µg/L)	***116***	3.5	**6.5**	5
Lead (µg/L)	<1	**2**	**3**	<1

Analyte/Location	Surface Water Concentrations (50th percentile) 2019/20			Wangcol Creek at WX22 Pre-placement 90th Percentile [a]
Silver (µg/L)	<1	<1	<1	-
Selenium (µg/L)	0.4	0.3	0.6	<1
Zinc (µg/L)	44.5	30	36	116

Notes

[a] Wangcol Creek at WX22 Pre-placement 90th Percentile values for analytes (OEMP)

[b] Unfiltered concentration used for iron and manganese

[c] Filtered concentration used for iron and manganese

All metals concentrations presented are from unfiltered samples unless otherwise noted

Shaded cell indicates value is equal to or exceeds the adopted criterion (Wangcol Creek at WX22 Pre-placement 90th percentile)

Bold *indicates result is 1 - <10 times the adopted criterion*

Bold and italicised *indicates result is >10 times the adopted criterion*

The 50th percentile concentrations (for the 2019/20 period) for arsenic, boron, cadmium, chromium, copper, iron (unfiltered), molybdenum, nickel and lead at upstream monitoring location LMP01 were at or above the 90th percentile pre-placement levels. At upstream monitoring location NC01 the 50th percentile concentrations for TDS, arsenic, barium, boron, copper, iron (unfiltered), molybdenum and lead were reported at or above the 90th percentile levels. Downstream of the Ash Repositories at WX22, the 50th percentile concentrations for TDS, sulfate, chloride, barium, boron, copper, iron (unfiltered), manganese, molybdenum and nickel were above the 90th percentile pre-placement levels.

The elevated concentrations (50th percentile for the 2019/20 period) of boron, copper, iron and molybdenum identified at WX22 were reported at levels comparable to the upstream site suggesting these exceedances are potentially due to upstream/background conditions, as noted in Section 6.6.

Concentrations of sulfate, chloride, manganese and nickel were, however, higher in downstream site WX22 than at the upstream locations LMP01 and NC01.

Chloride concentrations (50th percentile) were an order of magnitude higher in downstream monitoring location WX22 compared to the background chloride 50th percentile results at LMP01 and NC01. However, these concentrations are unlikely to be related to the LNAR given that no BCA placement activity has been conducted at the LNAR.

The comparison of 50th percentile results indicate a potential change in the surface water quality downstream of the Ash Repositories. This is the "early warning trigger"; however, theses concentrations are considered to be unrelated to operations at the LNAR. A separate investigation into surface and groundwater impacts is currently underway, as outlined in Section 4.6.

5.7.1 Trend Analysis

A review of concentration trends in surface water with respect to key indicators including chloride, TDS, sulfate and nickel is presented below. These indicators were selected based on their exceedances of Environmental Goals for surface water, the potential increase in concentration observed downstream of the Ash Repositories and/or trend analysis presented in previous annual monitoring reports. Surface water trend graphs for the period 2010 to the end of the current reporting period are presented in Appendix E.

5.7.1.1 Chloride

Chloride concentrations for all surface water monitoring locations were consistently below the Environmental Goal of 350 mg/L throughout the period 2010-2020. Chloride concentrations at WX22 during the 2019/20 monitoring period appear to be comparable with previous years, with the highest concentrations reported during the summer months. These peaks are likely associated with low stream flows, and increased influence of groundwater seepage during the summer months.

The highest concentration of chloride was reported during this reporting period in January 2020 (212 mg/L). Prior to that, the highest chloride concentrations recorded were in February 2018 (164 mg/L) and February 2014 (130 mg/L).

Chloride concentrations at both LMP01 and NC01, upstream of the Ash Repositories, have remained relatively stable and low since 2010.

5.7.1.2 Nickel

Nickel concentrations at LMP01 and NC01 have been generally stable since monitoring commenced in 2012. These upstream monitoring locations have reported concentrations of nickel equal to the Environmental Goal for surface water in March 2014 (NC01 – 17 µg/L) and February 2020 (LMP01 - 17 µg/L), however there is no concentration trend apparent.

The maximum nickel concentration of 195 µg/L was reported in a surface water at WX22 in January 2020. Nickel concentrations from October and November 2019 and February 2020 ranged between 112 µg/L and 122 µg/L). These concentrations were similar to those reported at WX22 in January and February 2018 (115 µg/L and 136 µg/L respectively) and in February 2014 (150 µg/L). Similar to chloride, the highest nickel concentrations at WX22 typically occurred during periods of lower surface water flows. Nickel concentrations in surface water from WX22 exceeded the pre-placement trigger level on numerous occasions during the 12 months of the current monitoring period, and as with chloride, the peak concentrations of nickel in surface water at WX22 appear to becoming higher over time.

5.7.1.3 Sulfate

Sulfate concentrations at LMP01 and NC01 have remained relatively stable since 2010, consistently below the Environmental Goal for surface water.

The sulfate concentrations at WX22, downstream of the LNAR, were generally stable between 2010 and 2012, with fluctuations in sulfate concentrations occurring more frequently after this time. Post 2012, the sulfate concentrations at WX22 were equal to or above the Environmental Goal for surface water during the summer period in February 2014, February 2018, November 2019 and January 2020. Again, the highest sulfate concentrations are likely associated with low stream flows and increased influence of groundwater seepage during the summer months, and the peak concentrations of sulfate in surface water at WX22 appear to have increased with time.

5.7.1.4 TDS

TDS concentrations in surface water at LMP01 and NC01 have remained relatively stable since 2010, and consistently below the Environmental Goal for surface water.

At WX22, downstream of the LNAR, the TDS concentrations were generally stable between 2010 and 2012, with sporadic increases in TDS levels above the pre-placement levels observed after this time. Post 2012, the TDS concentrations at WX22 have been reported above the Environmental Goal for surface water during the summer period in February 2014, February 2018, November 2019 and January 2020. Again, the peaks for TDS are likely associated with low stream flows, and increased influence of groundwater seepage during the summer months, and the peak concentrations of sulfate in surface water at WX22 appear to becoming higher over time.

6. GROUNDWATER

6.1 Objectives

The objective of the groundwater monitoring program is to monitor the impacts of ash placement activities at LNAR occurring under the Project Approval on local groundwater conditions.

6.2 Groundwater Monitoring Locations and Frequency

A summary of the groundwater monitoring site locations is presented in Table 6 and Figure 4.

Table 6 Groundwater Monitoring Network and Frequency

Bore ID	Location Description	Screened Material [1]	Frequency[2]	No. of Samples
MPGM4/D1	North-east boundary of LNAR	Mudstone, sandstone and coal	Quarterly	7
MPGM4/D8	Downgradient of LNAR, adjacent to Wangcol Creek	Alluvial deposits	Quarterly	7
MPGM4/D9	Downgradient of LNAR, adjacent to Wangcol Creek	Alluvial deposits	Quarterly	7
MPGM4/D10	Inside of MPAR	Fill beneath the ash	Quarterly	5
MPGM4/D11	Inside of MPAR	Fill beneath the ash	Quarterly	6
MPGM4/D15	Centennial Coal leased area south of LNAR	Sandstone and/or shale	Quarterly	7
MPGM4/D16	Centennial Coal leased area south of LNAR	Sandstone and/or shale	Quarterly	7
MPGM4/D17	Centennial Coal leased area south of LNAR	Sandstone and/or shale	Quarterly	5
MPGM4/D18	Centennial Coal leased area south of LNAR	Sandstone and/or shale	Quarterly	7
MPGM4/D19	Downgradient of LNAR	Fill (mine spoil)	Quarterly	7

1.ERM 2020
2.Frequency specified in the OEMP

6.3 Groundwater Monitoring Methodology

Groundwater quality monitoring was undertaken by Nalco on behalf of EnergyAustralia. It is understood that the sampling methodology applied by Nalco was with in accordance with that outlined in the OEMP.

6.4 Groundwater Quality Dataset

Groundwater samples were obtained for analysis in accordance with the following:

- pH - field measurement;
- EC - field measurement;
- TDS - laboratory analysis;
- Major and minor anions including chloride, fluoride and alkalinity – laboratory analysis;
- Sulfate (as SO_4) – laboratory analysis;

- Major cations including calcium, potassium, magnesium, sodium – monthly laboratory analysis; and
- Metals (including Al, As, Ba, B, Cd, Cr (total), Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, V and Zn) – monthly laboratory analysis.

The trace metals in groundwater samples were measured on unfiltered samples, except for iron, manganese and vanadium where results from both filtered and unfiltered samples were obtained.

Evidence of the collection of field QC samples (i.e. rinsate, trip blanks or trip spikes) during the field based programs was not provided. Results of laboratory QC measures including laboratory duplicate, triplicate, internal duplicates, method blanks or spike data were also not presented for review during compilation of this report.

6.5 Groundwater Results

6.5.1 Groundwater Levels and Inferred Flow Direction

With reference to the hydrographs provided in Appendix D, water levels in the groundwater monitoring bores were relatively stable across the monitoring period. The lowest groundwater elevations during the monitoring period typically occurred in January 2020, at the end of an extended dry period. Water levels subsequently rose following a series of rainfall events that occurred from January to April 2020. Groundwater levels in the monitored bores adjacent to and upgradient of the LNAR (i.e. D10 and D11) increased over the monitoring period but remained below the base of ash placement (917m AHD).

As discussed in Section 3.3, groundwater elevation contours indicate a primary flow direction to the east and north-east, away from the LNAR towards Wangcol Creek. Groundwater elevations in bores D11 and D10 to the north-west and south-west of the LNAR respectively and to the east of the MPAR increased to a maximum of 912 m AHD (D10, June 2020). Groundwater elevations declined to approximately 907 m AHD to the south-east of the repository (i.e. D19) and to approximately 902 m AHD in the vicinity of Wangcol Creek at D8 (January, 2020). The groundwater flow directions have remained relatively consistent throughout the monitoring period based on groundwater contour plans prepared for each season. Groundwater contour plans are presented in Figures 5a - 5d.

6.5.2 Groundwater Analytical Results Summary

A summary of the groundwater analytical results obtained for the 2019/20 reporting period is presented in Table 7. Tabulated results along with summary statistics for each monitoring point (minimum, maximum, 50th percentile and 90th percentile) are presented in Appendix C and Figures 7a - 7d.

Table 7 Summary of Groundwater Concentrations - 2019/20 Reporting Period

Analyte/Location	Groundwater Concentration Range				Screening Criteria	
	South/ Cross-Gradient[1]	Up-gradient /Adjacent to MPAR[2]	At boundary of LNAR[3]	Down-gradient /Adjacent to Wangcol Creek[4]	Groundwater Collection Basin Pre-Ash Placement 90th Percentile[a]	Groundwater Environmental Goal[a b,c,e]
pH	**4.93** – 7.00	**5.54 – 6.3**	**5.59 – 6.14**	**5.43 – 6.4**	-	6.5 – 8.0[a]
Conductivity (µS/cm)	660 – **3,640**	**2,784 – 11,230**	**3,490 – 9,810**	222 – **9,310**	1,576	2,600[a]
TDS (mg/L)	310 **– 3,460**	**3,440 – 9,550**	**2,520 – 7,840**	118 – **10,100**	1,306	1,500[a]
Sulfate (as SO_4) (mg/L)	9.4 **– 1,840**	**2,140 – 5,870**	**1,590 – 4,450**	82.6 – **4,700**	824	1,000[a]
Chloride (mg/L)	7.5 - 228	303 **– 1,070**	228 **– 1,020**	3.4 – **1,190**	31.5	350[a]
Arsenic (µg/L)	2 - **124**	<1 - 10	1 - **52**	<1 – 8	1	24[b]
Silver (µg/L)	**<1**	**<1**	**<1**	**<1**	<1	0.05[b]
Barium (µg/L)	8 - 139	14 - 55	13 - 206	22 – 54	37	700[f]
Boron (µg/L)	50 - 260	**940 – 5,070**	**1,320 – 2,560**	70 **– 1,930**	244	370[b]
Cadmium (µg/L)	<0.1 – 1.4	<0.1 **– 6.9**	<0.1 – 0.7	<0.1 – 0.2	2	2[d,e]
Chromium (total) (µg/L)	**2 - 129**	<1	<1 **- 51**	<1 – 1	1	5[d]
Copper (µg/L)	1 - **191**	<1	<1 - **54**	<1 – **7**	1	5[a]
Fluoride (mg/L)	0.11 – <0.5	<0.5 - <1	<0.5 – 0.18	<0.05 - <1	0.435	1.5[d]
Iron (µg/L)	206 – **32,500**	**4,420 – 121,000**	**1,320 – 63,200**	80 – **65,800**	664	664[e]
Mercury (µg/L)	<0.04 – **0.14**	<0.04	<0.04 – **0.42**	<0.04 – **0.31**	<0.1	0.06[c]
Manganese (µg/L)	46 – 3,550	**7,150 – 19,400**	3,880 – **28,300**	393 – **22,600**	5,704	5,704[e]
Molybdenum (µg/L)	<1 - **12**	<1	<1 - 4	<1 – 2	1	10[a]

Analyte/Location	Groundwater Concentration Range				Screening Criteria	
	South/ Cross-Gradient[1]	Up-gradient /Adjacent to MPAR[2]	At boundary of LNAR[3]	Down-gradient /Adjacent to Wangcol Creek[4]	Groundwater Collection Basin Pre-Ash Placement 90th Percentile[a]	Groundwater Environmental Goal[a b,c,e]
Nickel (µg/L)	3 - **934**	404 **– 1,120**	375 **– 1,940**	20 – **1,750**	550.9	550.9[e]
Lead (µg/L)	<1 - 2	<1 - **9**	<1 - **202**	<1 – **13**	1	5[f]
Selenium (µg/L)	<0.2 – **12.6**	<0.2 – 2.9	<0.2 - **6**	<0.2 – 1.1	2	5[c]
Zinc (µg/L)	7 – **1,810**	13 – **1,080**	85 - 813	33 – **1,130**	908	908[e]

Notes:

1. Monitoring bores south and cross-gradient of ash repository: MPGM4/D15, MPGM4/D16, MPGM4/D17, MPGM4/D18
2. Monitoring bores adjacent to the MPAR and up-gradient of the LNAR: MPGM4/D10 and MPGM4/D11.
3. Monitoring bores at boundary of the LNAR MPGM4/D1 and MPGM4/D19.
4. Monitoring bores adjacent to Wangcol Creek MPGM4/D8 (north of Wangcol Creek) and MPGM4/D9 (south of Wangcol Creek).

Shaded and bold cells indicate values are equal to or exceed the Groundwater Environmental Goals.
a Criteria from OEMP.
b OEMP Criteria - ANZECC (2000) 95% Level of species protection for freshwater aquatic ecosystems.
c OEMP Criteria - ANZECC (2000) 99% Level of species protection for freshwater aquatic ecosystems.
d OEMP Criteria - NHMRC (2011) Australian Drinking Water Guidelines.
e OEMP Criteria - adopted from Groundwater Collection Basin Pre-Ash Placement 90th Percentile.
f OEMP Criteria - NHMRC (2008) Guidelines for Managing Risks in Recreational Waters.
g Lamberts North pre-placement 90th Percentile baseline data from October 2012 to August, 2013 and Neubecks Creek (now referred to as Wangcol Creek) at WX22 (Aurecon, 2017).

6.6 Discussion

With reference to Table 7, Appendix C and Figures 7a and 7b, the following subsections provide a discussion of the groundwater results in each of the monitored areas.

6.6.1 Bores South/Cross Gradient of the LNAR

Groundwater from bores D15, D16, and D17 to the south of the LNAR had pH values that were more acidic that the Environmental Goal, and sulfate, EC and TDS concentrations in groundwater from bores D15 and D16 also exceeded the Environmental Goals. Concentrations of select metals (arsenic, chromium, copper, iron, mercury, molybdenum, nickel, lead, selenium, and zinc) in groundwater from bore D15, located to the south-west of the LNAR exceeded the Environmental Goals at some time during the monitoring period. Intermittent exceedances of the groundwater Environmental Goals for fluoride and iron were also reported in groundwater from bore D18, for iron from bore D16, and for iron and chromium from bore D17. These exceedances are considered unlikely to be a result of activities at the LNAR based on the inferred direction of groundwater flow.

Concentrations of analytes including sulfate, chloride and metals were typically lower in groundwater from D18 when compared to D15, D16 and D17. Groundwater elevations in bore D18 are also more variable than in nearby bores, with more rapid responses to rainfall. Based on this information, the integrity of bore D18 may have been compromised, allowing fresh water to enter the borehole from the surface or may be directly connected through mine void or fill to surface water. Consequently, water quality in bore D18 is not considered to represent groundwater quality in the area.

6.6.2 Bores Upgradient / Adjacent to LNAR

Bores D10 and D11 are located upgradient of the LNAR, and immediately downgradient of the MPAR. Concentrations of EC and TDS in groundwater from these bores were above the Environmental Goals, and were the highest of the bores monitored. Similarly, concentrations of anions including chloride, sulfate, and metals including boron, cadmium, iron, lead, nickel, and manganese and zinc in groundwater from at least one of these bores were at or above the Environmental Goals for groundwater during the monitoring period.

The detections of iron, nickel and zinc and levels of TDS and sulfate above the Environmental Goals at D10 and D11 are likely to be related to the local groundwater quality in the area. Based on the location of the bores and groundwater flow directions, they are not considered to be related to ash placement activities at the LNAR.

Exceedances of chloride, boron, cadmium, manganese, nickel and lead are considered to be unrelated to either background groundwater conditions in the region or to potential impacts resulting from activities at the LNAR. These groundwater conditions are currently subject to review and management as part of the independent investigation. Further discussion related to the early warning assessment are discussed in Section 6.7.

Low groundwater pH (more acidic than the Environmental Goal) was also evident in groundwater from this area, however this is typical of the monitored bores and is related in part to regional groundwater conditions.

6.6.3 Bores Downgradient / Adjacent to the LNAR

Concentrations of boron, iron, manganese and nickel, chloride, sulfate and levels of EC and TDS (D1 and D19) and chromium, copper and lead (at D19) consistently exceeded the Environmental Goals for groundwater in groundwater from bores located to the north-east and east of the LNAR.

The elevated detections of these constituents are also elevated relative to concentrations in bores to the south of the LNAR and are considered to be related to groundwater conditions reported at D10 and D11. These groundwater conditions are currently subject to review and management as part of the independent investigation. Further discussion related to the early warning assessment are discussed in Section 6.7.

6.6.4 Bores Adjacent to Wangcol Creek

At times during the monitoring period, EC and TDS values, sulfate, chloride, boron, copper, lead, manganese, mercury and nickel and zinc concentrations in groundwater from bore D9, and low pH values and iron in groundwater from bores D8 and D9 exceeded the Environmental Goals for groundwater. Of these, low pH levels, iron and manganese concentrations are considered to be associated with background conditions.

The elevated copper, lead and zinc (D9) and iron (D8) concentrations were sporadic and do not demonstrate clear trends. The elevated EC and TDS, sulfate, boron and nickel concentrations that exceeded the Environmental Goals for groundwater were identified in groundwater from D9 (south side of Wangcol Creek) rather than in groundwater from D8, to the north of Wangcol Creek. Elevated nickel and chloride levels were identified in groundwater from D9 consistently, however this is considered to be unrelated to groundwater quality from the LNAR and is subject to review and management as part of the independent investigation. Further discussion related to the early warning assessment are discussed in Section 6.7.

There was no clear evidence of trends in water quality at D8.

6.7 Early Warning Assessment

A summary of the groundwater analytical results (50th percentile) for the 2019/20 reporting period compared with the adopted Groundwater Collection Basin Pre-Ash Placement 90th Percentile is presented in Table 8 and in Appendix C. The results are also presented on Figure7c and Figure 7d.

This assessment serves to provide an early indication of changes in groundwater quality. As outlined above, and with reference to Section 4.6, the independent investigation is being conducted in relation to the surface water and groundwater impacts associated with the MPAR and mitigation measures are proposed to address these impacts.

Table 8 Groundwater Concentrations (50th Percentile) - 2019/20

Analyte/Location	Groundwater Concentration (mg/L) - 50th percentile (2019 – 2020)										Groundwater Collection Basin Pre-Ash Placement 90th Percentile (mg/L)[a]
	South/Cross Gradient				Up-gradient/Adjacent to Ash Repository		Adjacent to Repository		Down-gradient		
	D15	D16	D17	D18	D10	D11	D1	D19	D8	D9	
pH	5.11	6.36	6.13	6.69	5.61	6.27	5.92	6.04	5.73	6	-
Conductivity (µS/cm)	**3,530**	**1,950**	**3,500**	680	**9299**	**9,925**	**7,470**	**4,750**	609	**8,840**	1,576
TDS (mg/L)	**2,860**	**1,570**	**2,680**	-	**8,050**	**8,875**	**6,870**	**3,480**	444	**8,120**	1,306
Sulfate (as SO_4) (mg/L)	**1,700**	775	1,620	11.9	**4,870**	**4,695**	**3,570**	**2,290**	195	**4,210**	824
Chloride (mg/L)	**166**	**93**	**216**	8.1	***843***	***983***	***828***	***337***	25	***1,070***	31.5
Fluoride (mg/L)	<0.5	0.19	0.11	0.4	0.34	<1	<1	0.18	0.02	0.13	0.435
Arsenic (µg/L)	**6**	<1	**2**	**9**	<1	**4.5**	**5**	**8**	<1	**2**	1
Barium (µg/L)	20	10	15	***667***	16	31	30	22	27	39	37
Boron (µg/L)	210	<50	190	55	***4,290***	***2,720***	**2,340**	**1,970**	110	**1,620**	244
Cadmium (µg/L)	0.5	<0.1	<0.1	0.2	**5.1**	<0.1	<0.1	0.2	<0.1	0.15	2
Chromium (total) (µg/L)	***52***	**2**	**3.5**	**2**	<1	<1	<1	***20***	<1	1	1
Copper (µg/L)	**7**	<1	<1	**1**	<1	<1	<1	**5**	**3**	**2**	1
Iron (µg/L)	***29,750***	**2,790**	***12,440***	**744**	**6,290**	***60,900***	***25,550***	***15,950***	128[b]	***50,950***[b]	664
Mercury (µg/L)	0.08	<0.04	<0.04	<0.04	<0.04	<0.04	**0.24**	**0.24**	<0.04	0.055	<0.1
Manganese (µg/L)	2,200	57	3,145	113	**8,530**	**16,450**	**22,600**	**10,115**	616	**21,500**	5,704
Molybdenum (µg/L)	**3**	<1	<1	**2**	<1	<1	<1	**3**	<1	**1**	1

Analyte/Location	Groundwater Concentration (mg/L) - 50th percentile (2019 – 2020)										Groundwater Collection Basin Pre-Ash Placement 90th Percentile (mg/L)[a]
	South/Cross Gradient				Up-gradient/Adjacent to Ash Repository		Adjacent to Repository		Down-gradient		
Nickel (µg/L)	**853**	15	98	5	**976**	**936**	**1,480**	**715**	50	**1,660**	356
Lead (µg/L)	**7**	<1	<1	**2**	**6**	<1	<1	***21***	**2**	***13***	1
Selenium (µg/L)	0.9	<0.2	<0.2	0.2	1.6	0.25	0.2	1.2	<0.2	0.2	2
Silver (µg/L)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Zinc (µg/L)	**1,600**	10.5	71	24	881	72	138	330	63	104	908

a Groundwater Collection Basin Pre-Ash Placement 90th Percentile from Aurecon (2017)
b Filtered iron results reported
Shaded cells value equals or exceeds the trigger level
Bold indicates result equals exceeds the Pre-Ash Placement 90th Percentile level by 1 to 10 times.
Bold and Italicised indicates result exceeds the Pre-Ash Placement 90th Percentile level by > 10 times.

Bores (D15, D16, D17) to the south and cross-hydraulic gradient of the LNAR, reported 50th percentile levels of EC and TDS and concentrations of sulfate, chloride, arsenic, chromium (total), copper, iron, molybdenum, nickel, lead and zinc from the 2019/20 reporting period that exceeded the pre-placement trigger levels. Based on the location of these bores relative to the LNAR, the concentrations of these analytes in groundwater are not considered to be related to the LNAR.

Upgradient monitoring bores (D10, D11) located adjacent to the LNAR show a clear change in the groundwater quality relative to the groundwater monitoring bores located to the south/cross gradient of the LNAR. These monitoring bores are located down gradient of the MPAR, and between the Ash Repositories. In groundwater from bores in this area, increases are evident in the 50th percentile concentrations for EC, TDS, sulfate, chloride, boron, cadmium (minor change), iron (to a degree), manganese (minor change), and nickel relative to the south/cross gradient bores. These increased concentrations suggest a change in groundwater quality within groundwater bores monitoring the MPAR. Based on the location of these bores up gradient of the LNAR, and on the analytes that exceeded the 50th percentile levels, the concentrations of these analytes in groundwater are not considered to be related to the LNAR.

Adjacent to the LNAR at bores D1 and D19, 50th percentile concentrations for EC, TDS, sulfate, chloride, arsenic, boron, iron, mercury, manganese and nickel in groundwater and chromium, copper, molybdenum and lead (D19 only) exceeded the 90th percentile pre-placement levels. D1 is located to the north of the LNAR while D19 is located to the east of the LNAR. The concentrations of these analytes are not considered to be related primarily to the LNAR, based on the concentrations of these analytes in bores upgradient of the LNAR. The concentrations of chromium, copper, molybdenum and lead are greater than those reported in upgradient bores (D10 and D11); however, they are also not considered to be primarily related to the LNAR.

50th percentile results for the 2019/20 reporting period for EC, TDS, sulfate, chloride, arsenic, barium, boron, chromium, copper, iron, manganese, nickel and lead in groundwater from bore D9 (and some instances D8) exceeded the 90th percentile pre-placement levels. Elevated levels of EC, TDS and concentrations of sulfate, chloride, arsenic, boron, iron, manganese, nickel and lead in groundwater from these bores are considered to be associated with groundwater quality upgradient and cross gradient to the LNAR. As in other areas where groundwater concentrations exceeded the trigger levels and are not considered to be related to background concentrations, the concentrations of these analytes in groundwater are not considered to be related primarily to the LNAR and they are being evaluated as part of the independent investigation.

6.7.1 Trend Analysis

A review of concentration trends in groundwater with respect to key indicators including EC, TDS, sulfate, chloride, boron, iron, nickel and manganese is presented below. These indicators were selected based on their exceedances of Environmental Goals for groundwater, the potential increase in concentration observed downgradient of the LNAR and/or trend analysis presented in previous annual monitoring reports. Graphs are provided for select bores from the areas south/cross gradient of the ash repository (D15), adjacent to Mt Piper and up-gradient of LNAR (D11), and south of Wangcol Creek (D9). These graphs are presented in Appendix F.

6.7.1.1 Electrical Conductivity

EC levels in groundwater from D11, to the east and up gradient of the LNAR, have been increasing since at least September 2013 and were above the Groundwater Environmental Goal during the 2019/20 monitoring period.

To the south of the LNAR, EC in groundwater from D15 has varied over time and remains above the Environmental Goal. It is noted that in September 2017, EC values in groundwater from D15 reached a maximum, and have since marginally declined, remaining relatively consistent although above the Environmental Goal for groundwater.

An increasing trend in EC in groundwater from D9, to the north of LNAR, was noted from November 2017 and has continued in an upward trend during the start of this monitoring period. However a potential flattening of this trend is evident after January 2020.

During the monitoring period, EC concentrations in groundwater from D15, D11 and D9 were above the Environmental Goal for groundwater, above the pre-placement trigger value.

6.7.1.2 TDS

A generally increasing trend in TDS concentrations is noted in groundwater from bore D11 since September 2013, especially between 2013 and 2016. TDS concentrations have generally been more variable, not increasing, in groundwater from D11 since March 2016.

TDS concentrations in groundwater from D15 and D9 increased slightly until July 2018. Beyond July 2018 concentrations in groundwater from bore D15 have stabilised whereas those in groundwater from bore D9 have increased, reaching the highest reported concentration in February 2020.

A peak in TDS concentrations at bore D15 occurred in August 2019. This peak appears anomalous though is comparable with peaks identified for boron, chloride, sulfate and manganese from the same monitoring event. Since August 2019, the overall trend for TDS at D15 appears generally stable and consistent with the historical dataset.

During the monitoring period, TDS concentrations in groundwater from D15, D11 and D9 were above the Environmental Goal for groundwater, above the pre-placement trigger value.

6.7.1.3 Sulfate

In November 2013, an increase in sulfate concentrations was noted in groundwater from D11, with this trend continuing until June 2017. Since then concentrations have fluctuated but have remained near that concentration; however, they continue to exceed the Environmental Goal for groundwater.

Consistent with the EC and TDS trends, increasing sulate concentration trends were identified at bore D9 since approximately July 2018. This trend has continued through the current monitoring period.

An increasing sulfate trend was apparent at bore D15 through 2017; however concentrations have stabilised since that time. A peak in sulfate concentrations at bore D15 occurred in August 2019. This peak appears anomalous although it is comparable with peaks identified for boron, chloride, TDS and manganese from the same monitoring event. Since August 2019, the overall trend for sulfate at D15 has returned to be generally stable and consistent with the historical dataset.

During the monitoring period, sulfate concentrations in groundwater from bores D11, D15 and D9 were above the Environmental Goal for groundwater, and above the pre-placement trigger value.

6.7.1.4 Chloride

A generally increasing trend in chloride concentrations, particularly from the end of October 2013, when they increased above the Environmental Goal for groundwater, is noted in groundwater from D11 upgradient of the LNAR. Concentrations of chloride in groundwater from this bore appear to have stabilised since 2018 and have declined since November 2019.

To the south of the LNAR, chloride concentrations in groundwater from bore D15 increased in 2017, but have subsequently declined. A peak in chloride concentrations at bore D15 occurred in August 2019; however, this peak appears anomalous and is comparable with peaks identified for boron, sulfate, TDS and manganese from the same monitoring event. Since August 2019, the overall trend for chloride at D15 has returned to being generally stable and consistent with the historical dataset. With the exception of the August 2019 value, chloride concentrations in groundwater from D15 have remained below the Environmental Goal for groundwater.

In groundwater from bore D9, chloride concentrations were generally stable from November 2013 to May 2018. However, since then, chloride concentrations have generally increased in groundwater from bore D9, reaching a maximum in June 2020. The concentrations of chloride in groundwater at D9 have been above the Environmental Goal for groundwater since December 2018.

Chloride concentrations are above the Environmental Goal for groundwater at D9 and D11, and generally below the Environmental Goal for groundwater at D15. Each of these locations have concentrations of chloride above the pre-placement trigger value.

6.7.1.5 Boron

A trend of increasing boron concentrations was noted in D11 in November 2013 to December 2015. Since then boron concentrations have fluctuated within a generally stable range and have remained above the Environmental Goal for groundwater.

Boron concentrations are generally lower in groundwater from D9 than in D11; however, they have increased since December 2016. Concentrations of boron in groundwater from D11 remain above the Environmental Goal for groundwater.

To the south of the LNAR, boron concentrations in groundwater from bore D15 have been variable over time, within concentrations at times being reported above the pre-placement trigger value and, less frequently, above the Environmental Goal for groundwater. Concentrations of boron at D15 have generally declined since the end of 2017, however a peak in boron concentrations occurred in August 2019. This peak appears anomalous although is comparable with peaks identified for chloride, sulfate, TDS and manganese from the same monitoring event. Concentrations of boron in groundwater from bore D15 (with the exception of August 2019) have been below the Environmental Goal for groundwater since November 2017.

6.7.1.6 Iron

An increasing trend in iron concentrations in groundwater from bore D11 was noted from November 2013 to mid-2015. Since then, concentrations have been highly variable, although they are no longer increasing.

Concentrations of iron in groundwater from bores D9 and D15 have been variable although they increased from 2013 to approximately 2015/16. Concentrations in groundwater from bore D15 increased from August 2017 to December 2018 and have since remained stable or declined slightly. Iron concentration in groundwater from bore D9 have increased relatively consistently since August 2017.

During the monitoring period, iron concentrations in groundwater from bores D11, D15 and D9 were above the Environmental Goal for groundwater, and above the pre-placement trigger value.

6.7.1.7 Manganese

Manganese concentrations in groundwater from bores D11 and D9 have been generally increasing from at least 2010 to the end of the current monitoring period. The rate of increase in manganese concentrations at D11 has stabilised from approximately January 2015, however manganese concentrations in groundwater from D9 continue to increase. Manganese concentrations in groundwater from both D9 and D11 exceed the Environmental Goal for groundwater.

Manganese concentrations in groundwater from D15 have remained generally stable and below the Environmental Goal groundwater. An apparently anomalous manganese concentration was reported in bore D15 during August 2019, and this reported peak is comparable with those identified for boron, chloride, TDS and sulfate.

6.7.1.8 Nickel

To the south of the LNAR, nickel concentrations in groundwater from bore D15 have fluctuated above and, at times below, the Environmental Goal for groundwater since monitoring commenced in 2012. However, since October 2017 nickel concentrations have consistently remained above the Environmental Goal for groundwater, although they are generally stable and within the historical range for D15.

Nickel concentrations in groundwater from D9 increased from at least 2010 to the beginning of 2014. Nickel concentrations at bore D9 were generally stable from 2014 to mid-2017, after which concentrations have generally increased.

Nickel concentrations in groundwater from D11 increased from late 2012 to the end of 2017. Concentrations of nickel have stabilised since the beginning of 2018 and have, overall, declined since September 2019.

During the monitoring period, iron concentrations in groundwater from bores D11, D15 and D9 were above the Environmental Goal for groundwater, and above the pre-placement trigger value.

7. CONCLUSION

Based on the review of the surface water and groundwater quality data at the LNAR for the 2019/20 reporting period, the following conclusions are drawn:

- Exceedances of the adopted Environmental Goals (as set out in the OEMP) were recorded during the reporting period with respect to surface water and groundwater;
- In surface water samples collected at locations described in the OEMP, sporadic exceedances of the Environmental Goals for surface water were identified at LMP01 and NC01 which are located upstream of the Ash Repositories. Based on the position of the LNAR relative to these surface water monitoring locations and the surface water and groundwater flow paths, it is unlikely that activities at the LNAR have contributed to exceedances at these locations.

  Surface water monitoring location WX22 consistently reported concentrations of select target analytes at concentrations above the Environmental Goals for surface water. Although there is the potential that activities at the LNAR may have contributed to the exceedances in surface water at WX22, the reported water quality results are unlikely to be predominately related to the LNAR;
- Concentrations of several compounds in groundwater from multiple bores, including bore D9 located towards Wangcol Creek, exceeded Environmental Goals for groundwater. Although there is the potential that activities at the LNAR may have contributed to these exceedances in groundwater, these concentrations are unlikely to be predominately related to the LNAR; and
- It is noted that the reported groundwater levels have generally remained below the maximum predicted groundwater level (912.0 m AHD) from CDM Smith (2013) and below the base of the ash placement (917 m AHD) at the LNAR.

While the exceedances of the Environmental Goals noted in this report are considered to be predominately unrelated to the Lamberts North Ash Repository, a separate and broader investigation into surface and groundwater impacts in the vicinity of the Ash Repositories is well progressed. As part of this investigation, management measures, including the Mt Piper Groundwater Interception Project, are currently being identified and assessed for implementation.

The OEMP and the associated monitoring and reporting requirements will be revised following completion of the independent investigation to reflect the key findings and further contingency measures if recommended. Please refer to Appendix I for a summary of the Project Approval and OEMP requirements pertaining to water quality monitoring and reporting, and how each item is addressed in this report.

8. REFERENCES

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9. STATEMENT OF LIMITATIONS

1. This report is based solely on the scope of work described in our proposal P0533074 dated 20/3/20 and confirmed via email on 24/4/20 (Scope of Work) and performed by Environmental Resources Management Australia Pty Ltd (ERM) for EnergyAustralia NSW Pty Ltd (the Client). The Scope of Work was governed by a contract between ERM and the Client (Contract).
2. No limitation, qualification or caveat set out below is intended to derogate from the rights and obligations of ERM and the Client under the Contract.
3. The findings of this report are solely based on, and the information provided in this report is strictly limited to that required by, the Scope of Work. Except to the extent stated otherwise, in preparing this report ERM has not considered any question, nor provides any information, beyond that required by the Scope of Work.
4. This report was prepared between 3 August 2020 and 9 November 2020 is based on conditions encountered and information reviewed at the time of preparation. The report does not, and cannot, take into account changes in law, factual circumstances, applicable regulatory instruments or any other future matter. ERM does not, and will not, provide any on-going advice on the impact of any future matters unless it has agreed with the Client to amend the Scope of Work or has entered into a new engagement to provide a further report.
5. Unless this report expressly states to the contrary, ERM's Scope of Work was limited strictly to identifying typical environmental conditions associated with the subject site(s) and does not evaluate the condition of any structure on the subject site nor any other issues. Although normal standards of professional practice have been applied, the absence of any identified hazardous or toxic materials or any identified impacted soil or groundwater on the site(s) should not be interpreted as a guarantee that such materials or impacts do not exist.
6. This report is based on one or more site inspections conducted by ERM personnel, the sampling and analyses described in the report, and information provided by the Client or third parties (including regulatory agencies). All conclusions and recommendations made in the report are the professional opinions of the ERM personnel involved. Whilst normal checking of data accuracy was undertaken, except to the extent expressly set out in this report ERM:
    a. did not, nor was able to, make further enquiries to assess the reliability of the information or independently verify information provided by;
    b. assumes no responsibility or liability for errors in data obtained from,
    c. the Client, any third parties or external sources (including regulatory agencies).
7. Although the data that has been used in compiling this report is generally based on actual circumstances, if the report refers to hypothetical examples those examples may, or may not, represent actual existing circumstances.
8. Only the environmental conditions and or potential contaminants specifically referred to in this report have been considered. To the extent permitted by law and except as is specifically stated in this report, ERM makes no warranty or representation about:
    a. the suitability of the site(s) for any purpose or the permissibility of any use;
    b. the presence, absence or otherwise of any environmental conditions or contaminants at the site(s) or elsewhere; or
    c. the presence, absence or otherwise of asbestos, asbestos containing materials or any hazardous materials on the site(s).

9. Use of the site for any purpose may require planning and other approvals and, in some cases, environmental regulator and accredited site auditor approvals. ERM offers no opinion as to the likelihood of obtaining any such approvals, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environment works.

10. The ongoing use of the site or use of the site for a different purpose may require the management of or remediation of site conditions, such as contamination and other conditions, including but not limited to conditions referred to in this report.

11. This report should be read in full and no excerpts are to be taken as representative of the whole report. To ensure its contextual integrity, the report is not to be copied, distributed or referred to in part only. No responsibility or liability is accepted by ERM for use of any part of this report in any other context.

12. Except to the extent that ERM has agreed otherwise with the Client in the Scope of Work or the Contract, this report:

    a. has been prepared and is intended only for the exclusive use of the Client;

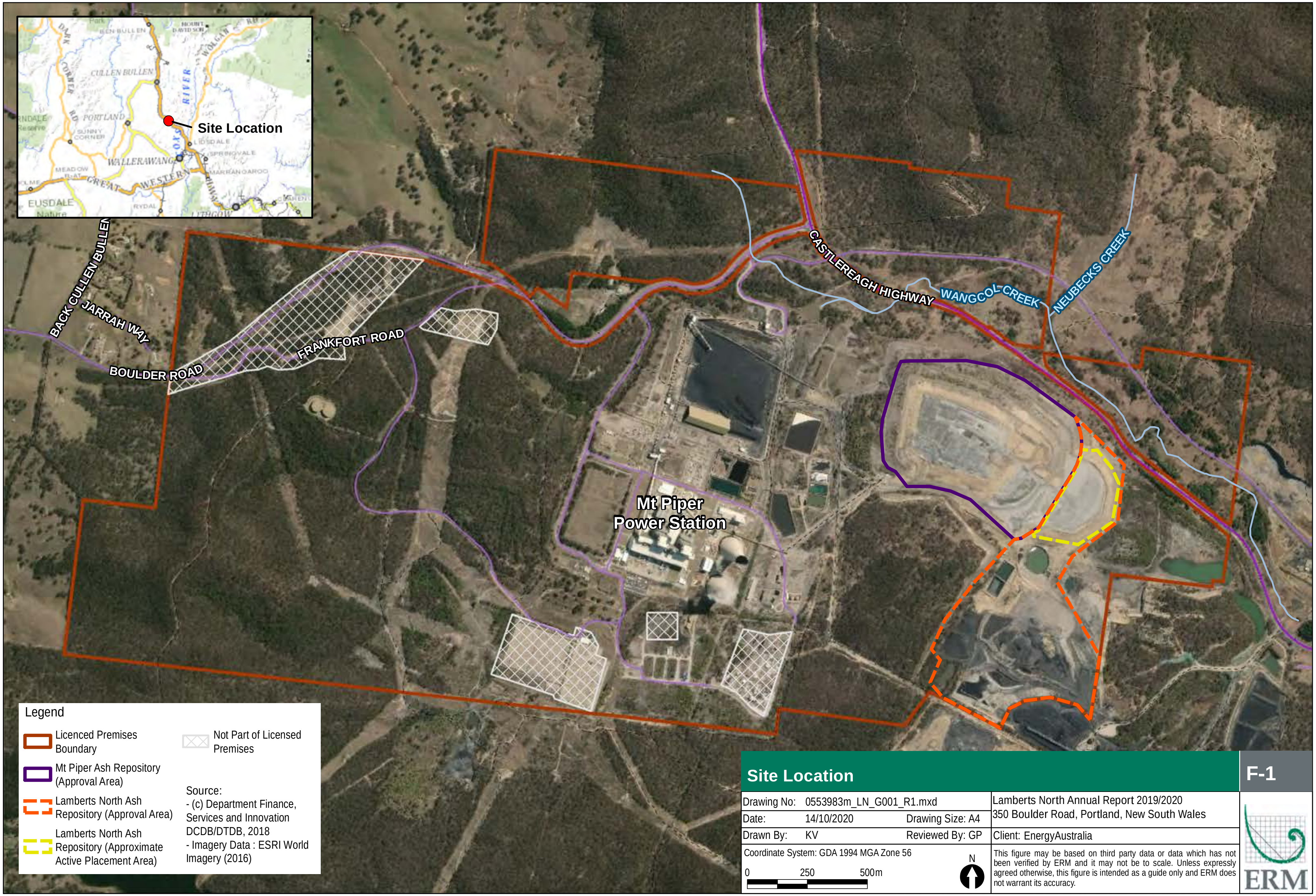
    b. must not to be relied upon or used by any other party;

    c. has not been prepared nor is intended for the purpose of advertising, sales, promoting or endorsing any Client interests including raising investment capital, recommending investment decisions, or other publicity purposes;

    d. does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise in or in relation to the site(s); and

    e. does not purport to provide, nor should be construed as, legal advice.

APPENDIX A FIGURES



Site Location

F-1

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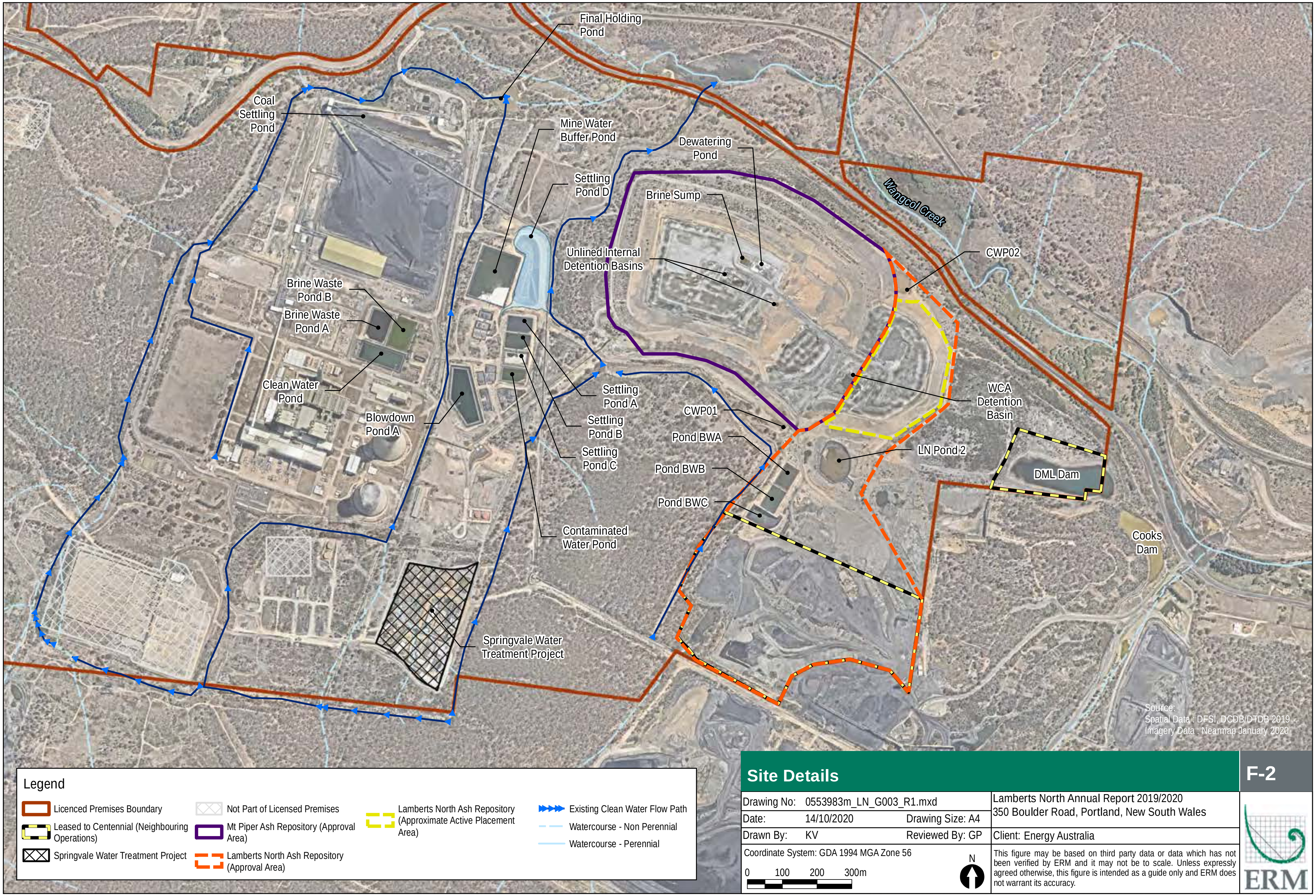
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM


Final Holding Pond
Coal Settling Pond
Mine Water Buffer Pond
Dewatering Pond
Settling Pond D
Brine Sump
Wangcol Creek
Unlined Internal Detention Basins
CWP02
Brine Waste Pond B
Brine Waste Pond A
Clean Water Pond
Blowdown Pond A
Settling Pond A
Settling Pond B
Settling Pond C
CWP01
WCA Detention Basin
Pond BWA
LN Pond 2
Pond BWB
DML Dam
Pond BWC
Contaminated Water Pond
Cooks Dam
Springvale Water Treatment Project
Source:
Spatial Data : DFSI, DCDB/DTDB 2019
Imagery Data : Nearmap January 2020
Legend
Licenced Premises Boundary
Leased to Centennial (Neighbouring Operations)
Springvale Water Treatment Project
Not Part of Licensed Premises
Mt Piper Ash Repository (Approval Area)
Lamberts North Ash Repository (Approval Area)
Lamberts North Ash Repository (Approximate Active Placement Area)
Existing Clean Water Flow Path
Watercourse - Non Perennial
Watercourse - Perennial
Site Details
F-2
Drawing No: 0553983m_LN_G003_R1.mxd
Date: 14/10/2020
Drawing Size: A4
Drawn By: KV
Reviewed By: GP
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Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales
Client: Energy Australia
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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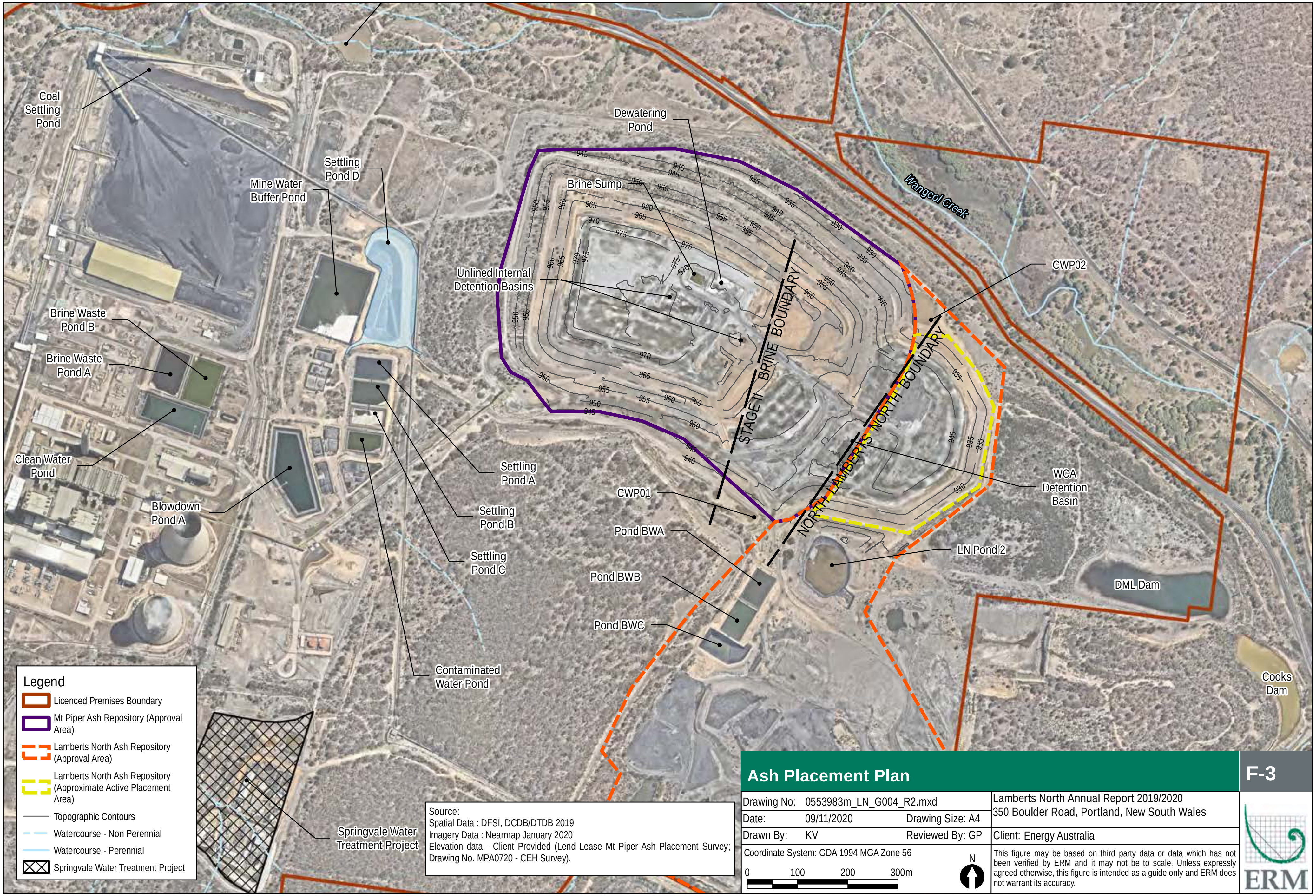
Coal Settling Pond
Settling Pond D
Mine Water Buffer Pond
Dewatering Pond
Brine Sump
Wangcol Creek
Unlined Internal Detention Basins
CWP02
Brine Waste Pond B
Brine Waste Pond A
STAGE II BRINE BOUNDARY
LAMBERTS NORTH BOUNDARY
Clean Water Pond
Settling Pond A
WCA Detention Basin
Blowdown Pond A
Settling Pond B
CWP01
Pond BWA
LN Pond 2
Settling Pond C
Pond BWB
DML Dam
Pond BWC
Contaminated Water Pond
Cooks Dam
Springvale Water Treatment Project
Legend
Licenced Premises Boundary
Mt Piper Ash Repository (Approval Area)
Lamberts North Ash Repository (Approval Area)
Lamberts North Ash Repository (Approximate Active Placement Area)
Topographic Contours
Watercourse - Non Perennial
Watercourse - Perennial
Springvale Water Treatment Project
Source:
Spatial Data : DFSI, DCDB/DTDB 2019
Imagery Data : Nearmap January 2020
Elevation data - Client Provided (Lend Lease Mt Piper Ash Placement Survey; Drawing No. MPA0720 - CEH Survey).
Ash Placement Plan
F-3
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Date: 09/11/2020
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Reviewed By: GP
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Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales
Client: Energy Australia
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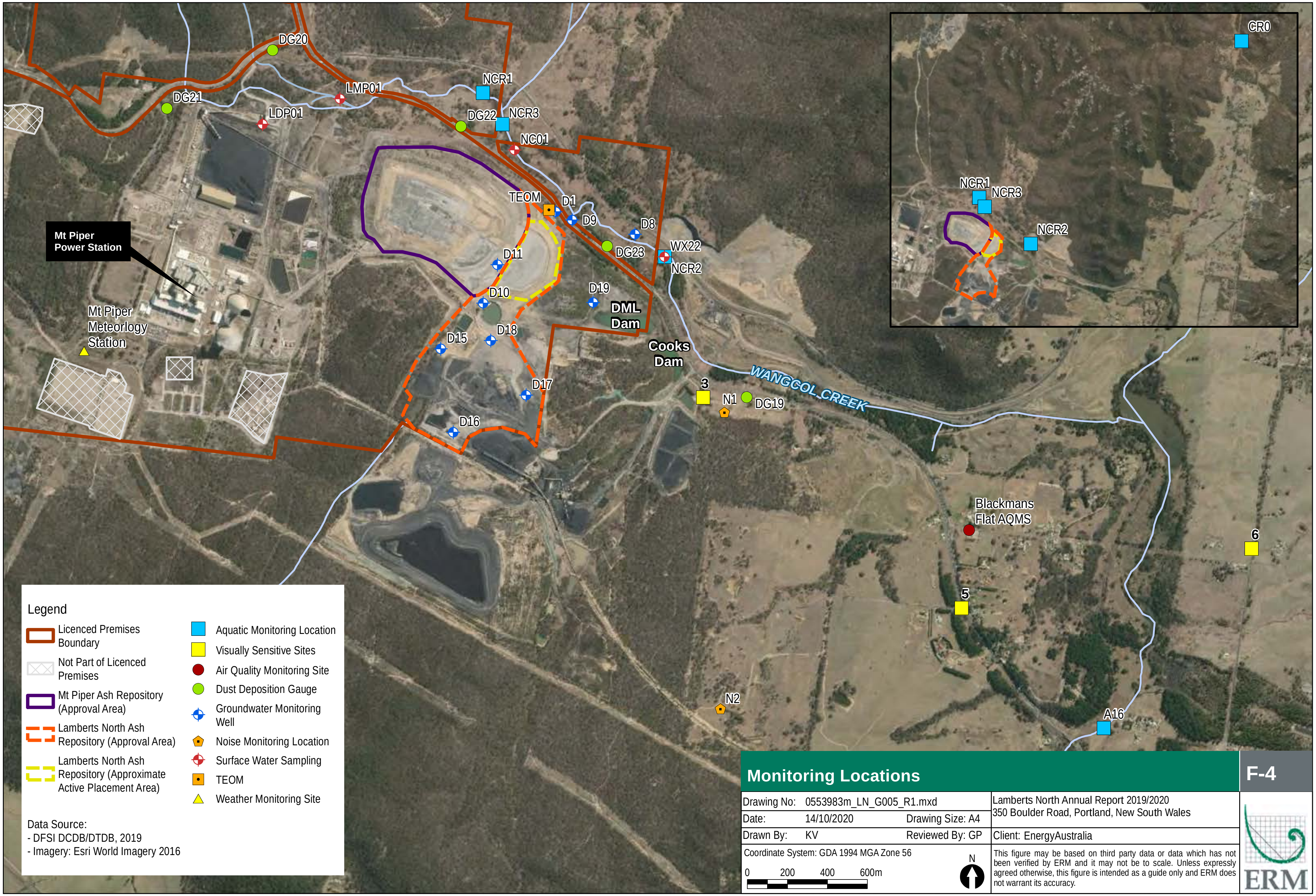
DG20
DG21
LMP01
LDP01
NCR1
DG22
NCR3
NC01
Mt Piper
Power Station
TEOM
D1
D9
D8
DG23
WX22
NCR2
D11
D10
D19
DML
Dam
Mt Piper
Meteorlogy
Station
D15
D18
Cooks
Dam
D17
3
N1
DG19
WANGCOL CREEK
D16
Blackmans
Flat AQMS
6
5
N2
A16
CR0
NCR1
NCR3
NCR2
Legend
Licenced Premises
Boundary
Not Part of Licenced
Premises
Mt Piper Ash Repository
(Approval Area)
Lamberts North Ash
Repository (Approval Area)
Lamberts North Ash
Repository (Approximate
Active Placement Area)
Aquatic Monitoring Location
Visually Sensitive Sites
Air Quality Monitoring Site
Dust Deposition Gauge
Groundwater Monitoring
Well
Noise Monitoring Location
Surface Water Sampling
TEOM
Weather Monitoring Site
Data Source:
- DFSI DCDB/DTDB, 2019
- Imagery: Esri World Imagery 2016
Monitoring Locations
F-4
Drawing No: 0553983m_LN_G005_R1.mxd
Date: 14/10/2020
Drawing Size: A4
Drawn By: KV
Reviewed By: GP
Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales
Client: EnergyAustralia
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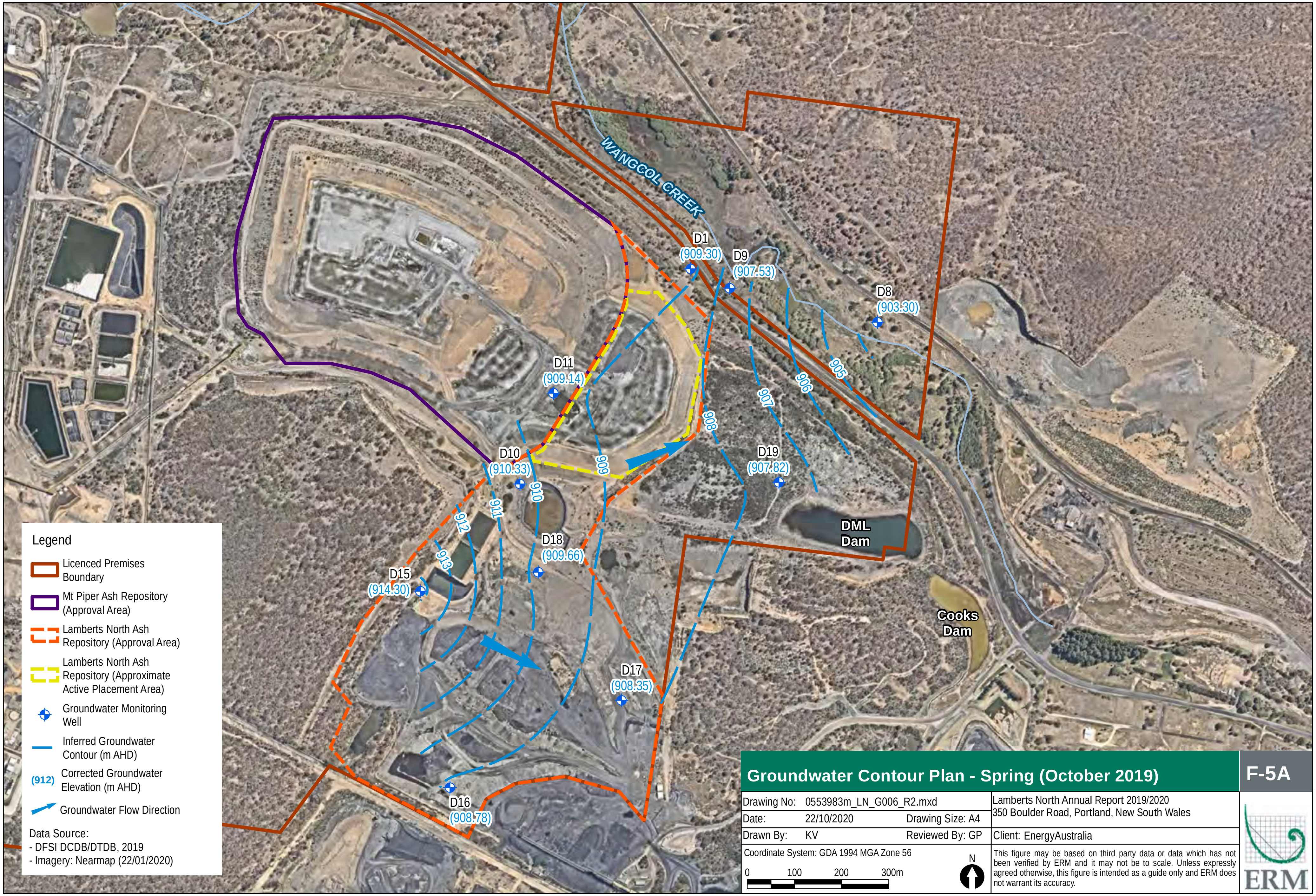

Groundwater Contour Plan - Spring (October 2019)

F-5A

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Date: 22/10/2020 Drawing Size: A4
Drawn By: KV Reviewed By: GP

Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales

Client: EnergyAustralia

Coordinate System: GDA 1994 MGA Zone 56

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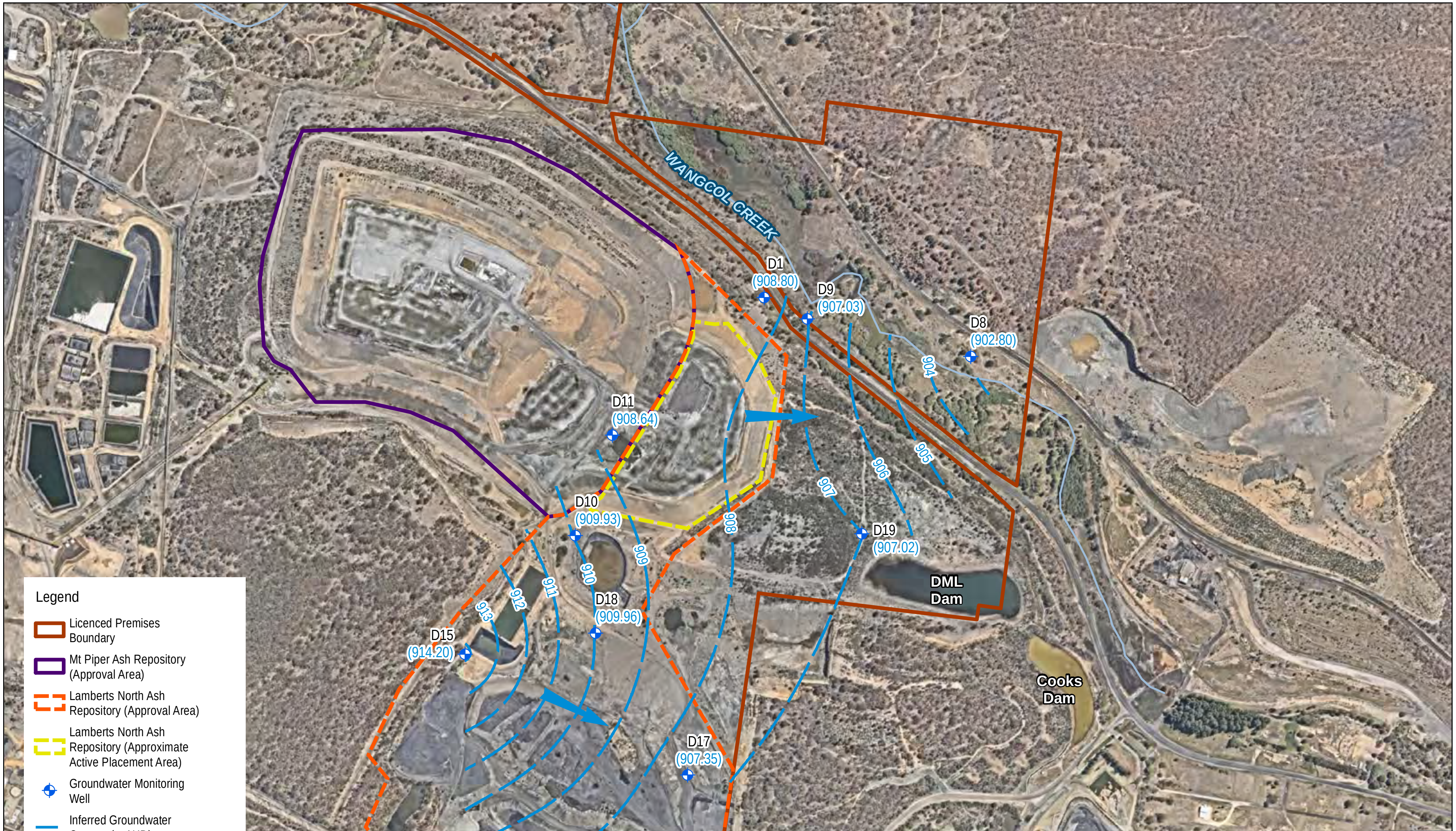


Groundwater Contour Plan - Summer (January 2020)

F-5B

Drawing No: 0553983m_LN_G007_R2.mxd

Date: 22/10/2020 Drawing Size: A4

Drawn By: KV Reviewed By: GP

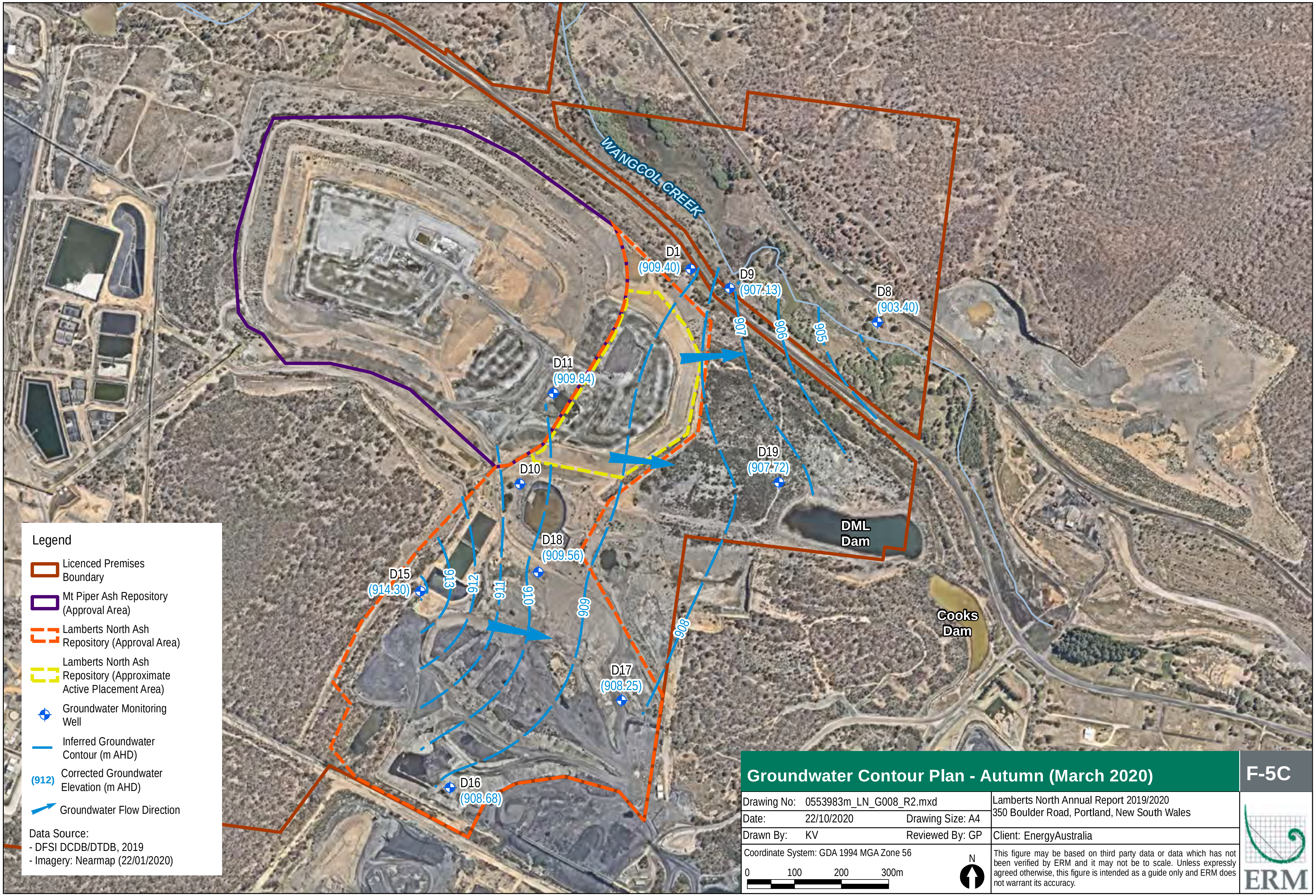
Coordinate System: GDA 1994 MGA Zone 56

Lamberts North Annual Report 2019/2020

350 Boulder Road, Portland, New South Wales

Client: EnergyAustralia

ERM


WANGCOL CREEK
D1
(909.40)
D9
(907.13)
D8
(903.40)
D11
(909.84)
D19
(907.72)
D10
DML
Dam
D18
(909.56)
D15
(914.30)
Cooks
Dam
D17
(908.25)
D16
(908.68)
907
906
905
913
912
911
910
909
908
Legend
Licenced Premises Boundary
Mt Piper Ash Repository (Approval Area)
Lamberts North Ash Repository (Approval Area)
Lamberts North Ash Repository (Approximate Active Placement Area)
Groundwater Monitoring Well
Inferred Groundwater Contour (m AHD)
(912) Corrected Groundwater Elevation (m AHD)
Groundwater Flow Direction
Data Source:
- DFSI DCDB/DTDB, 2019
- Imagery: Nearmap (22/01/2020)
Groundwater Contour Plan - Autumn (March 2020)
F-5C
Drawing No: 0553983m_LN_G008_R2.mxd
Date: 22/10/2020
Drawing Size: A4
Drawn By: KV
Reviewed By: GP
Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales
Client: EnergyAustralia
Coordinate System: GDA 1994 MGA Zone 56
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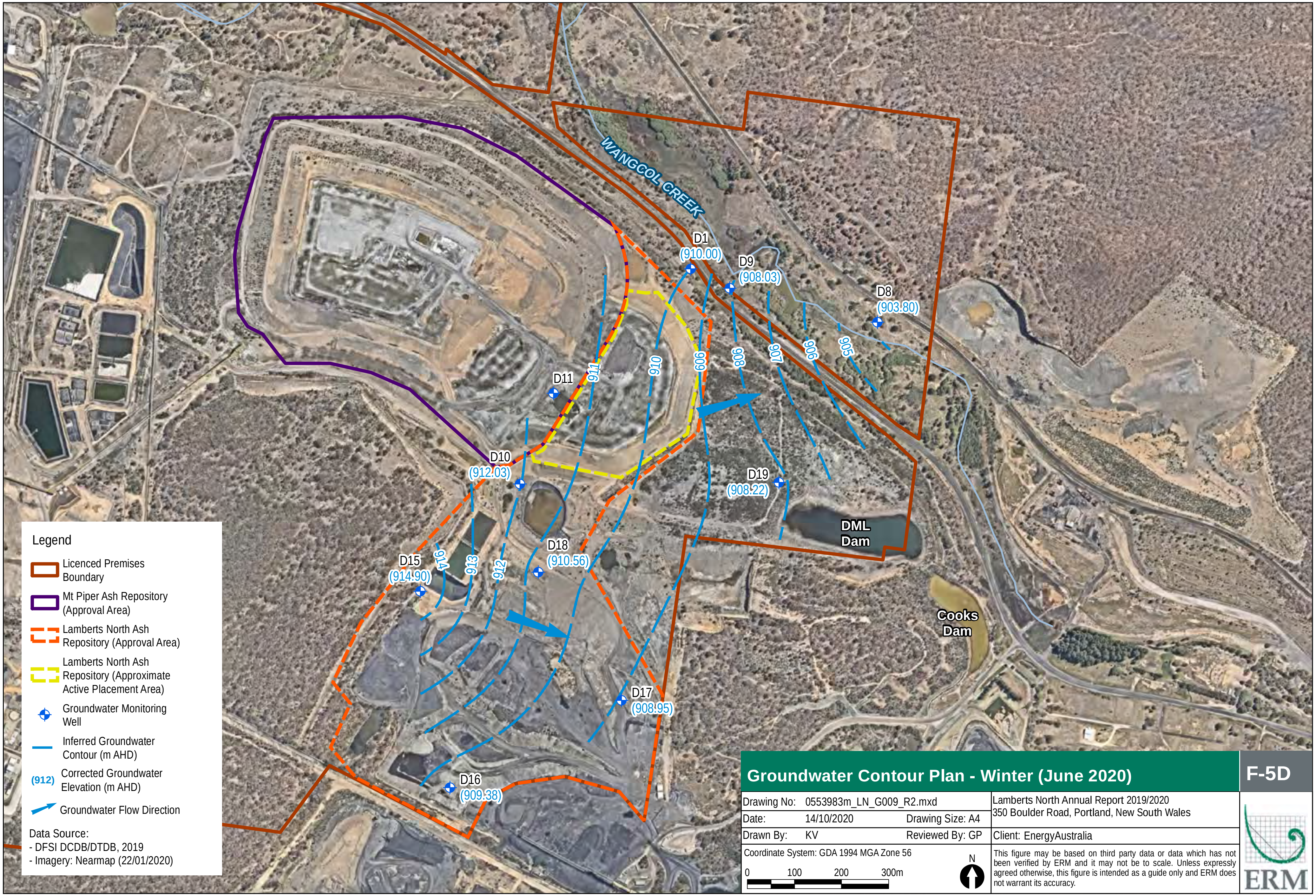
ERM


WANGCOL CREEK
D1
(910.00)
D9
(908.03)
D8
(903.80)
D11
D10
(912.03)
D19
(908.22)
D18
(910.56)
D15
(914.90)
D17
(908.95)
D16
(909.38)
914
913
912
911
910
909
908
907
906
905
DML Dam
Cooks Dam
Legend
Licenced Premises Boundary
Mt Piper Ash Repository (Approval Area)
Lamberts North Ash Repository (Approval Area)
Lamberts North Ash Repository (Approximate Active Placement Area)
Groundwater Monitoring Well
Inferred Groundwater Contour (m AHD)
(912) Corrected Groundwater Elevation (m AHD)
Groundwater Flow Direction
Data Source:
- DFSI DCDB/DTDB, 2019
- Imagery: Nearmap (22/01/2020)
Groundwater Contour Plan - Winter (June 2020)
F-5D
Drawing No: 0553983m_LN_G009_R2.mxd
Date: 14/10/2020
Drawing Size: A4
Drawn By: KV
Reviewed By: GP
Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales
Client: EnergyAustralia
Coordinate System: GDA 1994 MGA Zone 56
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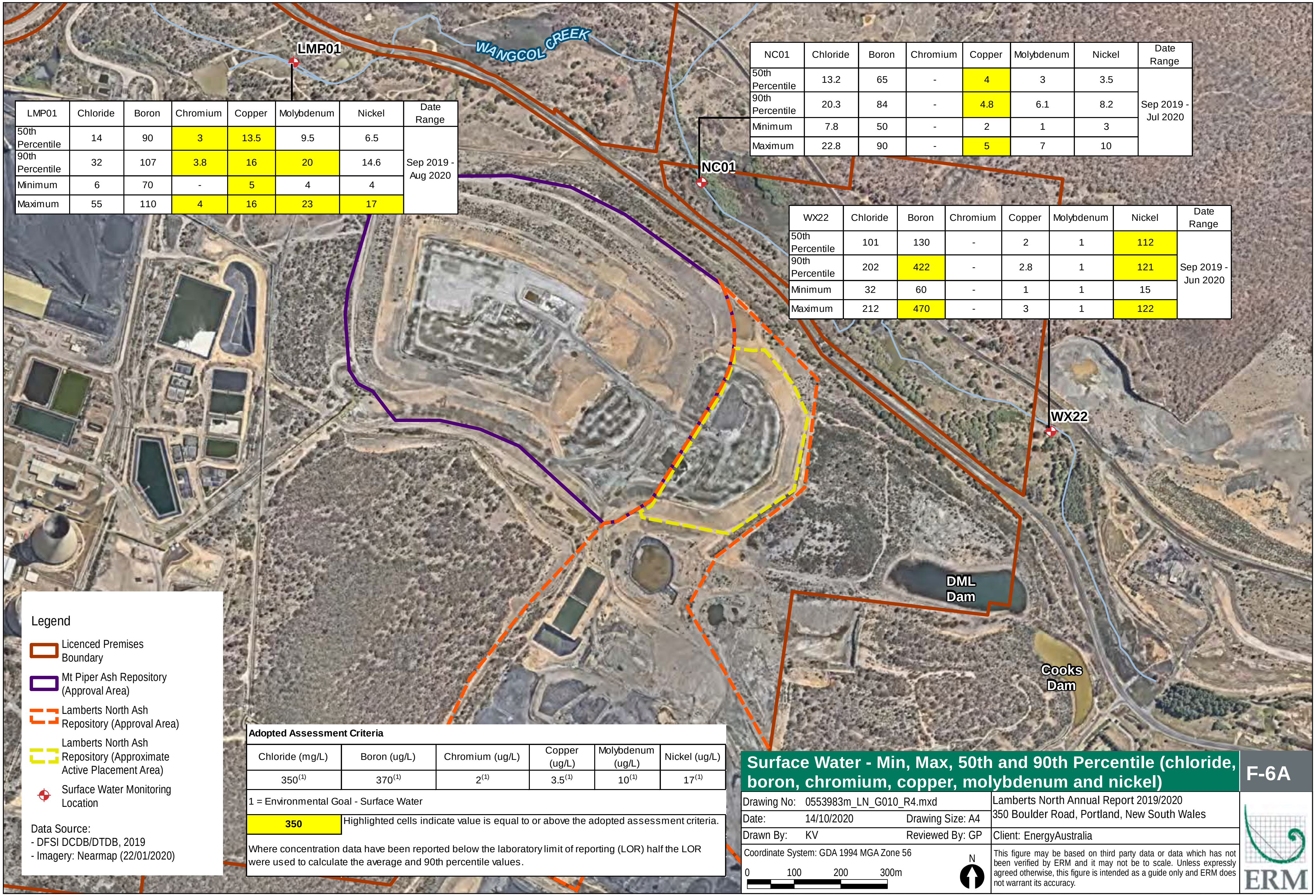
ERM



LMP01	Chloride	Boron	Chromium	Copper	Molybdenum	Nickel	Date Range
50th Percentile	14	90	3	13.5	9.5	6.5	Sep 2019 - Aug 2020
90th Percentile	32	107	3.8	16	20	14.6	
Minimum	6	70	-	5	4	4	
Maximum	55	110	4	16	23	17	

NC01	Chloride	Boron	Chromium	Copper	Molybdenum	Nickel	Date Range
50th Percentile	13.2	65	-	4	3	3.5	Sep 2019 - Jul 2020
90th Percentile	20.3	84	-	4.8	6.1	8.2	
Minimum	7.8	50	-	2	1	3	
Maximum	22.8	90	-	5	7	10	

WX22	Chloride	Boron	Chromium	Copper	Molybdenum	Nickel	Date Range
50th Percentile	101	130	-	2	1	112	Sep 2019 - Jun 2020
90th Percentile	202	422	-	2.8	1	121	
Minimum	32	60	-	1	1	15	
Maximum	212	470	-	3	1	122	

Legend

- Licenced Premises Boundary
- Mt Piper Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approximate Active Placement Area)
- Surface Water Monitoring Location

Data Source:
- DFSI DCDB/DTDB, 2019
- Imagery: Nearmap (22/01/2020)

Adopted Assessment Criteria

Chloride (mg/L)	Boron (ug/L)	Chromium (ug/L)	Copper (ug/L)	Molybdenum (ug/L)	Nickel (ug/L)
350 (1)	370 (1)	2 (1)	3.5 (1)	10 (1)	17 (1)

1 = Environmental Goal - Surface Water

350 Highlighted cells indicate value is equal to or above the adopted assessment criteria.

Where concentration data have been reported below the laboratory limit of reporting (LOR) half the LOR were used to calculate the average and 90th percentile values.

Surface Water - Min, Max, 50th and 90th Percentile (chloride, boron, chromium, copper, molybdenum and nickel)

F-6A

Drawing No: 0553983m_LN_G010_R4.mxd
Date: 14/10/2020 Drawing Size: A4
Drawn By: KV Reviewed By: GP
Coordinate System: GDA 1994 MGA Zone 56
0 100 200 300m
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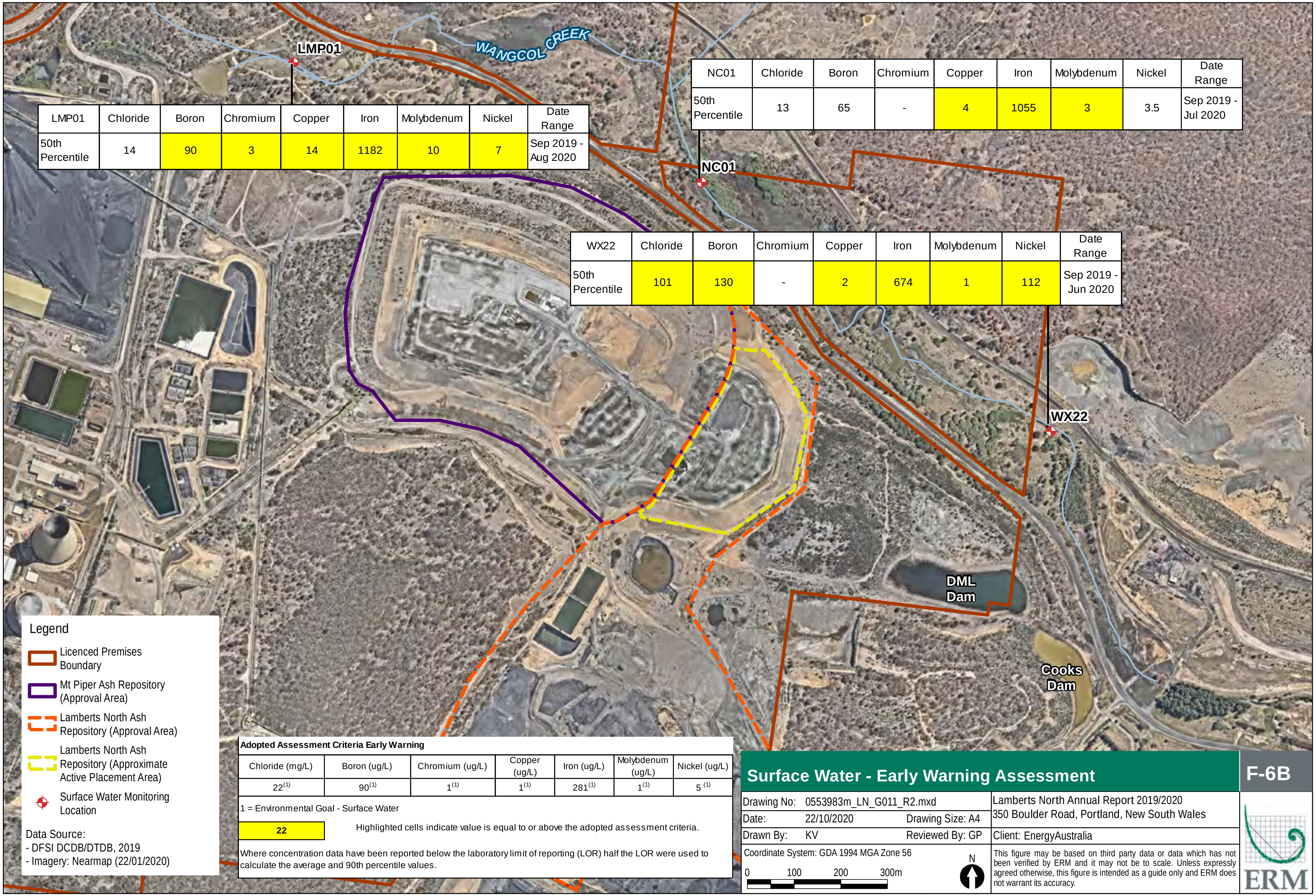
Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales
Client: EnergyAustralia

ERM



LMP01	Chloride	Boron	Chromium	Copper	Iron	Molybdenum	Nickel	Date Range
50th Percentile	14	90	3	14	1182	10	7	Sep 2019 - Aug 2020

NC01	Chloride	Boron	Chromium	Copper	Iron	Molybdenum	Nickel	Date Range
50th Percentile	13	65	-	4	1055	3	3.5	Sep 2019 - Jul 2020

WX22	Chloride	Boron	Chromium	Copper	Iron	Molybdenum	Nickel	Date Range
50th Percentile	101	130	-	2	674	1	112	Sep 2019 - Jun 2020

Legend

- Licenced Premises Boundary
- Mt Piper Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approximate Active Placement Area)
- Surface Water Monitoring Location

Data Source:
- DFSI DCDB/DTDB, 2019
- Imagery: Nearmap (22/01/2020)

Adopted Assessment Criteria Early Warning

Chloride (mg/L)	Boron (ug/L)	Chromium (ug/L)	Copper (ug/L)	Iron (ug/L)	Molybdenum (ug/L)	Nickel (ug/L)
22 (1)	90 (1)	1 (1)	1 (1)	281 (1)	1 (1)	5 (1)

1 = Environmental Goal - Surface Water

22 — Highlighted cells indicate value is equal to or above the adopted assessment criteria.

Where concentration data have been reported below the laboratory limit of reporting (LOR) half the LOR were used to calculate the average and 90th percentile values.

Surface Water - Early Warning Assessment

F-6B

Drawing No: 0553983m_LN_G011_R2.mxd	Lamberts North Annual Report 2019/2020
Date: 22/10/2020 Drawing Size: A4	350 Boulder Road, Portland, New South Wales
Drawn By: KV Reviewed By: GP	Client: EnergyAustralia
Coordinate System: GDA 1994 MGA Zone 56	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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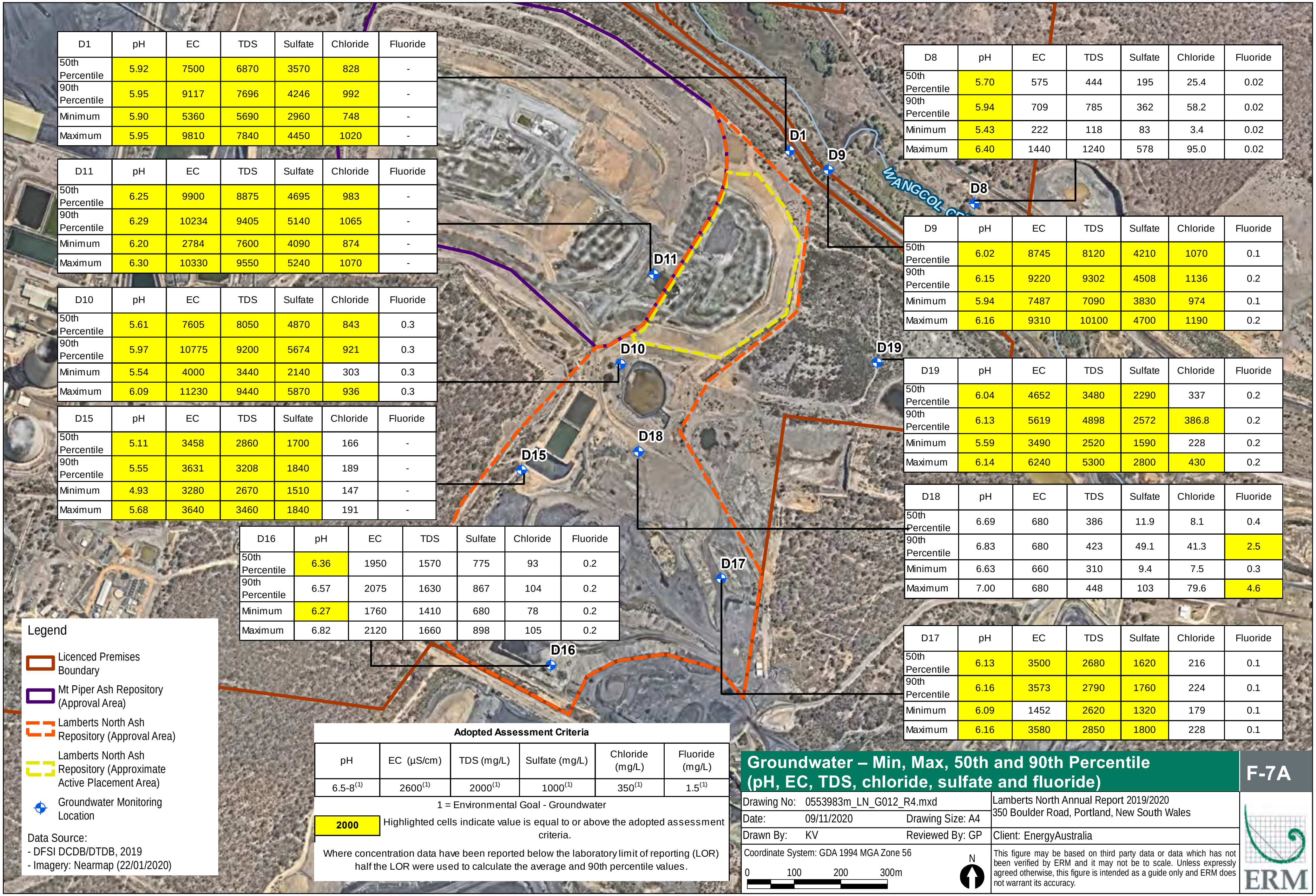
ERM



D1	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	5.92	7500	6870	3570	828	-
90th Percentile	5.95	9117	7696	4246	992	-
Minimum	5.90	5360	5690	2960	748	-
Maximum	5.95	9810	7840	4450	1020	-

D11	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	6.25	9900	8875	4695	983	-
90th Percentile	6.29	10234	9405	5140	1065	-
Minimum	6.20	2784	7600	4090	874	-
Maximum	6.30	10330	9550	5240	1070	-

D10	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	5.61	7605	8050	4870	843	0.3
90th Percentile	5.97	10775	9200	5674	921	0.3
Minimum	5.54	4000	3440	2140	303	0.3
Maximum	6.09	11230	9440	5870	936	0.3

D15	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	5.11	3458	2860	1700	166	-
90th Percentile	5.55	3631	3208	1840	189	-
Minimum	4.93	3280	2670	1510	147	-
Maximum	5.68	3640	3460	1840	191	-

D16	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	6.36	1950	1570	775	93	0.2
90th Percentile	6.57	2075	1630	867	104	0.2
Minimum	6.27	1760	1410	680	78	0.2
Maximum	6.82	2120	1660	898	105	0.2

D8	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	5.70	575	444	195	25.4	0.02
90th Percentile	5.94	709	785	362	58.2	0.02
Minimum	5.43	222	118	83	3.4	0.02
Maximum	6.40	1440	1240	578	95.0	0.02

D9	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	6.02	8745	8120	4210	1070	0.1
90th Percentile	6.15	9220	9302	4508	1136	0.2
Minimum	5.94	7487	7090	3830	974	0.1
Maximum	6.16	9310	10100	4700	1190	0.2

D19	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	6.04	4652	3480	2290	337	0.2
90th Percentile	6.13	5619	4898	2572	386.8	0.2
Minimum	5.59	3490	2520	1590	228	0.2
Maximum	6.14	6240	5300	2800	430	0.2

D18	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	6.69	680	386	11.9	8.1	0.4
90th Percentile	6.83	680	423	49.1	41.3	2.5
Minimum	6.63	660	310	9.4	7.5	0.3
Maximum	7.00	680	448	103	79.6	4.6

D17	pH	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	6.13	3500	2680	1620	216	0.1
90th Percentile	6.16	3573	2790	1760	224	0.1
Minimum	6.09	1452	2620	1320	179	0.1
Maximum	6.16	3580	2850	1800	228	0.1

Adopted Assessment Criteria

pH	EC (µS/cm)	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)
6.5-8[1]	2600[1]	2000[1]	1000[1]	350[1]	1.5[1]

1 = Environmental Goal - Groundwater

2000 Highlighted cells indicate value is equal to or above the adopted assessment criteria.

Where concentration data have been reported below the laboratory limit of reporting (LOR) half the LOR were used to calculate the average and 90th percentile values.

Groundwater – Min, Max, 50th and 90th Percentile (pH, EC, TDS, chloride, sulfate and fluoride)

F-7A

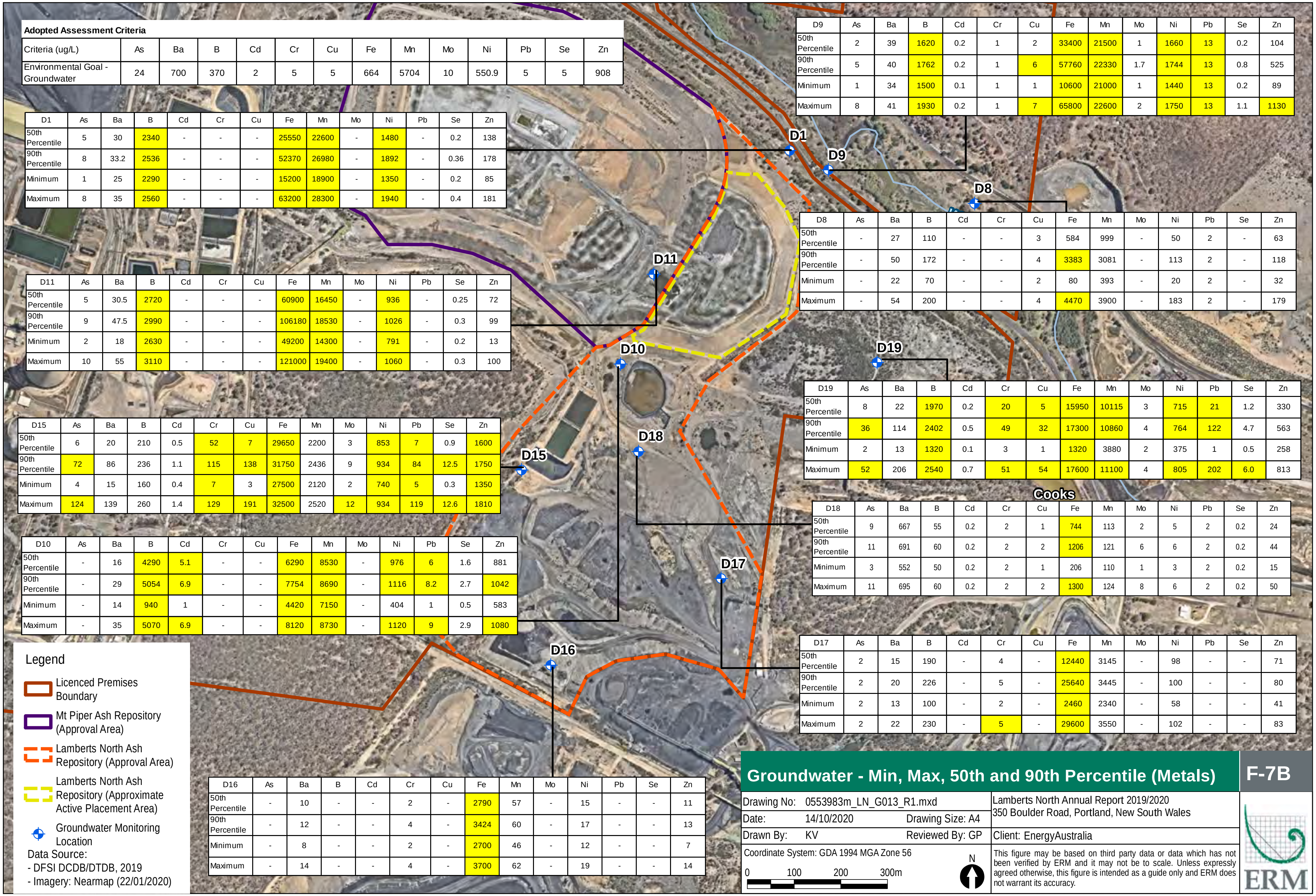
Drawing No: 0553983m_LN_G012_R4.mxd
Date: 09/11/2020 Drawing Size: A4
Drawn By: KV Reviewed By: GP

Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales

Client: EnergyAustralia

Coordinate System: GDA 1994 MGA Zone 56

ERM



Adopted Assessment Criteria

Criteria (ug/L)	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
Environmental Goal - Groundwater	24	700	370	2	5	5	664	5704	10	550.9	5	5	908

D1	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	5	30	2340	-	-	-	25550	22600	-	1480	-	0.2	138
90th Percentile	8	33.2	2536	-	-	-	52370	26980	-	1892	-	0.36	178
Minimum	1	25	2290	-	-	-	15200	18900	-	1350	-	0.2	85
Maximum	8	35	2560	-	-	-	63200	28300	-	1940	-	0.4	181

D9	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	2	39	1620	0.2	1	2	33400	21500	1	1660	13	0.2	104
90th Percentile	5	40	1762	0.2	1	6	57760	22330	1.7	1744	13	0.8	525
Minimum	1	34	1500	0.1	1	1	10600	21000	1	1440	13	0.2	89
Maximum	8	41	1930	0.2	1	7	65800	22600	2	1750	13	1.1	1130

D8	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	-	27	110	-	-	3	584	999	-	50	2	-	63
90th Percentile	-	50	172	-	-	4	3383	3081	-	113	2	-	118
Minimum	-	22	70	-	-	2	80	393	-	20	2	-	32
Maximum	-	54	200	-	-	4	4470	3900	-	183	2	-	179

D11	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	5	30.5	2720	-	-	-	60900	16450	-	936	-	0.25	72
90th Percentile	9	47.5	2990	-	-	-	106180	18530	-	1026	-	0.3	99
Minimum	2	18	2630	-	-	-	49200	14300	-	791	-	0.2	13
Maximum	10	55	3110	-	-	-	121000	19400	-	1060	-	0.3	100

D19	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	8	22	1970	0.2	20	5	15950	10115	3	715	21	1.2	330
90th Percentile	36	114	2402	0.5	49	32	17300	10860	4	764	122	4.7	563
Minimum	2	13	1320	0.1	3	1	1320	3880	2	375	1	0.5	258
Maximum	52	206	2540	0.7	51	54	17600	11100	4	805	202	6.0	813

D15	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	6	20	210	0.5	52	7	29650	2200	3	853	7	0.9	1600
90th Percentile	72	86	236	1.1	115	138	31750	2436	9	934	84	12.5	1750
Minimum	4	15	160	0.4	7	3	27500	2120	2	740	5	0.3	1350
Maximum	124	139	260	1.4	129	191	32500	2520	12	934	119	12.6	1810

D18	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	9	667	55	0.2	2	1	744	113	2	5	2	0.2	24
90th Percentile	11	691	60	0.2	2	2	1206	121	6	6	2	0.2	44
Minimum	3	552	50	0.2	2	1	206	110	1	3	2	0.2	15
Maximum	11	695	60	0.2	2	2	1300	124	8	6	2	0.2	50

D10	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	-	16	4290	5.1	-	-	6290	8530	-	976	6	1.6	881
90th Percentile	-	29	5054	6.9	-	-	7754	8690	-	1116	8.2	2.7	1042
Minimum	-	14	940	1	-	-	4420	7150	-	404	1	0.5	583
Maximum	-	35	5070	6.9	-	-	8120	8730	-	1120	9	2.9	1080

D17	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	2	15	190	-	4	-	12440	3145	-	98	-	-	71
90th Percentile	2	20	226	-	5	-	25640	3445	-	100	-	-	80
Minimum	2	13	100	-	2	-	2460	2340	-	58	-	-	41
Maximum	2	22	230	-	5	-	29600	3550	-	102	-	-	83

D16	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	-	10	-	-	2	-	2790	57	-	15	-	-	11
90th Percentile	-	12	-	-	4	-	3424	60	-	17	-	-	13
Minimum	-	8	-	-	2	-	2700	46	-	12	-	-	7
Maximum	-	14	-	-	4	-	3700	62	-	19	-	-	14

Legend

- Licenced Premises Boundary
- Mt Piper Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approximate Active Placement Area)
- Groundwater Monitoring Location

Data Source:
- DFSI DCDB/DTDB, 2019
- Imagery: Nearmap (22/01/2020)

Groundwater - Min, Max, 50th and 90th Percentile (Metals)

F-7B

Drawing No: 0553983m_LN_G013_R1.mxd
Date: 14/10/2020 Drawing Size: A4
Drawn By: KV Reviewed By: GP
Coordinate System: GDA 1994 MGA Zone 56

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N

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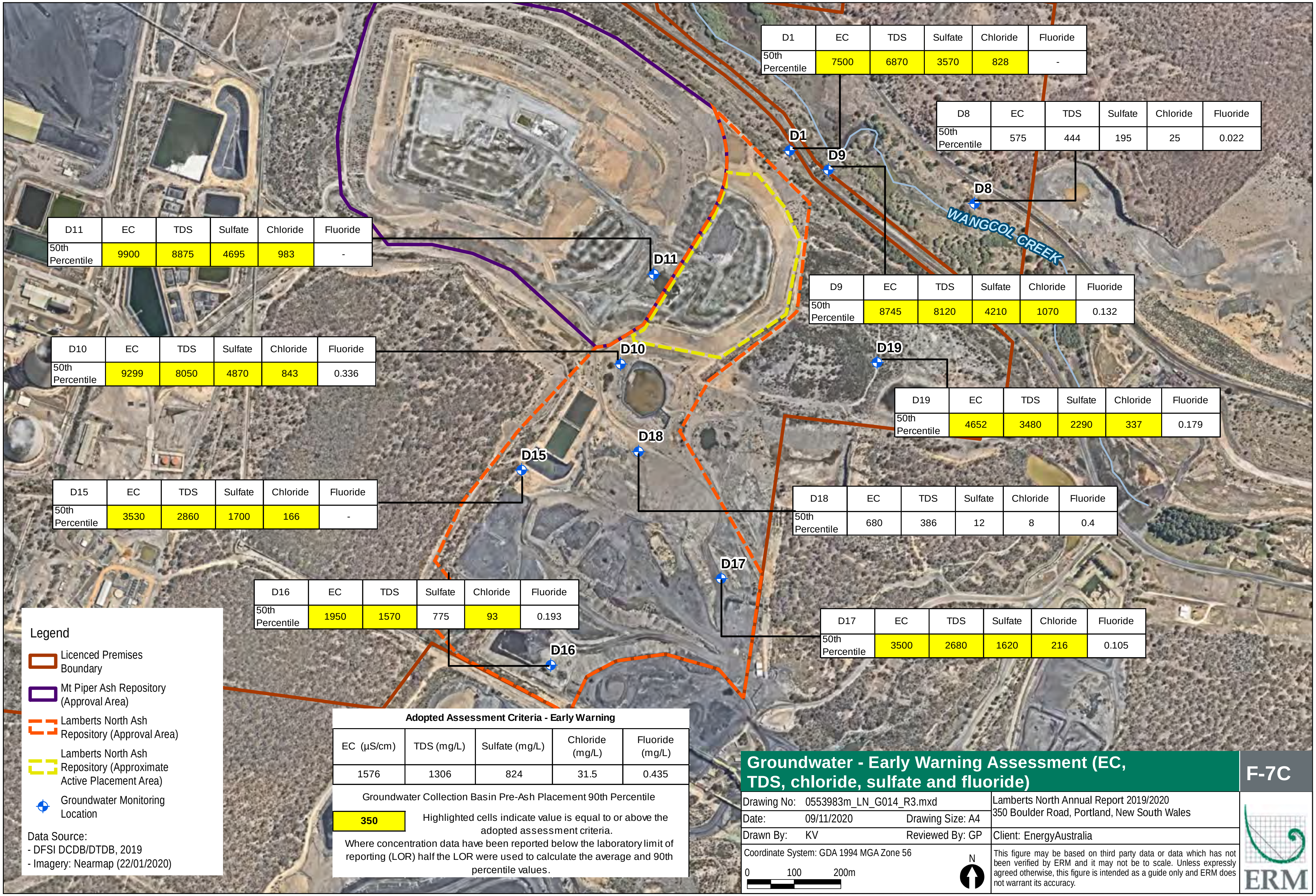
350 Boulder Road, Portland, New South Wales

Client: EnergyAustralia

ERM



D1	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	7500	6870	3570	828	-

D8	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	575	444	195	25	0.022

D11	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	9900	8875	4695	983	-

D9	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	8745	8120	4210	1070	0.132

D10	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	9299	8050	4870	843	0.336

D19	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	4652	3480	2290	337	0.179

D15	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	3530	2860	1700	166	-

D18	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	680	386	12	8	0.4

D16	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	1950	1570	775	93	0.193

D17	EC	TDS	Sulfate	Chloride	Fluoride
50th Percentile	3500	2680	1620	216	0.105

Legend
- Licenced Premises Boundary
- Mt Piper Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approximate Active Placement Area)
- Groundwater Monitoring Location

Data Source:
- DFSI DCDB/DTDB, 2019
- Imagery: Nearmap (22/01/2020)

Adopted Assessment Criteria - Early Warning

EC (µS/cm)	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)
1576	1306	824	31.5	0.435

Groundwater Collection Basin Pre-Ash Placement 90th Percentile

350 Highlighted cells indicate value is equal to or above the adopted assessment criteria.

Where concentration data have been reported below the laboratory limit of reporting (LOR) half the LOR were used to calculate the average and 90th percentile values.

Groundwater - Early Warning Assessment (EC, TDS, chloride, sulfate and fluoride)

F-7C

Drawing No: 0553983m_LN_G014_R3.mxd
Date: 09/11/2020 Drawing Size: A4
Drawn By: KV Reviewed By: GP
Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

N

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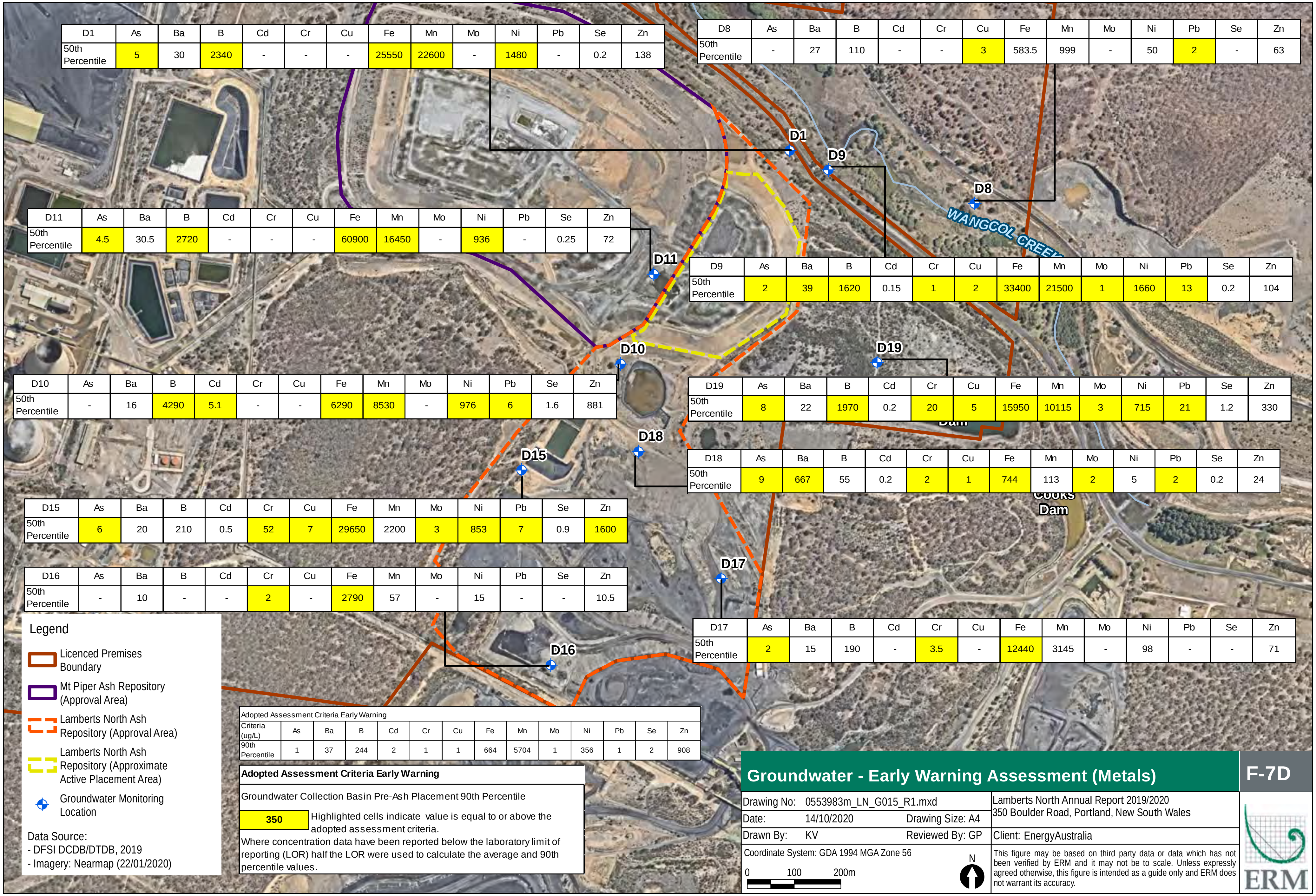
350 Boulder Road, Portland, New South Wales

Client: EnergyAustralia

ERM



D1	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	5	30	2340	-	-	-	25550	22600	-	1480	-	0.2	138

D8	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	-	27	110	-	-	3	583.5	999	-	50	2	-	63

D11	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	4.5	30.5	2720	-	-	-	60900	16450	-	936	-	0.25	72

D9	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	2	39	1620	0.15	1	2	33400	21500	1	1660	13	0.2	104

D10	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	-	16	4290	5.1	-	-	6290	8530	-	976	6	1.6	881

D19	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	8	22	1970	0.2	20	5	15950	10115	3	715	21	1.2	330

D18	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	9	667	55	0.2	2	1	744	113	2	5	2	0.2	24

D15	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	6	20	210	0.5	52	7	29650	2200	3	853	7	0.9	1600

D16	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	-	10	-	-	2	-	2790	57	-	15	-	-	10.5

D17	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
50th Percentile	2	15	190	-	3.5	-	12440	3145	-	98	-	-	71

Legend

- Licenced Premises Boundary
- Mt Piper Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approval Area)
- Lamberts North Ash Repository (Approximate Active Placement Area)
- Groundwater Monitoring Location

Data Source:
- DFSI DCDB/DTDB, 2019
- Imagery: Nearmap (22/01/2020)

Adopted Assessment Criteria Early Warning

Criteria (ug/L)	As	Ba	B	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	Zn
90th Percentile	1	37	244	2	1	1	664	5704	1	356	1	2	908

Adopted Assessment Criteria Early Warning

Groundwater Collection Basin Pre-Ash Placement 90th Percentile

350 Highlighted cells indicate value is equal to or above the adopted assessment criteria.

Where concentration data have been reported below the laboratory limit of reporting (LOR) half the LOR were used to calculate the average and 90th percentile values.

Groundwater - Early Warning Assessment (Metals)

F-7D

Drawing No: 0553983m_LN_G015_R1.mxd
Date: 14/10/2020 Drawing Size: A4
Drawn By: KV Reviewed By: GP
Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

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Lamberts North Annual Report 2019/2020
350 Boulder Road, Portland, New South Wales

Client: EnergyAustralia

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APPENDIX B TABULATED SURFACE WATER DATA

Field_ID	LocCode	Sampled_Date-Time	Physical Parameters (Laboratory)					Physical Parameters (Field)				Major Anions and Cations									
			Electrical Conductivity (Lab)	pH (Lab)	Total Dissolved Solids (TDS)	Total Suspended Solids (TSS)	Turbidity	Dissolved Oxygen (Field)	Electrical Conductivity (Field)	pH (Field)	Temperature (Field)	Bicarbonate Alkalinity (as CaCO3)	Bicarbonate Alkalinity (as CaCO3) (Filtered)	Phenolphthalein Alkalinity (CaCO3)	Phenolphthalein Alkalinity (CaCO3) (Filtered)	Total Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3) (Filtered)	Total Hardness (CaCO3)	Total Hardness (CaCO3) (Filtered)	Calcium	Calcium (Filtered)
			µS/cm	pH units	mg/L	mg/L	NTU	mg/L	uS/cm	pH units	oC	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Environmental Goal - Surface Water			2200	6.5-8	1500				2200	6.5-8											
Wangcol Creek at WX22 Pre-placement 90th Percentile				6.7-7.8	580				894	6.7-7.8											
2 Downstream Final Holding Pond	LMP01	3/09/2019	640	8.1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/09/2019	640	8.1	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	17/09/2019	480	8.1	-	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	19/09/2019	-	-	276	64	151	11.6	363	7.25	-	61	-	<1	-	61	-	-	-	22.4	-
2 Downstream Final Holding Pond	LMP01	24/09/2019	300	7.9	-	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	1/10/2019	350	8	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/10/2019	360	7.7	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	15/10/2019	420	7.9	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	22/10/2019	420	7.9	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	24/10/2019	-	-	266	16	30.8	8.9	425	7.18	-	99	-	<1	-	99	-	-	-	25.3	-
2 Downstream Final Holding Pond	LMP01	29/10/2019	400	8.1	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/02/2020	-	-	446	96	289	7.9	590	8.86	-	98	-	<1	-	98	-	-	-	22.8	-
2 Downstream Final Holding Pond	LMP01	24/02/2020	750	9.1	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	2/03/2020	930	8.9	-	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/03/2020	250	7.6	-	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	16/03/2020	380	7.7	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	23/03/2020	450	8.3	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	30/03/2020	330	7.9	-	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/04/2020	540	7.4	14	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	11/05/2020	540	7.7	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	18/05/2020	660	8.1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	25/05/2020	630	7.5	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	1/06/2020	690	8.1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/06/2020	640	8.1	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	15/06/2020	400	8	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	22/06/2020	270	8	-	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	29/06/2020	330	7.9	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	6/07/2020	380	7.6	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/07/2020	360	8	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	23/07/2020	-	7.4	216	7	10.8	12.4	371	-	-	73	-	<1	-	73	-	-	-	28.8	-
2 Downstream Final Holding Pond	LMP01	27/07/2020	240	9.4	-	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	3/08/2020	450	8	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	10/08/2020	160	7.9	-	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	24/08/2020	240	8.9	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	31/08/2020	480	8	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Count Detects		**31**	**32**	**5**	**34**	**4**	**4**	**4**	**3**	**0**	**4**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**4**	**0**
	Average		**455**	**8.0**	**244**	**32**	**120.4**	**10.2**	**437**	**7.8**	**-**	**82.8**	**-**	**-**	**-**	**82.8**	**-**	**-**	**-**	**24.83**	**-**
	50th Percentile		**420**	**8.0**	**266**	**15**	**90.9**	**10.25**	**398**	**7.3**	**-**	**85.5**	**-**	**-**	**-**	**85.5**	**-**	**-**	**-**	**24.05**	**-**
	90th Percentile		**660**	**8.8**	**378**	**91**	**247.6**	**12.16**	**541**	**8.5**	**-**	**98.7**	**-**	**-**	**-**	**98.7**	**-**	**-**	**-**	**27.75**	**-**
	Minimum		**160**	**7.4**	**14**	**2**	**10.8**	**7.9**	**363**	**7.2**	**-**	**61**	**-**	**-**	**-**	**61**	**-**	**-**	**-**	**22.4**	**-**
	Maximum		**930**	**9.4**	**446**	**170**	**289**	**12.4**	**590**	**8.9**	**-**	**99**	**-**	**-**	**-**	**99**	**-**	**-**	**-**	**28.8**	**-**
219 Neubecks Creek	NC01	19/09/2019	-	-	251	-	57.2	9.9	378	7.04	-	62	-	<1	-	62	-	-	-	23	-
219 Neubecks Creek	NC01	23/10/2019	-	-	256	-	13.2	4.4	424	7.04	-	114	-	<1	-	114	-	-	-	24.4	-
219 Neubecks Creek	NC01	20/02/2020	-	-	363	-	124	6.1	559	6.88	-	98	-	<1	-	98	-	-	-	30	-
219 Neubecks Creek	NC01	22/07/2020	-	7.43	220	-	5.5	10.9	371	-	-	84	-	<1	-	-	-	-	-	22.7	-
	Count Detects		**0**	**1**	**4**	**0**	**4**	**4**	**4**	**3**	**0**	**4**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**4**	**0**
	Average		**-**	**7.43**	**273**	**-**	**49.975**	**7.8**	**433**	**6.98667**	**-**	**89.5**	**-**	**-**	**-**	**91.3**	**-**	**-**	**-**	**25.03**	**-**
	50th Percentile		**-**	**7.43**	**254**	**-**	**35.2**	**8.0**	**401**	**7.04**	**-**	**91**	**-**	**-**	**-**	**98**	**-**	**-**	**-**	**23.7**	**-**
	90th Percentile		**-**	**7.43**	**331**	**-**	**103.96**	**10.6**	**519**	**7.04**	**-**	**109**	**-**	**-**	**-**	**111**	**-**	**-**	**-**	**28.32**	**-**
	Minimum		**-**	**7.43**	**220**	**-**	**5.5**	**4.4**	**371**	**6.88**	**-**	**62**	**-**	**-**	**-**	**62**	**-**	**-**	**-**	**22.7**	**-**
	Maximum		**-**	**7.43**	**363**	**-**	**124**	**10.9**	**559**	**7.04**	**-**	**114**	**-**	**-**	**-**	**114**	**-**	**-**	**-**	**30**	**-**
3 Stream Gauge	WX22	25/09/2019	-	-	487	-	1.3	12.3	730	7.34	8.6	80	-	<1	-	80	-	-	-	41.4	-
3 Stream Gauge	WX22	30/10/2019	-	-	1390	-	5.1	8.4	1960	6.55	15.3	82	-	<1	-	82	-	-	-	144	-
WX22	WX22	6/11/2019	-	-	-	-	-	-	1886	-	-	-	-	-	-	-	-	-	-	-	-
3 Stream Gauge	WX22	27/11/2019	-	-	1610	-	6.7	9.5	2610	6.88	16.9	35	-	<1	-	35	-	-	-	163	-
3 Stream Gauge	WX22	22/01/2020	-	-	2680	-	8	7.5	3040	7.07	19.6	31	31	<1	<1	31	31	-	-	242	242
3 Stream Gauge	WX22	26/02/2020	-	-	652	-	5.2	8.8	850	6.48	17.5	23	-	<1	-	23	-	-	-	51.4	-
3 Stream Gauge	WX22	25/03/2020	-	-	518	-	4.4	8.7	730	7.03	15.3	56	-	<1	-	56	-	-	-	<39	-
3 Stream Gauge	WX22	24/06/2020	-	-	266	-	4.1	13.2	528	7.24	6.3	59	-	<1	-	59	-	-	-	27.5	-
	Count Detects		**0**	**0**	**7**	**0**	**7**	**7**	**8**	**7**	**7**	**7**	**1**	**0**	**0**	**7**	**1**	**0**	**0**	**6**	**1**
	Average		**-**	**-**	**1086**	**-**	**5**	**9.8**	**1542**	**6.94143**	**14.2**	**52.3**	**31**	**-**	**-**	**52.3**	**31**	**-**	**-**	**111.6**	**242**
	50th Percentile		**-**	**-**	**652**	**-**	**5**	**8.8**	**1368**	**7.03**	**15.3**	**56**	**31**	**-**	**-**	**56**	**31**	**-**	**-**	**97.7**	**242**
	90th Percentile		**-**	**-**	**2038**	**-**	**7**	**12.7**	**2739**	**7.28**	**18.3**	**80.8**	**31**	**-**	**-**	**80.8**	**31**	**-**	**-**	**202.5**	**242**
	Minimum		**-**	**-**	**266**	**-**	**1**	**7.5**	**528**	**6.48**	**6.3**	**23**	**31**	**-**	**-**	**23**	**31**	**-**	**-**	**27.5**	**242**
	Maximum		**-**	**-**	**2680**	**-**	**8**	**13.2**	**3040**	**7.34**	**19.6**	**82**	**31**	**-**	**-**	**82**	**31**	**-**	**-**	**242**	**242**

Field_ID	LocCode	Sampled_Date-Time	Major Anions and Cations												Nutrients													
			Chloride	Chloride (Filtered)	Magnesium	Magnesium (Filtered)	Potassium	Potassium (Filtered)	Sodium	Sodium (Filtered)	Sulfate (as SO4)	Sulfate (as SO4) (Filtered)	Fluoride	Fluoride (Filtered)	Ammonia (NH3-N)	Ammonia (NH3-N) (Filtered)	Nitrate (as N)	Nitrate (as N) (Filtered)	Nitrite (as N)	Nitrite (as N) (Filtered)	Nitrite + Nitrate (as N)	Nitrite + Nitrate (as N) (Filtered)	Nitrogen (N)	Nitrogen (N) - Kjeldahl	Nitrogen (N) - Kjeldahl (Filtered)	Nitrogen (N) (Filtered)	Phosphorus	Phosphorus (Filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Environmental Goal - Surface Water			350	350							1000	1000	1.5	1.5														
Wangcol Creek at WX22 Pre-placement 90th Percentile			22	22							332	332	0.338	0.338														
2 Downstream Final Holding Pond	LMP01	3/09/2019	26	-	-	-	-	-	-	-	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/09/2019	28	-	-	-	-	-	-	-	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	17/09/2019	48	-	-	-	-	-	-	-	110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	19/09/2019	12.9	-	8.82	-	5.65	-	39.3	-	88	-	<1	-	<0.1	-	0.19	-	<0.01	-	0.19	-	0.7	0.5	-	-	0.06	-
2 Downstream Final Holding Pond	LMP01	24/09/2019	10	-	-	-	-	-	-	-	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	1/10/2019	14	-	-	-	-	-	-	-	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/10/2019	15	-	-	-	-	-	-	-	70.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	15/10/2019	14	-	-	-	-	-	-	-	97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	22/10/2019	14	-	-	-	-	-	-	-	110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	24/10/2019	11.9	-	11.6	-	5.96	-	45.6	-	73.8	-	0.138	-	<0.1	-	0.1	-	<0.01	-	0.1	-	0.4	0.3	-	-	<0.02	-
2 Downstream Final Holding Pond	LMP01	29/10/2019	15	-	-	-	-	-	-	-	89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/02/2020	24.2	-	9.48	-	9.93	-	99.8	-	138	-	0.301	-	<0.1	-	0.26	-	0.03	-	0.29	-	0.9	0.6	-	-	0.12	-
2 Downstream Final Holding Pond	LMP01	24/02/2020	40	-	-	-	-	-	-	-	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	2/03/2020	55	-	-	-	-	-	-	-	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/03/2020	12	-	-	-	-	-	-	-	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	16/03/2020	16	16	-	-	-	-	-	-	-	110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	23/03/2020	14	-	-	-	-	-	-	-	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	30/03/2020	10	-	-	-	-	-	-	-	110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/04/2020	14	-	-	-	-	-	-	-	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	11/05/2020	16	-	-	-	-	-	-	-	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	18/05/2020	16	-	-	-	-	-	-	-	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	25/05/2020	14	-	-	-	-	-	-	-	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	1/06/2020	18	-	-	-	-	-	-	-	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/06/2020	18	-	-	-	-	-	-	-	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	15/06/2020	14	-	-	-	-	-	-	-	140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	22/06/2020	10	-	-	-	-	-	-	-	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	29/06/2020	12	-	-	-	-	-	-	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	6/07/2020	12	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/07/2020	14	-	-	-	-	-	-	-	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	23/07/2020	11.2	-	14.7	-	6.71	-	34.7	-	81.9	-	0.112	-	<0.1	-	0.04	-	<0.01	-	0.04	-	0.3	0.3	-	-	0.01	-
2 Downstream Final Holding Pond	LMP01	27/07/2020	10	-	-	-	-	-	-	-	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	3/08/2020	10	-	-	-	-	-	-	-	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	10/08/2020	8	-	-	-	-	-	-	-	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	24/08/2020	6	-	-	-	-	-	-	-	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	31/08/2020	35	-	-	-	-	-	-	-	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Count Detects		**35**	**1**	**4**	**0**	**4**	**0**	**4**	**0**	**34**	**1**	**3**	**0**	**0**	**0**	**4**	**0**	**1**	**0**	**4**	**0**	**4**	**4**	**0**	**0**	**3**	**0**
	Average		**17.66**	**16**	**11.15**	**-**	**7.06**	**-**	**54.85**	**-**	**140.44**	**110**	**0.184**	**-**	**-**	**-**	**0.15**	**-**	**0.03**	**-**	**0.155**	**-**	**0.6**	**0.43**	**-**	**-**	**0.063**	**-**
	50th Percentile		**14**	**16**	**10.54**	**-**	**6.34**	**-**	**42.45**	**-**	**110**	**110**	**0.138**	**-**	**-**	**-**	**0.15**	**-**	**0.03**	**-**	**0.145**	**-**	**0.6**	**0.4**	**-**	**-**	**0.06**	**-**
	90th Percentile		**32.2**	**16**	**13.77**	**-**	**8.96**	**-**	**83.54**	**-**	**244**	**110**	**0.268**	**-**	**-**	**-**	**0.24**	**-**	**0.03**	**-**	**0.26**	**-**	**0.8**	**0.57**	**-**	**-**	**0.108**	**-**
	Minimum		**6**	**16**	**8.82**	**-**	**5.65**	**-**	**34.7**	**-**	**52**	**110**	**0.112**	**-**	**-**	**-**	**0.04**	**-**	**0.03**	**-**	**0.04**	**-**	**0.3**	**0.3**	**-**	**-**	**0.01**	**-**
	Maximum		**55**	**16**	**14.7**	**-**	**9.93**	**-**	**99.8**	**-**	**270**	**110**	**0.301**	**-**	**-**	**-**	**0.26**	**-**	**0.03**	**-**	**0.29**	**-**	**0.9**	**0.6**	**-**	**-**	**0.12**	**-**
219 Neubecks Creek	NC01	19/09/2019	14.3	-	10.2	-	6.04	-	38.6	-	83.9	-	1.56	-	-	-	0.07	-	<0.01	-	0.07	-	0.6	0.5	-	-	0.05	-
219 Neubecks Creek	NC01	23/10/2019	7.72	-	10.6	-	7.04	-	37.7	-	32.2	-	0.223	-	-	-	<0.01	-	<0.01	-	<0.01	-	0.6	0.6	-	-	<0.01	-
219 Neubecks Creek	NC01	20/02/2020	22.8	-	11.6	-	9.08	-	86	-	140	-	<0.05	-	-	-	0.02	-	0.01	-	0.03	-	1.1	1.1	-	-	0.12	-
219 Neubecks Creek	NC01	22/07/2020	12.1	-	11.8	-	5.57	-	35.3	-	88.1	-	0.139	-	-	-	0.02	-	<0.01	-	0.02	-	0.2	0.2	-	-	<0.01	-
	Count Detects		**4**	**0**	**4**	**0**	**4**	**0**	**4**	**0**	**4**	**0**	**3**	**0**	**0**	**0**	**3**	**0**	**1**	**0**	**3**	**0**	**4**	**4**	**0**	**0**	**2**	**0**
	Average		**14.23**	**-**	**11.05**	**-**	**6.93**	**-**	**49.4**	**-**	**86.05**	**-**	**0.641**	**-**	**-**	**-**	**0.04**	**-**	**0.01**	**-**	**0.04**	**-**	**0.6**	**0.6**	**-**	**-**	**0.085**	**-**
	50th Percentile		**13.2**	**-**	**11.1**	**-**	**6.54**	**-**	**38.15**	**-**	**86**	**-**	**0.223**	**-**	**-**	**-**	**0.02**	**-**	**0.01**	**-**	**0.03**	**-**	**0.6**	**0.6**	**-**	**-**	**0.085**	**-**
	90th Percentile		**20.25**	**-**	**11.74**	**-**	**8.47**	**-**	**71.78**	**-**	**124.43**	**-**	**1.293**	**-**	**-**	**-**	**0.06**	**-**	**0.01**	**-**	**0.062**	**-**	**1.0**	**1.0**	**-**	**-**	**0.113**	**-**
	Minimum		**7.72**	**-**	**10.2**	**-**	**5.57**	**-**	**35.3**	**-**	**32.2**	**-**	**0.139**	**-**	**-**	**-**	**0.02**	**-**	**0.01**	**-**	**0.02**	**-**	**0.2**	**0.2**	**-**	**-**	**0.05**	**-**
	Maximum		**22.8**	**-**	**11.8**	**-**	**9.08**	**-**	**86**	**-**	**140**	**-**	**1.56**	**-**	**-**	**-**	**0.07**	**-**	**0.01**	**-**	**0.07**	**-**	**1.1**	**1.1**	**-**	**-**	**0.12**	**-**
3 Stream Gauge	WX22	25/09/2019	47.6	-	27.1	-	7.24	-	65.2	-	203	-	0.142	-	-	-	0.02	-	<0.01	-	0.02	-	0.1	0.1	-	-	<0.01	-
3 Stream Gauge	WX22	30/10/2019	155	-	95.2	-	13.6	-	187	-	711	-	<0.1	-	-	-	<0.01	-	<0.01	-	<0.01	-	0.2	0.2	-	-	<0.01	-
WX22	WX22	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 Stream Gauge	WX22	27/11/2019	191	-	138	-	13.7	-	266	-	1150	-	<0.1	-	-	-	<0.01	-	<0.01	-	<0.01	-	0.3	0.3	-	-	<0.01	-
3 Stream Gauge	WX22	22/01/2020	212	212	166	166	22.5	22.5	264	264	1350	-	<0.5	<0.5	-	-	0.03	0.03	<0.01	<0.01	0.03	0.03	1.6	1.6	1.6	1.6	0.05	0.05
3 Stream Gauge	WX22	26/02/2020	38.8	-	27.4	-	8.87	-	71.2	-	317	-	<0.1	-	-	-	<0.01	-	<0.01	-	<0.01	-	0.2	0.2	-	-	<0.01	-
3 Stream Gauge	WX22	25/03/2020	<42.9	-	<23.8	-	<8.07	-	<72	-	<215	-	<0.1	-	-	-	<0.01	-	<0.01	-	<0.01	-	<0.3	0.3	-	-	<0.01	-
3 Stream Gauge	WX22	24/06/2020	31.6	-	17.1	-	6.04	-	53.5	-	179	-	0.13	-	-	-	0.01	-	<0.01	-	0.01	-	0.1	0.1	-	-	<0.01	-
	Count Detects		**6**	**1**	**6**	**1**	**6**	**1**	**6**	**1**	**6**	**0**	**2**	**0**	**0**	**0**	**3**	**1**	**0**	**0**	**3**	**1**	**6**	**7**	**1**	**1**	**1**	**1**
	Average		**112.7**	**212**	**78.47**	**166**	**12**	**22.5**	**151.2**	**264**	**651.67**	**-**	**0.136**	**-**	**-**	**-**	**0.02**	**0.03**	**-**	**-**	**0.02**	**0.03**	**0.4**	**0.4**	**1.6**	**1.6**	**0.05**	**0.05**
	50th Percentile		**101.3**	**212**	**61.3**	**166**	**11.2**	**22.5**	**129.1**	**264**	**514**	**-**	**0.136**	**-**	**-**	**-**	**0.02**	**0.03**	**-**	**-**	**0.02**	**0.03**	**0.2**	**0.2**	**1.6**	**1.6**	**0.05**	**0.05**
	90th Percentile		**201.5**	**212**	**152**	**166**	**18.1**	**22.5**	**265**	**264**	**1250**	**-**	**0.141**	**-**	**-**	**-**	**0.03**	**0.03**	**-**	**-**	**0.028**	**0.03**	**1.0**	**0.8**	**1.6**	**1.6**	**0.05**	**0.05**
	Minimum		**31.6**	**212**	**17.1**	**166**	**6.04**	**22.5**	**53.5**	**264**	**179**	**-**	**0.13**	**-**	**-**	**-**	**0.01**	**0.03**	**-**	**-**	**0.01**	**0.03**	**0.1**	**0.1**	**1.6**	**1.6**	**0.05**	**0.05**
	Maximum		**212**	**212**	**166**	**166**	**22.5**	**22.5**	**266**	**264**	**1350**	**-**	**0.142**	**-**	**-**	**-**	**0.03**	**0.03**	**-**	**-**	**0.03**	**0.03**	**1.6**	**1.6**	**1.6**	**1.6**	**0.05**	**0.05**

Statistical Summary

	Electrical Conductivity (Lab)	pH (Lab)	Total Dissolved Solids (TDS)	Total Suspended Solids (TSS)	Turbidity	Dissolved Oxygen (Field)	Electrical Conductivity (Field)	pH (Field)	Temperature (Field)	Bicarbonate Alkalinity (as CaCO3)	Bicarbonate Alkalinity (as CaCO3) (Filtered)	Phenolphthalein Alkalinity (CaCO3)	Phenolphthalein Alkalinity (CaCO3) (Filtered)	Total Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3) (Filtered)	Total Hardness (CaCO3)	Total Hardness (CaCO3) (Filtered)	Calcium	Calcium (Filtered)
Number of Results	49	51	34	53	33	33	34	31	25	33	19	33	19	32	19	18	18	33	19
Number of Detects	49	51	34	52	33	33	34	31	25	33	19	18	18	32	19	18	18	32	19
Minimum Concentration	0	0	4	0	1.3	4	4	3	0	4	0	0	0	3	0	0	0	4	0
Minimum Detect	31	1	4	2	1.3	4	4	3	6.3	4	1	ND	ND	3	1	ND	ND	4	1
Maximum Concentration	930	32	2680	170	289	13.2	3040	8.86	19.6	114	31	<1	<1	114	31	0	0	242	242
Maximum Detect	930	32	2680	170	289	13.2	3040	8.86	19.6	114	31	ND	ND	114	31	ND	ND	242	242
Average Concentration	430	8.2	572	33	56	9.2	872	7	12	68	21	0.42	0.13	68	21	0	0	56	161
Median Concentration	420	7.95	274.25	14.5	8	8.9	528	7.04	15.3	80	31	0.5	0	76.5	31	0	0	27.5	242
Standard Deviation	220	3.9	701	43	83	2.7	865	1.2	6.7	32	15	0.19	0.25	33	15	0	0	67	121
Number of Guideline Exceedances	0	31	8	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	31	8	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0

	Chloride	Chloride (Filtered)	Magnesium	Magnesium (Filtered)	Potassium	Potassium (Filtered)	Sodium	Sodium (Filtered)	Sulfate (as SO4)	Sulfate (as SO4) (Filtered)	Fluoride	Fluoride (Filtered)	Ammonia (NH3-N)	Ammonia (NH3-N) (Filtered)	Nitrate (as N)	Nitrate (as N) (Filtered)	Nitrite (as N)	Nitrite (as N) (Filtered)	Nitrite + Nitrate (as N)	Nitrite + Nitrate (as N) (Filtered)	Nitrogen (N)	Nitrogen (N) - Kjeldahl	Nitrogen (N) - Kjeldahl (Filtered)	Nitrogen (N) (Filtered)	Phosphorus	Phosphorus (Filtered)
Number of Results	64	20	33	19	33	19	33	19	63	19	33	19	22	18	33	19	33	19	33	19	33	33	19	19	33	19
Number of Detects	63	20	32	19	32	19	32	19	62	19	26	18	18	18	28	19	20	18	28	19	32	33	19	19	24	19
Minimum Concentration	4	0	4	0	4	0	4	0	4	0	<0.05	0	0	0	<0.01	0	0	0	<0.01	0	0.1	0.1	0	0	<0.01	0
Minimum Detect	4	1	4	1	4	1	4	1	4	1	0.112	ND	ND	ND	0.01	0.03	0.01	ND	0.01	0.03	0.1	0.1	1	1	0.01	0.05
Maximum Concentration	212	212	166	166	22.5	22.5	266	264	1350	110	3	<0.5	<0.1	0	4	1	1	<0.01	4	1	6	7	1.6	1.6	3	1
Maximum Detect	212	212	166	166	22.5	22.5	266	264	1350	110	3	ND	ND	ND	4	1	1	ND	4	1	6	7	1.6	1.6	3	1
Average Concentration	36	91	36	111	8.8	15	86	176	229	73	0.52	0.063	0.03	0	0.36	0.13	0.082	0.001	0.37	0.13	0.95	0.93	1.2	1.2	0.23	0.14
Median Concentration	15	16	11.8	166	7.04	22.5	53.5	264	124.43	110	0.142	0	0.05	0	0.03	0.03	0.008	0	0.03	0.03	0.6	0.5	1.6	1.6	0.05	0.05
Standard Deviation	51	102	50	83	4.7	11	78	132	304	55	0.81	0.13	0.03	0	0.97	0.33	0.26	0.003	0.97	0.33	1.3	1.4	0.7	0.7	0.62	0.32
Number of Guideline Exceedances	24	6	0	0	0	0	0	0	7	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	23	6	0	0	0	0	0	0	7	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Field_ID	LocCode	Sampled_Date-Time	Aluminium	Aluminium (Filtered)	Arsenic	Arsenic (Filtered)	Barium	Barium (Filtered)	Beryllium	Beryllium (Filtered)	Boron	Boron (Filtered)	Cadmium	Cadmium (Filtered)	Chromium	Chromium (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Manganese	Manganese (Filtered)	Mercury	Mercury (Filtered)	Molybdenum	Molybdenum (Filtered)	Nickel	Nickel (Filtered)	Selenium	Selenium (Filtered)	Silver	Silver (Filtered)	Strontium	Strontium (Filtered)	Vanadium	Vanadium (Filtered)	Zinc	Zinc (Filtered)
			Metals																																					
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L
Environmental Goal - Surface Water					24	24	700	700	100	100	370	370	0.85	0.85	2	2	3.5	3.5	300	300	5	5	1900	1900	0.06	0.06	10	10	17	17	5	5	0.05	0.05					116	116
Wangcol Creek at WX22 Pre-placement 90th Percentile					1	1	29	29	1	1	90	90	1	1	1	1	1	1	281	281	1	1	720	720			1	1	5	5	1	1							116	116
2 Downstream Final Holding Pond	LMP01	3/09/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/09/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	17/09/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	19/09/2019	1360	80	2	-	29	-	<1	-	70	-	<0.1	-	2	-	16	6	1830	110	3	-	121	22	<0.04	-	4	-	9	-	0.7	-	<1	-	0.068	-	<10	<10	56	14
2 Downstream Final Holding Pond	LMP01	24/09/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	1/10/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/10/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	15/10/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	22/10/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	24/10/2019	420	-	<1	-	26	-	<1	-	110	-	<0.1	-	<1	-	11	-	533	-	1	-	103	-	<0.04	-	6	-	4	-	0.5	-	<1	-	0.085	-	<10	-	22	-
2 Downstream Final Holding Pond	LMP01	29/10/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/02/2020	3110	140	6	-	42	-	<1	-	80	-	0.2	-	4	-	16	6	3480	212	8	-	208	33	<0.04	-	13	-	17	-	0.9	-	<1	-	0.067	-	<10	<10	79	8
2 Downstream Final Holding Pond	LMP01	24/02/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	2/03/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/03/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	16/03/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	23/03/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	30/03/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/04/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	11/05/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	18/05/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	25/05/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	1/06/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	9/06/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	15/06/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	22/06/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	29/06/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	6/07/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	20/07/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	23/07/2020	120	10	<1	-	19	-	<1	-	100	-	0.4	-	<1	-	5	3	292	26	<1	-	120	10	<0.04	-	23	-	4	-	0.5	-	<1	-	0.076	-	<10	<10	17	10
2 Downstream Final Holding Pond	LMP01	27/07/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	3/08/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	10/08/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	24/08/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Downstream Final Holding Pond	LMP01	31/08/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Count Detects		**4**	**3**	**2**	**0**	**4**	**0**	**0**	**0**	**4**	**0**	**2**	**0**	**2**	**0**	**4**	**3**	**4**	**3**	**3**	**0**	**4**	**3**	**0**	**0**	**4**	**0**	**4**	**0**	**4**	**0**	**4**	**0**	**4**	**0**	**0**	**0**	**4**	**3**
	Average		**1252.5**	**76.667**	**4**	**-**	**29**	**-**	**-**	**-**	**90**	**-**	**0.3**	**-**	**3**	**-**	**12**	**5**	**1533.75**	**116**	**4**	**-**	**138**	**22**	**-**	**-**	**11.5**	**-**	**9**	**-**	**0.65**	**-**	**-**	**-**	**0.074**	**-**	**-**	**-**	**43.5**	**10.7**
	50th Percentile		**890**	**80**	**4**	**-**	**27.5**	**-**	**-**	**-**	**90**	**-**	**0.3**	**-**	**3**	**-**	**13.5**	**6**	**1181.5**	**110**	**3**	**-**	**120.5**	**22**	**-**	**-**	**9.5**	**-**	**7**	**-**	**0.6**	**-**	**-**	**-**	**0.072**	**-**	**-**	**-**	**39**	**10**
	90th Percentile		**2585**	**128**	**5.6**	**-**	**38.1**	**-**	**-**	**-**	**107**	**-**	**0.38**	**-**	**3.8**	**-**	**16**	**6**	**2985**	**191.6**	**7**	**-**	**181.9**	**31**	**-**	**-**	**20**	**-**	**15**	**-**	**0.84**	**-**	**-**	**-**	**0.082**	**-**	**-**	**-**	**72.1**	**13.2**
	Minimum		**120**	**10**	**2**	**-**	**19**	**-**	**-**	**-**	**70**	**-**	**<0.1**	**-**	**<1**	**-**	**5**	**3**	**292**	**26**	**1**	**-**	**103**	**10**	**-**	**-**	**4**	**-**	**4**	**-**	**0.5**	**-**	**0**	**-**	**0.067**	**-**	**-**	**-**	**17**	**8**
	Maximum		**3110**	**140**	**6**	**-**	**42**	**-**	**-**	**-**	**110**	**-**	**0.4**	**-**	**4**	**-**	**16**	**6**	**3480**	**212**	**8**	**-**	**208**	**33**	**-**	**-**	**23**	**-**	**17**	**-**	**0.9**	**-**	**0**	**-**	**0.085**	**-**	**-**	**-**	**79**	**14**
219 Neubecks Creek	NC01	19/09/2019	660	60	1	-	25	-	<1	-	70	-	<0.1	-	<1	-	5	2	1070	154	2	-	198	59	<0.04	-	2	-	4	-	0.3	-	<1	-	0.067	-	<10	<10	14	5
219 Neubecks Creek	NC01	23/10/2019	70	-	<1	-	51	-	<1	-	60	-	<0.1	-	<1	-	<1	-	1040	-	<1	-	859	-	<0.04	-	1	-	3	-	0.2	-	<1	-	0.089	-	<10	-	74	-
219 Neubecks Creek	NC01	20/02/2020	1660	40	2	-	43	-	<1	-	90	-	<0.1	-	<1	-	4	1	3560	238	2	-	425	248	<0.04	-	7	-	10	-	0.6	-	<1	-	0.078	-	<10	<10	46	11
219 Neubecks Creek	NC01	22/07/2020	60	20	<1	-	19	-	<1	-	50	-	<0.1	-	<1	-	2	1	763	174	<1	-	124	111	<0.04	-	4	-	3	-	<0.2	-	<1	-	0.062	-	<10	<10	6	6
	Count Detects		**4**	**3**	**2**	**0**	**4**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**4**	**3**	**2**	**0**	**4**	**3**	**0**	**0**	**4**	**0**	**4**	**0**	**3**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**4**	**3**
	Average		**612.5**	**40**	**1.5**	**-**	**34.5**	**-**	**-**	**-**	**67.5**	**-**	**-**	**-**	**-**	**-**	**3.67**	**1.33**	**1608.25**	**188.67**	**2**	**-**	**401.5**	**139.33**	**-**	**-**	**3.5**	**-**	**5**	**-**	**0.37**	**-**	**-**	**-**	**0.074**	**-**	**-**	**-**	**35**	**7.33**
	50th Percentile		**365**	**40**	**1.5**	**-**	**34**	**-**	**-**	**-**	**65**	**-**	**-**	**-**	**-**	**-**	**4**	**1**	**1055**	**174**	**2**	**-**	**311.5**	**111**	**-**	**-**	**3**	**-**	**3.5**	**-**	**0.3**	**-**	**-**	**-**	**0.073**	**-**	**-**	**-**	**30**	**6**
	90th Percentile		**1360**	**56**	**1.9**	**-**	**48.6**	**-**	**-**	**-**	**84**	**-**	**-**	**-**	**-**	**-**	**4.8**	**1.8**	**2813**	**225.2**	**2**	**-**	**728.8**	**220.6**	**-**	**-**	**6.1**	**-**	**8.2**	**-**	**0.54**	**-**	**-**	**-**	**0.086**	**-**	**-**	**-**	**65.6**	**10**
	Minimum		**60**	**20**	**1**	**-**	**19**	**-**	**-**	**-**	**50**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**763**	**154**	**2**	**-**	**124**	**59**	**-**	**-**	**1**	**-**	**3**	**-**	**0.2**	**-**	**-**	**-**	**0.062**	**-**	**-**	**-**	**6**	**5**
	Maximum		**1660**	**60**	**2**	**-**	**51**	**-**	**-**	**-**	**90**	**-**	**-**	**-**	**-**	**-**	**5**	**2**	**3560**	**238**	**2**	**-**	**859**	**248**	**-**	**-**	**7**	**-**	**10**	**-**	**0.6**	**-**	**-**	**-**	**0.089**	**-**	**-**	**-**	**74**	**11**
3 Stream Gauge	WX22	25/09/2019	30	<10	<1	-	20	-	-	-	90	-	<0.1	-	<1	-	3	<1	179	95	<1	-	176	177	<0.04	-	<1	-	22	-	<0.2	-	<1	-	0.154	-	<10	<10	11	6
3 Stream Gauge	WX22	30/10/2019	30	-	<1	-	81	-	-	-	240	-	<0.1	-	<1	-	<1	-	674	-	<1	-	1430	-	0.14	-	<1	-	112	-	<0.2	-	<1	-	0.549	-	<10	-	43	-
WX22	WX22	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 Stream Gauge	WX22	27/11/2019	80	<10	<1	-	57	-	-	-	390	-	<0.1	-	<1	-	<1	<1	809	95	<1	-	1680	1580	<0.04	-	<1	-	122	-	<0.2	-	<1	-	0.745	-	<10	<10	46	44
3 Stream Gauge	WX22	22/01/2020	130	<10	<1	<1	31	31	-	-	470	-	<0.1	<0.1	<1	<1	1	1	648	80	<1	<1	9060	8620	<0.04	<0.04	<1	<1	[illegible]	-	0.4	0.4	<1	<1	0.896	0.896	<10	<10	142	133
3 Stream Gauge	WX22	26/02/2020	20	<10	<1	-	36	-	-	-	130	-	<0.1	-	<1	-	<1	<1	1000	596	<1	-	3260	3040	<0.04	-	<1	-	120	-	<0.2	-	<1	-	0.194	-	<10	<10	114	112
3 Stream Gauge	WX22	25/03/2020	<10	<10	<1	-	<27	-	-	-	70	-	<0.1	-	<1	-	<1	<1	1050	<550	<1	-	1770	1660	<0.04	-	<1	-	<53	-	<0.2	-	<1	-	0.134	-	<10	<10	<16	<14
3 Stream Gauge	WX22	24/06/2020	130	<10	<1	-	14	-	-	-	60	-	<0.1	-	<1	-	<1	<1	319	85	<1	-	156	151	<0.04	-	1	-	15	-	<0.2	-	<1	-	0.097	-	<10	<10	10	<5
	Count Detects		**6**	**0**	**0**	**0**	**6**	**1**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**7**	**5**	**0**	**0**	**7**	**6**	**1**	**0**	**1**	**0**	**5**	**0**	**1**	**1**	**0**	**0**	**7**	**1**	**0**	**0**	**6**	**4**
	Average		**70**	**-**	**-**	**-**	**39.8**	**31**	**-**	**-**	**207.1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**668.4286**	**190.2**	**-**	**-**	**2504.6**	**2538**	**0.14**	**-**	**1**	**-**	**78.2**	**-**	**0.4**	**0.4**	**-**	**-**	**0.396**	**0.896**	**-**	**-**	**61**	**73.8**
	50th Percentile		**55**	**-**	**-**	**-**	**33.5**	**31**	**-**	**-**	**130**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**674**	**95**	**-**	**-**	**1680**	**1620**	**0.14**	**-**	**1**	**-**	**112**	**-**	**0.4**	**0.4**	**-**	**-**	**0.194**	**0.896**	**-**	**-**	**44.5**	**78**
	90th Percentile		**130**	**-**	**-**	**-**	**69**	**31**	**-**	**-**	**422**	**-**	**-**	**-**	**-**	**-**	**2.8**	**1**	**1020**	**395.6**	**-**	**-**	**5580**	**5830**	**0.14**	**-**	**1**	**-**	**121.2**	**-**	**0.4**	**0.4**	**-**	**-**	**0.805**	**0.896**	**-**	**-**	**128**	**127**
	Minimum		**20**	**-**	**-**	**-**	**14**	**31**	**-**	**-**	**60**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**179**	**80**	**-**	**-**	**156**	**151**	**0.14**	**-**	**1**	**-**	**15**	**-**	**0.4**	**0.4**	**-**	**-**	**0.097**	**0.896**	**-**	**-**	**10**	**6**
	Maximum		**130**	**-**	**-**	**-**	**81**	**31**	**-**	**-**	**470**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1050**	**596**	**-**	**-**	**9060**	**8620**	**0.14**	**-**	**1**	**-**	**122**	**-**	**0.4**	**0.4**	**-**	**-**	**0.896**	**0.896**	**-**	**-**	**142**	**133**

Statistical Summary

Statistic	Aluminium	Aluminium (Filtered)	Arsenic	Arsenic (Filtered)	Barium	Barium (Filtered)	Beryllium	Beryllium (Filtered)	Boron	Boron (Filtered)	Cadmium	Cadmium (Filtered)	Chromium	Chromium (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Manganese	Manganese (Filtered)	Mercury	Mercury (Filtered)	Molybdenum	Molybdenum (Filtered)	Nickel	Nickel (Filtered)	Selenium	Selenium (Filtered)	Silver	Silver (Filtered)	Strontium	Strontium (Filtered)	Vanadium	Vanadium (Filtered)	Zinc	Zinc (Filtered)
Number of Results	33	30	33	19	33	19	26	18	33	18	33	19	33	19	33	30	33	30	33	19	33	30	33	19	33	19	32	18	33	19	33	19	33	19	33	30	33	30
Number of Detects	32	24	22	18	32	19	18	18	33	18	19	18	19	18	27	25	33	29	23	18	33	30	19	18	27	18	31	18	26	19	18	18	33	19	18	18	32	28
Minimum Concentration	4	0	0	0	4	0	0	0	4	0	0	0	0	0	<1	<1	4	3	0	0	4	3	0	0	<1	0	3	0	<0.2	0	0	0	0.062	0	0	0	4	3
Minimum Detect	4	3	1	ND	4	1	ND	ND	4	ND	0.2	ND	2	ND	1	1	4	3	1	ND	4	3	0.14	ND	1	ND	3	ND	0.2	0.4	4	ND	0.062	0.896	ND	ND	4	3
Maximum Concentration	3110	140	6	<1	81	31	<1	0	470	0	2	<0.1	4	<1	16	6	3560	596	8	<1	9060	8620	1	<0.04	23	<1	122	0	4	1	4	<1	7	1	<10	<10	142	133
Maximum Detect	3110	140	6	ND	81	31	ND	ND	470	ND	2	ND	4	ND	16	6	3560	596	8	ND	9060	8620	1	ND	23	ND	122	ND	4	1	4	ND	7	1	ND	ND	142	133
Average Concentration	616	41	1.8	0.13	33	21	0.36	0	128	0	0.2	0.013	1.3	0.13	5.1	2.3	1216	171	2.1	0.13	1269	1179	0.092	0.005	5	0.13	32	0	0.62	0.38	0.58	0.13	0.65	0.71	4.2	4	47	29
Median Concentration	130	20	1.25	0	31	31	0.5	0	90	0	0.05	0	0.5	0	3	1	1000	154	2	0	208	125.17	0.02	0	3	0	9.5	0	0.4	0.4	0.5	0	0.089	0.896	5	5	43	10
Standard Deviation	907	45	1.8	0.25	20	15	0.23	0	127	0	0.41	0.025	1.3	0.25	5.2	2	1105	146	2.2	0.25	2323	2383	0.21	0.01	6.4	0.25	44	0	0.8	0.29	0.83	0.25	1.5	0.4	1.9	2.1	40	43
Number of Guideline Exceedances	0	0	16	0	19	6	0	0	17	0	1	0	7	0	27	25	28	4	17	0	12	8	7	0	27	0	22	0	3	1	16	1	0	0	0	0	3	3
Number of Guideline Exceedances(Detects Only)	0	0	16	0	19	6	0	0	17	0	1	0	7	0	27	25	28	3	17	0	12	8	7	0	27	0	21	0	3	1	1	0	0	0	0	0	3	3

APPENDIX C TABULATED GROUNDWATER DATA

Field_ID	LocCode	Sampled_Date-Time	Physical Parameters					Major Anions and Cations								
			Electrical Conductivity (Field)	pH (Field)	Temperature (Field)	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS) (Filtered)	Calcium	Chloride	Fluoride	Magnesium	Potassium	Sodium	Sulfate (as SO4)	Total Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3) (Filtered)
			uS/cm	pH units	oC	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Environmental Goal - Groundwater			2600	6.5-8		2000	2000		350	1.5				1000		
Groundwater Collection Basin Pre-placement 90th Percentile			1576			1306	1306		31.5	0.435				824		
6 Groundwater Bore MPGM4	D1	26/09/2019	8650	5.91	-	7550	-	611	973	<0.1	506	60.6	1150	4110	175	-
6 Groundwater Bore MPGM4	D1	30/10/2019	8300	5.92	-	6410	-	570	929	<0.5	477	77.4	1180	3770	175	-
D1	D1	5/11/2019	5360	-	-	-	-	-	-	-	-	-	-	-	-	-
D1	D1	5/11/2019	6700	-	-	-	-	-	-	-	-	-	-	-	-	-
6 Groundwater Bore MPGM4	D1	27/11/2019	7530	5.95	-	5690	-	521	828	<0.5	415	51.8	939	3570	114	-
6 Groundwater Bore MPGM4	D1	22/01/2020	7240	5.92	-	6530	-	432	748	<1	363	67.4	770	3110	138	138
6 Groundwater Bore MPGM4	D1	26/02/2020	7470	5.90	-	7600	-	472	783	<1	388	64.2	894	3300	150	-
6 Groundwater Bore MPGM4	D1	25/03/2020	7460	5.90	-	6870	-	483	752	<1	396	70.6	900	2960	199	-
6 Groundwater Bore MPGM4	D1	24/06/2020	9040	5.93	-	7840	-	601	1020	<1	517	93.6	1090	4450	154	-
	Count Detects		**9**	**7**	**0**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**7**	**7**	**7**	**1**
	Average		**7528**	**5.9**	**-**	**6927**	**-**	**527**	**862**	**-**	**437**	**69**	**989**	**3610**	**158**	**138**
	50th Percentile		**7470**	**5.9**	**-**	**6870**	**-**	**521**	**828**	**-**	**415**	**67**	**939**	**3570**	**154**	**138**
	90th Percentile		**8728**	**5.9**	**-**	**7696**	**-**	**605**	**992**	**-**	**510**	**84**	**1162**	**4246**	**185**	**138**
	Minimum		**5360**	**5.90**	**-**	**5690**	**-**	**432**	**748**	**-**	**363**	**51.8**	**770**	**2960**	**114**	**138**
	Maximum		**9040**	**5.95**	**-**	**7840**	**-**	**611**	**1020**	**-**	**517**	**93.6**	**1180**	**4450**	**199**	**138**
13 Groundwater Bore MPGM4	D8	26/09/2019	448	5.66	-	314	-	27.3	20.1	<0.1	21.1	3.52	28.4	154	17	-
13 Groundwater Bore MPGM4	D8	31/10/2019	628	5.74	-	460	-	43.7	33.6	<0.05	29.5	5.47	45.4	218	23	-
D8	D8	5/11/2019	622	-	-	-	-	-	-	-	-	-	-	-	-	-
D8	D8	5/11/2019	625	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Groundwater Bore MPGM4	D8	28/11/2019	609	5.74	-	440	-	36.5	28.3	<1	28.3	3.84	38	206	15	-
13 Groundwater Bore MPGM4	D8	23/01/2020	1440	5.43	-	1240	-	112	95	<0.2	83.6	10.9	110	578	16	-
13 Groundwater Bore MPGM4	D8	27/02/2020	541	5.49	-	444	-	33	25.4	<0.05	25.5	4.06	31.1	195	11	-
13 Groundwater Bore MPGM4	D8	26/03/2020	535	6.40	-	482	-	33.2	23.2	<0.05	25.3	4.95	30.2	168	15	-
13 Groundwater Bore MPGM4	D8	25/06/2020	222	5.73	-	118	-	16	3.4	0.022	11.8	2.23	6.04	82.6	12	-
	Count Detects		**9**	**7**	**0**	**7**	**0**	**7**	**7**	**1**	**7**	**7**	**7**	**7**	**7**	**0**
	Average		**630**	**5.7**	**-**	**500**	**-**	**43**	**33**	**0**	**32**	**5**	**41**	**229**	**16**	**-**
	50th Percentile		**609**	**5.7**	**-**	**444**	**-**	**33**	**25**	**0**	**26**	**4**	**31**	**195**	**15**	**-**
	90th Percentile		**790**	**6.0**	**-**	**785**	**-**	**71**	**58**	**0**	**51**	**8**	**71**	**362**	**19**	**-**
	Minimum		**222**	**5.43**	**-**	**118**	**-**	**16**	**3.4**	**0.022**	**11.8**	**2.2**	**6.0**	**83**	**11**	**-**
	Maximum		**1440**	**6.40**	**-**	**1240**	**-**	**112**	**95.0**	**0.022**	**83.6**	**10.9**	**110**	**578**	**23**	**-**
14 Groundwater Bore MPGM4	D9	25/09/2019	8040	5.97	-	7180	-	658	974	<0.5	476	44.4	944	3830	140	-
14 Groundwater Bore MPGM4	D9	30/10/2019	8650	5.94	-	7090	-	616	1010	<0.5	482	58.2	1060	3960	138	-
D9	D9	5/11/2019	7487	-	-	-	-	-	-	-	-	-	-	-	-	-
D9	D9	5/11/2019	7498	-	-	-	-	-	-	-	-	-	-	-	-	-
14 Groundwater Bore MPGM4	D9	27/11/2019	9210	5.97	-	7320	-	715	1100	0.05	540	51.2	1120	4380	96	-
14 Groundwater Bore MPGM4	D9	22/01/2020	9310	6.00	-	8770	8770	612	1070	<1	514	71.4	1010	4280	120	120
14 Groundwater Bore MPGM4	D9	26/02/2020	9070	6.03	-	10,100	-	655	1070	<1	479	60.8	1030	4210	133	-
14 Groundwater Bore MPGM4	D9	25/03/2020	8840	6.16	-	8230	-	686	1020	<1	492	70.3	1060	3870	153	-
14 Groundwater Bore MPGM4	D9	24/06/2020	9100	6.14	-	8120	-	730	1190	0.214	526	74.6	1040	4700	142	-
	Count Detects		**9**	**7**	**0**	**7**	**1**	**7**	**7**	**2**	**7**	**7**	**7**	**7**	**7**	**1**
	Average		**8578**	**6.0**	**-**	**8116**	**8770**	**667**	**1062**	**0**	**501**	**62**	**1038**	**4176**	**132**	**120**
	50th Percentile		**8840**	**6.0**	**-**	**8120**	**8770**	**658**	**1070**	**0**	**492**	**61**	**1040**	**4210**	**138**	**120**
	90th Percentile		**9230**	**6.1**	**-**	**9302**	**8770**	**721**	**1136**	**0**	**532**	**73**	**1084**	**4508**	**146**	**120**
	Minimum		**7487**	**5.94**	**-**	**7090**	**8770**	**612**	**974**	**0.1**	**476**	**44.4**	**944**	**3830**	**96**	**120**
	Maximum		**9310**	**6.16**	**-**	**10100**	**8770**	**730**	**1190**	**0.2**	**540**	**74.6**	**1120**	**4700**	**153**	**120**

Field_ID	LocCode	Sampled_Date-Time	Metals																			
			Aluminium	Arsenic	Barium	Boron	Cadmium	Chromium	Copper	Iron	Iron (Filtered)	Lead	Manganese	Manganese (Filtered)	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Vanadium (Filtered)	Zinc
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Environmental Goal - Groundwater				24	700	370	2	5	5	664	664	5	5704	5704	0.06	10	550.9	5	0.05			908
Groundwater Collection Basin Pre-placement 90th Percentile				1	37	244	2	1	1	664	664	1	5704	5704	0.1	1	356	2	1			908
6 Groundwater Bore MPGM4	D1	26/09/2019	50	8	35	2360	<0.1	<1	<1	63,200	63,200	<1	28,300	28,300	<0.04	<1	1940	0.2	<1	<10	<10	176
6 Groundwater Bore MPGM4	D1	30/10/2019	70	5	32	2520	<0.1	<1	<1	24,000	-	<1	23,900	-	0.24	<1	1810	0.2	<1	<10	-	153
D1	D1	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D1	D1	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 Groundwater Bore MPGM4	D1	27/11/2019	50	4	30	2320	<0.1	<1	<1	27,100	-	<1	21,300	-	<0.04	<1	1480	<0.2	<1	<10	<10	112
6 Groundwater Bore MPGM4	D1	22/01/2020	<10	1	25	2290	<0.1	<1	<1	15,200	15,200	<1	18,900	18,900	<0.04	<1	1370	<0.2	<1	<10	<10	85
6 Groundwater Bore MPGM4	D1	26/02/2020	40	4	27	2330	<0.1	<1	<1	-	11,400	<1	-	22,800	<0.04	<1	1350	<0.2	<1	<10	<10	112
6 Groundwater Bore MPGM4	D1	25/03/2020	60	6	27	2340	<0.1	<1	<1	-	48,700	<1	-	20,000	<0.04	<1	1420	<0.2	<1	<10	<10	138
6 Groundwater Bore MPGM4	D1	24/06/2020	60	8	32	2560	<0.1	<1	<1	-	55,800	<1	-	25,700	<0.04	<1	1860	0.4	<1	<10	<10	181
	Count Detects		**6**	**7**	**7**	**7**	**0**	**0**	**0**	**4**	**5**	**0**	**4**	**5**	**1**	**0**	**7**	**3**	**0**	**0**	**0**	**7**
	Average		**55**	**5**	**30**	**2389**	**-**	**-**	**-**	**32375**	**38860**	**-**	**23100**	**23140**	**0.2**	**-**	**1604**	**0.3**	**-**	**-**	**-**	**137**
	50th Percentile		**55**	**5**	**30**	**2340**	**-**	**-**	**-**	**25550**	**48700**	**-**	**22600**	**22800**	**0.2**	**-**	**1480**	**0.2**	**-**	**-**	**-**	**138**
	90th Percentile		**65**	**8**	**33**	**2536**	**-**	**-**	**-**	**52370**	**60240**	**-**	**26980**	**27260**	**0.2**	**-**	**1892**	**0.4**	**-**	**-**	**-**	**178**
	Minimum		**40**	**1**	**25**	**2290**	**-**	**-**	**-**	**15200**	**11400**	**-**	**18900**	**18900**	**0.2**	**-**	**1350**	**0.2**	**-**	**-**	**-**	**85**
	Maximum		**70**	**8**	**35**	**2560**	**-**	**-**	**-**	**63200**	**63200**	**-**	**28300**	**28300**	**0.2**	**-**	**1940**	**0.4**	**-**	**-**	**-**	**181**
13 Groundwater Bore MPGM4	D8	26/09/2019	340	<1	24	70	<0.1	<1	4	-	80	<1	393	393	<0.04	<1	32	<0.2	<1	<10	<10	39
13 Groundwater Bore MPGM4	D8	31/10/2019	70	<1	22	130	<0.1	<1	3	-	-	<1	828	-	<0.04	<1	50	<0.2	<1	<10	-	63
D8	D8	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D8	D8	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Groundwater Bore MPGM4	D8	28/11/2019	70	<1	27	90	<0.1	<1	2	-	848	<1	1170	-	<0.04	<1	66	<0.2	<1	<10	<10	78
13 Groundwater Bore MPGM4	D8	23/01/2020	<10	<1	54	200	<0.1	<1	2	-	4470	<1	3900	3900	<0.04	<1	183	<0.2	<1	<10	<10	179
13 Groundwater Bore MPGM4	D8	27/02/2020	270	<1	48	110	<0.1	<1	2	-	39	<1	-	616	<0.04	<1	48	<0.2	<1	<10	<10	55
13 Groundwater Bore MPGM4	D8	26/03/2020	680	<1	45	<50	<0.1	<1	3	-	9	2	-	780	<0.04	<1	50	<0.2	<1	<10	<10	77
13 Groundwater Bore MPGM4	D8	25/06/2020	580	<1	25	<50	<0.1	<1	4	-	176	<1	-	45	<0.04	<1	20	<0.2	<1	<10	<10	32
	Count Detects		**6**	**0**	**7**	**5**	**0**	**0**	**7**	**0**	**6**	**1**	**4**	**5**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**7**
	Average		**335**	**-**	**35**	**120**	**-**	**-**	**3**	**-**	**937**	**2**	**1573**	**1147**	**-**	**-**	**64**	**-**	**-**	**-**	**-**	**75**
	50th Percentile		**305**	**-**	**27**	**110**	**-**	**-**	**3**	**-**	**128**	**2**	**999**	**616**	**-**	**-**	**50**	**-**	**-**	**-**	**-**	**63**
	90th Percentile		**630**	**-**	**50**	**172**	**-**	**-**	**4**	**-**	**2659**	**2**	**3081**	**2652**	**-**	**-**	**113**	**-**	**-**	**-**	**-**	**118.4**
	Minimum		**70**	**-**	**22**	**70**	**-**	**-**	**2**	**-**	**9**	**2**	**393**	**45**	**-**	**-**	**20**	**-**	**-**	**-**	**-**	**32**
	Maximum		**680**	**-**	**54**	**200**	**-**	**-**	**4**	**-**	**4470**	**2**	**3900**	**3900**	**-**	**-**	**183**	**-**	**-**	**-**	**-**	**179**
14 Groundwater Bore MPGM4	D9	25/09/2019	20	3	34	1500	<0.1	<1	<1	-	65,800	<1	21,700	21,700	0.06	2	1440	<0.2	<1	<10	<10	104
14 Groundwater Bore MPGM4	D9	30/10/2019	40	2	41	1640	<0.1	<1	<1	-	-	<1	21,300	-	<0.04	1	1660	0.2	<1	<10	-	104
D9	D9	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D9	D9	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14 Groundwater Bore MPGM4	D9	27/11/2019	30	2	39	1620	<0.1	<1	1	-	39,000	<1	22,600	-	0.05	<1	1740	<0.2	<1	<10	<10	113
14 Groundwater Bore MPGM4	D9	22/01/2020	<10	1	34	1600	<0.1	<1	<1	-	10,600	<1	21,000	21,000	<0.04	<1	1680	0.2	<1	<10	<10	96
14 Groundwater Bore MPGM4	D9	26/02/2020	20	2	39	1930	<0.1	1	<1	-	9940	<1	-	22,600	<0.04	<1	1750	0.2	<1	<10	<10	89
14 Groundwater Bore MPGM4	D9	25/03/2020	540	8	40	1560	0.2	1	7	-	62,900	13	-	18,600	0.05	1	1510	1.1	<1	<10	<10	1130
14 Groundwater Bore MPGM4	D9	24/06/2020	140	3	36	1650	0.1	<1	2	-	69,000	<1	-	20,400	0.31	1	1620	0.4	<1	<10	<10	121
	Count Detects		**6**	**7**	**7**	**7**	**2**	**2**	**3**	**0**	**6**	**1**	**4**	**5**	**4**	**4**	**7**	**5**	**0**	**0**	**0**	**7**
	Average		**132**	**3**	**38**	**1643**	**0.2**	**1**	**3**	**-**	**42873**	**13**	**21650**	**20860**	**0.1**	**1**	**1629**	**0.4**	**-**	**-**	**-**	**251**
	50th Percentile		**35**	**2**	**39**	**1620**	**0.2**	**1**	**2**	**-**	**50950**	**13**	**21500**	**21000**	**0.1**	**1**	**1660**	**0.2**	**-**	**-**	**-**	**104**
	90th Percentile		**340**	**5**	**40**	**1762**	**0.2**	**1**	**6**	**-**	**67400**	**13**	**22330**	**22240**	**0.2**	**2**	**1744**	**0.8**	**-**	**-**	**-**	**524.6**
	Minimum		**20**	**1**	**34**	**1500**	**0.1**	**1**	**1**	**-**	**9940**	**13**	**21000**	**18600**	**0.1**	**1**	**1440**	**0.2**	**-**	**-**	**-**	**89**
	Maximum		**540**	**8**	**41**	**1930**	**0.2**	**1**	**7**	**-**	**69000**	**13**	**22600**	**22600**	**0.3**	**2**	**1750**	**1.1**	**-**	**-**	**-**	**1130**

			Physical Parameters					Major Anions and Cations									Metals																			
			Electrical Conductivity (Field)	pH (Field)	Temperature (Field)	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS) (Filtered)	Calcium	Chloride	Fluoride	Magnesium	Potassium	Sodium	Sulfate (as SO4)	Total Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3) (Filtered)	Aluminium	Arsenic	Barium	Boron	Cadmium	Chromium	Copper	Iron	Iron (Filtered)	Lead	Manganese	Manganese (Filtered)	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Vanadium (Filtered)	Zinc
			uS/cm	pH units	oC	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Environmental Goal - Groundwater			2600	6.5-8		2000	2000		350	1.5				1000				24	700	370	2	5	5	664	664	5	5704	5704	0.06	10	550.9	5	0.05			908
Groundwater Collection Basin Pre-placement 90th Percentile			1576			1306	1306		31.5	0.435				824				1	37	244	2	1	1	664	664	1	5704	5704	0.1	1	356	2	1			908
Field_ID	**LocCode**	**Sampled_Date-Time**																																		
15 Groundwater Bore MPGM4	D10	31/10/2019	10,580	5.56	-	8050	-	315	899	<1	336	232	1870	5380	89	-	80	<1	35	5030	6.8	<1	<1	6290	-	7	8530	-	<0.04	<1	1120	2.4	<1	<10	-	1080
D10	D10	5/11/2019	4963	-	17.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D10	D10	5/11/2019	9299	-	17.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15 Groundwater Bore MPGM4	D10	28/11/2019	11,230	5.60	-	9440	-	373	936	<0.5	402	224	2060	5870	80	-	90	<1	19	5070	6.9	<1	<1	4420	-	5	8730	-	<0.04	<1	1110	2.9	<1	<10	<10	986
15 Groundwater Bore MPGM4	D10	23/01/2020	10,290	5.61	-	8840	-	315	843	<1	344	278	1720	4870	89	-	70	<1	14	4290	5.1	<1	<1	8120	8120	6	7150	7150	<0.04	<1	976	1.6	<1	<10	<10	881
15 Groundwater Bore MPGM4	D10	27/02/2020	5910	5.54	-	4750	-	173	386	<1	155	112	993	2520	64	-	50	<1	14	1630	1.9	<1	<1	-	13,500	1	-	3510	<0.04	<1	509	0.5	<1	<10	<10	731
15 Groundwater Bore MPGM4	D10	24/06/2020	4620	5.85	-	3440	-	136	303	0.336	98.1	72.2	685	2140	105	-	20	<1	16	940	1	<1	<1	-	12,700	9	-	2600	<0.04	<1	404	0.6	<1	<10	<10	583
	Count Detects		**7**	**5**	**2**	**5**	**0**	**5**	**5**	**1**	**5**	**5**	**5**	**5**	**5**	**0**	**5**	**0**	**5**	**5**	**5**	**0**	**0**	**3**	**3**	**5**	**3**	**3**	**0**	**0**	**5**	**5**	**0**	**0**	**0**	**5**
	Average		**8127**	**5.6**	**17.4**	**6904**	**-**	**262**	**673**	**0**	**267**	**184**	**1466**	**4156**	**85**	**-**	**62**	**-**	**20**	**3392**	**4**	**-**	**-**	**6277**	**11440**	**6**	**8137**	**4420**	**-**	**-**	**824**	**1.6**	**-**	**-**	**-**	**852.2**
	50th Percentile		**9299**	**5.6**	**17.4**	**8050**	**-**	**315**	**843**	**0**	**336**	**224**	**1720**	**4870**	**89**	**-**	**70**	**-**	**16**	**4290**	**5**	**-**	**-**	**6290**	**12700**	**6**	**8530**	**3510**	**-**	**-**	**976**	**1.6**	**-**	**-**	**-**	**881**
	90th Percentile		**10840**	**5.8**	**17.4**	**9200**	**-**	**350**	**921**	**0**	**379**	**260**	**1984**	**5674**	**99**	**-**	**86**	**-**	**29**	**5054**	**7**	**-**	**-**	**7754**	**13340**	**8**	**8690**	**6422**	**-**	**-**	**1116**	**2.7**	**-**	**-**	**-**	**1042.4**
	Minimum		**4620**	**5.54**	**17.4**	**3440**	**-**	**136**	**303**	**0.3**	**98.1**	**72.2**	**685**	**2140**	**64**	**-**	**20**	**-**	**14**	**940**	**1**	**-**	**-**	**4420**	**8120**	**1**	**7150**	**2600**	**-**	**-**	**404**	**0.5**	**-**	**-**	**-**	**583**
	Maximum		**11230**	**5.85**	**17.4**	**9440**	**-**	**373**	**936**	**0.3**	**402**	**278**	**2060**	**5870**	**105**	**-**	**90**	**-**	**35**	**5070**	**6.9**	**-**	**-**	**8120**	**13500**	**9**	**8730**	**7150**	**-**	**-**	**1120**	**2.9**	**-**	**-**	**-**	**1080**
16 Groundwater Bore MPGM4	D11	26/09/2019	10,330	6.20	-	9260	-	603	1070	<0.5	458	102	1680	5040	161	-	<10	10	19	2640	<0.1	<1	<1	121,000	121,000	<1	19,400	19,400	<0.04	<1	1060	0.2	<1	<10	<10	100
16 Groundwater Bore MPGM4	D11	31/10/2019	9900	6.25	-	7600	-	513	1060	<1	416	130	1640	5240	195	-	<10	3	35	2870	<0.1	<1	<1	49,200	-	<1	16,400	-	<0.04	<1	992	0.3	<1	<10	-	78
D11	D11	5/11/2019	2784	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D11	D11	5/11/2019	10,100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16 Groundwater Bore MPGM4	D11	28/11/2019	9860	6.28	-	7740	-	574	984	<0.5	419	108	1540	4740	86	-	20	6	40	2740	<0.1	<1	<1	71,600	-	<1	16,500	-	<0.04	<1	947	<0.2	<1	<10	<10	66
16 Groundwater Bore MPGM4	D11	23/01/2020	9320	6.29	-	8580	-	479	874	<1	358	116	1160	4090	171	-	<10	3	55	2630	<0.1	<1	<1	50,200	50,200	<1	14,300	14,300	<0.04	<1	791	0.3	<1	<10	<10	13
16 Groundwater Bore MPGM4	D11	27/02/2020	9950	6.23	-	9550	-	672	971	<1	499	124	1840	4650	145	-	<10	2	26	2700	<0.1	<1	<1	-	21,800	<1	-	18,700	<0.04	<1	849	<0.2	<1	<10	<10	42
16 Groundwater Bore MPGM4	D11	26/03/2020	10,210	6.30	-	9170	-	568	982	<1	433	113	1620	4600	161	-	30	8	18	3110	<0.1	<1	<1	-	110,000	<1	-	16,200	<0.04	<1	925	0.2	<1	<10	<10	97
	Count Detects		**8**	**6**	**0**	**6**	**0**	**6**	**6**	**0**	**6**	**6**	**6**	**6**	**6**	**0**	**2**	**6**	**6**	**6**	**0**	**0**	**0**	**4**	**4**	**0**	**4**	**4**	**0**	**0**	**6**	**4**	**0**	**0**	**0**	**6**
	Average		**9057**	**6.3**	**-**	**8650**	**-**	**568**	**990**	**<0.8**	**431**	**116**	**1580**	**4727**	**153**	**-**	**25**	**5**	**32**	**2782**	**-**	**-**	**-**	**73000**	**75750**	**-**	**16650**	**17150**	**-**	**-**	**927**	**0.25**	**-**	**-**	**-**	**66**
	50th Percentile		**9925**	**6.3**	**-**	**8875**	**-**	**571**	**983**	**<1**	**426**	**115**	**1630**	**4695**	**161**	**-**	**25**	**5**	**31**	**2720**	**-**	**-**	**-**	**60900**	**80100**	**-**	**16450**	**17450**	**-**	**-**	**936**	**0.25**	**-**	**-**	**-**	**72**
	90th Percentile		**10246**	**6.3**	**-**	**9405**	**-**	**638**	**1065**	**<1**	**479**	**127**	**1760**	**5140**	**183**	**-**	**29**	**9**	**48**	**2990**	**-**	**-**	**-**	**106180**	**117700**	**-**	**18530**	**19190**	**-**	**-**	**1026**	**0.3**	**-**	**-**	**-**	**99**
	Minimum		**2784**	**6.20**	**-**	**7600**	**-**	**479**	**874**	**<0.5**	**358**	**102**	**1160**	**4090**	**86**	**-**	**20**	**2**	**18**	**2630**	**-**	**-**	**-**	**49200**	**21800**	**-**	**14300**	**14300**	**-**	**-**	**791**	**0.2**	**-**	**-**	**-**	**13**
	Maximum		**10330**	**6.30**	**-**	**9550**	**-**	**672**	**1070**	**<1.0**	**499**	**130**	**1840**	**5240**	**195**	**-**	**30**	**10**	**55**	**3110**	**-**	**-**	**-**	**121000**	**121000**	**-**	**19400**	**19400**	**-**	**-**	**1060**	**0.3**	**-**	**-**	**-**	**100**
220 Groundwater Bore MPGM4	D15	25/09/2019	3630	4.97	-	2860	-	252	191	<0.5	111	38.1	541	1840	20	-	720	4	16	160	0.5	10	3	32,500	32,500	5	2520	2520	0.06	<1	890	0.3	<1	<10	<10	1600
220 Groundwater Bore MPGM4	D15	30/10/2019	3640	4.93	-	2730	-	243	187	<0.5	103	38.6	476	1840	12	-	860	5	20	210	0.5	52	6	29,300	-	6	2240	-	0.07	2	934	0.5	<1	<10	-	1610
D15	D15	4/11/2019	3357	-	16.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D15	D15	4/11/2019	3385	-	16.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220 Groundwater Bore MPGM4	D15	27/11/2019	3600	5.50	-	2790	-	242	177	<0.5	107	36.7	516	1830	8	-	1330	6	18	200	0.5	129	7	30,000	-	7	2160	-	<0.04	5	934	0.4	<1	<10	<10	1560
220 Groundwater Bore MPGM4	D15	22/01/2020	3530	4.94	-	3460	-	249	166	<0.5	110	48.6	426	1600	<1	-	4050	37	50	210	0.9	34	102	27,500	27,500	61	2120	2120	0.14	3	853	12.6	<1	10	<10	1710
220 Groundwater Bore MPGM4	D15	26/02/2020	3530	5.10	-	3040	-	223	166	<0.5	102	43.5	423	1680	4	-	16,600	124	139	260	1.4	106	191	-	11,300	119	-	2240	0.09	12	821	12.4	<1	50	<10	1810
220 Groundwater Bore MPGM4	D15	26/03/2020	3380	5.68	-	2940	-	252	147	<0.5	113	46.4	466	1510	16	-	530	4	27	220	0.7	7	4	-	29,200	9	-	2040	<0.04	<1	740	1.1	<1	<10	<10	1350
220 Groundwater Bore MPGM4	D15	24/06/2020	3340	5.15	-	2670	-	233	152	<0.5	102	40.8	378	1700	23	-	880	6	15	200	0.4	52	8	-	26,600	6	-	2010	<0.04	2	799	0.9	<1	<10	<10	1350
	Count Detects		**9**	**7**	**2**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**7**	**7**	**6**	**0**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**4**	**5**	**7**	**4**	**5**	**4**	**5**	**7**	**7**	**0**	**2**	**0**	**7**
	Average		**3488**	**5.2**	**16.5**	**2927**	**-**	**242**	**169**	**<0.5**	**107**	**42**	**461**	**1714**	**14**	**-**	**3567**	**27**	**41**	**209**	**1**	**56**	**46**	**29825**	**25420**	**30**	**2260**	**2186**	**0.1**	**5**	**853**	**4**	**<1**	**30**	**-**	**1570**
	50th Percentile		**3530**	**5.1**	**16.5**	**2860**	**-**	**243**	**166**	**<0.5**	**107**	**41**	**466**	**1700**	**14**	**-**	**880**	**6**	**20**	**210**	**1**	**52**	**7**	**29650**	**27500**	**7**	**2200**	**2120**	**0.1**	**3**	**853**	**1**	**<1**	**30**	**-**	**1600**
	90th Percentile		**3632**	**5.6**	**16.5**	**3208**	**-**	**252**	**189**	**<0.5**	**112**	**47**	**526**	**1840**	**22**	**-**	**9070**	**72**	**86**	**236**	**1**	**115**	**138**	**31750**	**31180**	**84**	**2436**	**2408**	**0.1**	**9**	**934**	**12**	**<1**	**46**	**-**	**1750**
	Minimum		**3340**	**4.93**	**16.5**	**2670**	**-**	**223**	**147**	**<0.5**	**102**	**36.7**	**378**	**1510**	**4**	**-**	**530**	**4**	**15**	**160**	**0.4**	**7**	**3**	**27500**	**11300**	**5**	**2120**	**2010**	**0.1**	**2**	**740**	**0.3**	**<1**	**10**	**-**	**1350**
	Maximum		**3640**	**5.68**	**16.5**	**3460**	**-**	**252**	**191**	**<0.5**	**113**	**48.6**	**541**	**1840**	**23**	**-**	**16600**	**124**	**139**	**260**	**1.4**	**129**	**191**	**32500**	**32500**	**119**	**2520**	**2520**	**0.1**	**12**	**934**	**12.6**	**<1**	**50**	**-**	**1810**
221 Groundwater Bore MPGM4	D16	25/09/2019	2010	6.31	-	1590	-	262	104	0.171	96.7	26.8	31.2	846	177	-	30	<1	9	<50	<0.1	<1	<1	3010	3010	<1	62	62	<0.04	<1	16	<0.2	<1	<10	<10	<5
221 Groundwater Bore MPGM4	D16	30/10/2019	1960	6.35	-	1560	-	276	93.1	<0.1	92.1	26.5	30.8	773	212	-	<10	<1	10	<50	<0.1	<1	<1	3700	-	<1	55	-	<0.04	<1	15	<0.2	<1	<10	-	<5
D16	D16	4/11/2019	1810	-	16.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D16	D16	4/11/2019	2023	-	15.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
221 Groundwater Bore MPGM4	D16	27/11/2019	1870	6.82	-	1410	1410	269	89.4	<0.1	93.7	26.1	26.2	775	210	-	<10	<1	10	<50	<0.1	<1	<1	2740	-	<1	57	-	<0.04	<1	12	<0.2	<1	<10	<10	<5
221 Groundwater Bore MPGM4	D16	22/01/2020	1760	6.43	-	1560	1560	258	77.8	0.218	88.8	30.3	41.4	680	216	-	<10	<1	8	<50	<0.1	<1	<1	2700	2700	<1	46	46	<0.04	<1	12	<0.2	<1	<10	<10	14
221 Groundwater Bore MPGM4	D16	26/02/2020	1900	6.36	-	1570	-	256	93	<0.2	89.3	25.6	33.4	768	189	-	20	<1	10	<50	<0.1	4	<1	2790	2790	<1	57	57	<0.04	<1	13	<0.2	<1	<10	<10	<5
221 Groundwater Bore MPGM4	D16	25/03/2020	1940	6.36	-	1660	-	289	96	<0.2	101	30.8	41.7	775	208	-	<10	<1	14	<50	<0.1	2	<1	-	3060	<1	-	62	<0.04	<1	16	<0.2	<1	<10	<10	<5
221 Groundwater Bore MPGM4	D16	24/06/2020	2070	6.46	-	1610	-	286	105	0.193	98.9	28.6	40	898	202	-	<10	<1	10	<50	<0.1	2	<1	-	3540	<1	-	65	<0.04	<1	19	<0.2	<1	<10	<10	7
	Count Detects		**9**	**7**	**2**	**7**	**2**	**7**	**7**	**3**	**7**	**7**	**7**	**7**	**7**	**0**	**2**	**0**	**7**	**0**	**0**	**3**	**0**	**5**	**5**	**0**	**5**	**5**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**2**
	Average		**1927**	**6.4**	**16.3**	**1566**	**1485**	**271**	**94**	**0.2**	**94**	**28**	**35**	**788**	**202**	**-**	**25**	**-**	**10**	**-**	**-**	**3**	**-**	**2988**	**3020**	**-**	**55**	**58**	**-**	**-**	**15**	**-**	**-**	**-**	**-**	**11**
	50th Percentile		**1940**	**6.4**	**16.3**	**1570**	**1485**	**269**	**93**	**0.2**	**94**	**27**	**33**	**775**	**208**	**-**	**25**	**-**	**10**	**-**	**-**	**2**	**-**	**2790**	**3010**	**-**	**57**	**62**	**-**	**-**	**15**	**-**	**-**	**-**	**-**	**11**
	90th Percentile		**2032**	**6.6**	**16.6**	**1630**	**1545**	**287**	**104**	**0.2**	**100**	**31**	**42**	**867**	**214**	**-**	**29**	**-**	**12**	**-**	**-**	**4**	**-**	**3424**	**3348**	**-**	**60**	**64**	**-**	**-**	**17**	**-**	**-**	**-**	**-**	**13**
	Minimum		**1760**	**6.31**	**15.9**	**1410**	**1410**	**256**	**77.8**	**0.2**	**88.8**	**25.6**	**26.2**	**680**	**177**	**-**	**20**	**-**	**8**	**-**	**-**	**2**	**-**	**2700**	**2700**	**-**	**46**	**46**	**-**	**-**	**12**	**-**	**-**	**-**	**-**	**7**
	Maximum		**2070**	**6.82**	**16.7**	**1660**	**1560**	**289**	**105**	**0.2**	**101**	**30.8**	**41.7**	**898**	**216**	**-**	**30**	**-**	**14**	**-**	**-**	**4**	**-**	**3700**	**3540**	**-**	**62**	**65**	**-**	**-**	**19**	**-**	**-**	**-**	**-**	**14**

Field_ID	LocCode	Sampled_Date-Time	Electrical Conductivity (Field)	pH (Field)	Temperature (Field)	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS) (Filtered)	Calcium	Chloride	Fluoride	Magnesium	Potassium	Sodium	Sulfate (as SO4)	Total Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3) (Filtered)
			Physical Parameters					Major Anions and Cations								
			uS/cm	pH units	oC	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Environmental Goal - Groundwater			2600	6.5-8		2000	2000		350	1.5				1000		
Groundwater Collection Basin Pre-placement 90th Percentile			1576			1306	1306		31.5	0.435				824		
222 Groundwater Bore MPGM4	D17	25/09/2019	3540	6.13	-	2700	-	270	216	<0.5	159	22.4	445	1620	116	-
222 Groundwater Bore MPGM4	D17	30/10/2019	3580	6.09	-	2680	-	260	208	<0.5	150	23.9	400	1580	117	-
D17	D17	4/11/2019	2807	-	19	-	-	-	-	-	-	-	-	-	-	-
D17	D17	4/11/2019	1452	-	18.7	-	-	-	-	-	-	-	-	-	-	-
222 Groundwater Bore MPGM4	D17	27/11/2019	3570	6.16	-	2850	-	253	219	<0.5	155	21.2	437	1700	90	-
222 Groundwater Bore MPGM4	D17	22/01/2020	3080	6.10	-	2620	-	240	179	<0.5	132	24.5	270	1320	113	-
222 Groundwater Bore MPGM4	D17	24/06/2020	3480	6.15	-	2620	-	259	228	0.105	153	25.3	318	1800	130	-
	Count Detects		**7**	**5**	**2**	**5**	**0**	**5**	**5**	**1**	**5**	**5**	**5**	**5**	**5**	**0**
	Average		**3073**	**6.1**	**18.9**	**2694**	**-**	**256**	**210**	**0.1**	**150**	**23**	**374**	**1604**	**113**	**-**
	50th Percentile		**3480**	**6.1**	**18.9**	**2680**	**-**	**259**	**216**	**0.1**	**153**	**24**	**400**	**1620**	**116**	**-**
	90th Percentile		**3574**	**6.2**	**19**	**2790**	**-**	**266**	**224**	**0.1**	**157**	**25**	**442**	**1760**	**125**	**-**
	Minimum		**1452**	**6.09**	**18.7**	**2620**	**-**	**240**	**179**	**0.1**	**132**	**21**	**270**	**1320**	**90**	**-**
	Maximum		**3580**	**6.16**	**19**	**2850**	**-**	**270**	**228**	**0.1**	**159**	**25**	**445**	**1800**	**130**	**-**
223 Groundwater Bore MPGM4	D18	26/09/2019	660	6.64	-	391	-	82.2	7.7	0.4	31.0	18.5	15.0	9.7	315	-
223 Groundwater Bore MPGM4	D18	31/10/2019	680	6.63	-	356	-	83.9	8.1	0.3	28.7	17.2	16.5	11.9	369	-
223 Groundwater Bore MPGM4	D18	28/11/2019	680	6.70	-	352	-	81.3	7.9	0.3	31.0	16.4	14.2	9.4	349	-
223 Groundwater Bore MPGM4	D18	23/01/2020	680	6.76	-	448	-	83.7	8.4	0.4	31.4	18.7	20.8	12.1	351	-
223 Groundwater Bore MPGM4	D18	27/02/2020	660	6.72	-	386	-	77.1	7.5	<0.1	28.8	16.2	14.0	9.8	353	-
223 Groundwater Bore MPGM4	D18	26/03/2020	680	7.00	-	406	-	80.4	15.8	0.4	30.8	19.2	17.0	13.2	377	-
223 Groundwater Bore MPGM4	D18	25/06/2020	660	6.67	-	310	-	73.2	79.6	4.6	26.9	16.2	14.4	103.0	362	-
223 Groundwater Bore MPGM4	D18	17/09/2020	680	6.67	-	-	-	-	-	-	-	-	-	-	-	-
	Count Detects		**8**	**8**	**0**	**7**	**0**	**7**	**7**	**6**	**7**	**7**	**7**	**7**	**7**	**0**
	Average		**673**	**6.7**	**-**	**378**	**-**	**80**	**19**	**1.1**	**30**	**17**	**16**	**24**	**354**	**-**
	50th Percentile		**680**	**6.7**	**-**	**386**	**-**	**81**	**8**	**0.4**	**31**	**17**	**15**	**12**	**353**	**-**
	90th Percentile		**680**	**6.8**	**-**	**423**	**-**	**84**	**41**	**2.5**	**31**	**19**	**19**	**49**	**372**	**-**
	Minimum		**660**	**6.63**	**-**	**310**	**-**	**73.2**	**7.5**	**0.3**	**26.9**	**16.2**	**14.0**	**9.4**	**315**	**-**
	Maximum		**680**	**7.00**	**-**	**448**	**-**	**83.9**	**80**	**4.6**	**31.4**	**19.2**	**20.8**	**103.0**	**377**	**-**
224 Groundwater Bore MPGM4	D19	25/09/2019	3490	5.59	-	2520	-	158	228	<0.5	125	46.1	571	1590	53	-
224 Groundwater Bore MPGM4	D19	30/10/2019	4750	5.92	-	3480	-	236	316	<0.5	197	68.5	761	2290	125	-
D19	D19	4/11/2019	4554	-	16.9	-	-	-	-	-	-	-	-	-	-	-
D19	D19	4/11/2019	4292	-	17	-	-	-	-	-	-	-	-	-	-	-
224 Groundwater Bore MPGM4	D19	27/11/2019	5190	6.12	-	3300	-	229	337	<1	201	66.8	832	2420	117	-
224 Groundwater Bore MPGM4	D19	22/01/2020	5550	5.97	-	4630	-	261	358	<1	226	84.9	715	2370	118	-
224 Groundwater Bore MPGM4	D19	26/02/2020	6240	6.05	-	5300	-	237	430	<1	209	98.1	941	2800	116	-
224 Groundwater Bore MPGM4	D19	26/03/2020	5250	6.14	-	4480	-	192	341	<0.5	172	93.1	827	2210	146	-
224 Groundwater Bore MPGM4	D19	24/06/2020	4480	6.04	-	3450	-	153	295	0.179	132	81.6	628	2190	151	-
	Count Detects		**9**	**7**	**2**	**7**	**0**	**7**	**7**	**1**	**7**	**7**	**7**	**7**	**7**	**0**
	Average		**4866**	**6.0**	**17**	**3880**	**-**	**209**	**329**	**0.2**	**180**	**77**	**754**	**2267**	**118**	**-**
	50th Percentile		**4750**	**6.0**	**17**	**3480**	**-**	**229**	**337**	**0.2**	**197**	**82**	**761**	**2290**	**118**	**-**
	90th Percentile		**5688**	**6.1**	**17**	**4898**	**-**	**247**	**387**	**0.2**	**216**	**95**	**876**	**2572**	**148**	**-**
	Minimum		**3490**	**5.59**	**17**	**2520**	**-**	**153**	**228**	**0.2**	**125**	**46.1**	**571**	**1590**	**53**	**-**
	Maximum		**6240**	**6.14**	**17**	**5300**	**-**	**261**	**430**	**0.2**	**226**	**98.1**	**941**	**2800**	**151**	**-**

Field_ID	LocCode	Sampled_Date-Time	Aluminium	Arsenic	Barium	Boron	Cadmium	Chromium	Copper	Iron	Iron (Filtered)	Lead	Manganese	Manganese (Filtered)	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Vanadium (Filtered)	Zinc
			Metals																			
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Environmental Goal - Groundwater				24	700	370	2	5	5	664	664	5	5704	5704	0.06	10	550.9	5	0.05			908
Groundwater Collection Basin Pre-placement 90th Percentile				1	37	244	2	1	1	664	664	1	5704	5704	0.1	1	356	2	1			908
222 Groundwater Bore MPGM4	D17	25/09/2019	10	2	16	100	<0.1	<1	<1	29,600	29,600	<1	3550	3550	<0.04	<1	98	<0.2	<1	<10	<10	83
222 Groundwater Bore MPGM4	D17	30/10/2019	<10	<1	13	230	<0.1	<1	<1	2460	-	<1	3090	-	<0.04	<1	98	<0.2	<1	<10	-	63
D17	D17	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D17	D17	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222 Groundwater Bore MPGM4	D17	27/11/2019	160	2	15	190	<0.1	5	<1	16,400	-	<1	3200	-	<0.04	<1	102	<0.2	<1	<10	<10	76
222 Groundwater Bore MPGM4	D17	22/01/2020	390	2	22	220	<0.1	2	<1	8480	8480	<1	2340	2340	<0.04	<1	58	<0.2	<1	<10	<10	41
222 Groundwater Bore MPGM4	D17	24/06/2020	<10	2	13	100	<0.1	<1	<1	-	28,700	<1	-	3000	<0.04	<1	73	<0.2	<1	<10	<10	71
	Count Detects		**3**	**4**	**5**	**5**	**0**	**2**	**0**	**4**	**3**	**0**	**4**	**3**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**5**
	Average		**187**	**2**	**16**	**168**	**-**	**4**	**-**	**14235**	**22260**	**-**	**3045**	**2963**	**-**	**-**	**86**	**-**	**-**	**-**	**-**	**67**
	50th Percentile		**160**	**2**	**15**	**190**	**-**	**4**	**-**	**12440**	**28700**	**-**	**3145**	**3000**	**-**	**-**	**98**	**-**	**-**	**-**	**-**	**71**
	90th Percentile		**344**	**2**	**20**	**226**	**-**	**5**	**-**	**25640**	**29420**	**-**	**3445**	**3440**	**-**	**-**	**100**	**-**	**-**	**-**	**-**	**80**
	Minimum		**10**	**2**	**13**	**100**	**-**	**2**	**-**	**2460**	**8480**	**-**	**2340**	**2340**	**-**	**-**	**58**	**-**	**-**	**-**	**-**	**41**
	Maximum		**390**	**2**	**22**	**230**	**-**	**5**	**-**	**29600**	**29600**	**-**	**3550**	**3550**	**-**	**-**	**102**	**-**	**-**	**-**	**-**	**83**
223 Groundwater Bore MPGM4	D18	26/09/2019	30	9	695	<50	<0.1	<1	<1	988	988	<1	110	110	<0.04	1	3	<0.2	<1	<10	<10	23
223 Groundwater Bore MPGM4	D18	31/10/2019	50	11	667	60	<0.1	<1	<1	1300	-	<1	114	-	<0.04	<1	4	<0.2	<1	<10	-	24
223 Groundwater Bore MPGM4	D18	28/11/2019	30	10	688	60	<0.1	<1	1	500	-	<1	111	-	<0.04	<1	6	<0.2	<1	<10	<10	19
223 Groundwater Bore MPGM4	D18	23/01/2020	20	3	629	60	<0.1	<1	<1	206	206	<1	124	124	<0.04	<1	6	<0.2	<1	<10	<10	40
223 Groundwater Bore MPGM4	D18	27/02/2020	40	9	668	50	<0.1	<1	<1	-	999	<1	-	82	<0.04	2	4	<0.2	<1	<10	<10	15
223 Groundwater Bore MPGM4	D18	26/03/2020	240	11	638	50	0.2	2	2	-	555	2	-	138	<0.04	1	5	<0.2	<1	<10	<10	50
223 Groundwater Bore MPGM4	D18	25/06/2020	50	9	552	50	<0.1	<1	1	-	539	<1	-	114	<0.04	8	5	0.20	<1	<10	<10	28
223 Groundwater Bore MPGM4	D18	17/09/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Count Detects		**7**	**7**	**7**	**6**	**1**	**1**	**3**	**4**	**5**	**1**	**4**	**5**	**0**	**4**	**7**	**1**	**0**	**0**	**0**	**7**
	Average		**66**	**9**	**648**	**55**	**0.2**	**2**	**1**	**749**	**657**	**2**	**115**	**114**	**-**	**3**	**5**	**0.2**	**-**	**-**	**-**	**28**
	50th Percentile		**40**	**9**	**667**	**55**	**0.2**	**2**	**1**	**744**	**555**	**2**	**113**	**114**	**-**	**2**	**5**	**0.2**	**-**	**-**	**-**	**24**
	90th Percentile		**126**	**11**	**691**	**60**	**0.2**	**2**	**2**	**1206**	**995**	**2**	**121**	**132**	**-**	**6**	**6**	**0.2**	**-**	**-**	**-**	**44**
	Minimum		**20**	**3**	**552**	**50**	**0.2**	**2**	**1**	**206**	**206**	**2**	**110**	**82**	**-**	**1**	**3**	**0.2**	**-**	**-**	**-**	**15**
	Maximum		**240**	**11**	**695**	**60**	**0.2**	**2**	**2**	**1300**	**999**	**2**	**124**	**138**	**-**	**8**	**6**	**0.2**	**-**	**-**	**-**	**50**
224 Groundwater Bore MPGM4	D19	25/09/2019	60	<1	13	1320	0.3	3	<1	1320	1320	1	3880	3880	0.42	<1	375	3.8	<1	<10	<10	329
224 Groundwater Bore MPGM4	D19	30/10/2019	320	2	17	1930	0.1	3	3	17,600	-	15	9930	-	<0.04	<1	726	0.6	<1	<10	-	258
D19	D19	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D19	D19	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
224 Groundwater Bore MPGM4	D19	27/11/2019	1550	20	52	1970	0.2	51	10	15,300	-	69	10,300	-	<0.04	3	737	1.2	<1	<10	<10	397
224 Groundwater Bore MPGM4	D19	22/01/2020	710	9	25	2060	0.2	14	7	16,600	16,600	47	11,100	11,100	<0.04	<1	805	1.4	<1	<10	<10	330
224 Groundwater Bore MPGM4	D19	26/02/2020	480	7	22	2540	0.2	46	3	-	14,200	21	-	11,000	<0.04	2	715	0.6	<1	<10	<10	361
224 Groundwater Bore MPGM4	D19	26/03/2020	6430	52	206	2310	0.7	26	54	-	16,500	202	-	7680	0.06	4	711	6	<1	40	<10	813
224 Groundwater Bore MPGM4	D19	24/06/2020	70	2	13	1780	0.2	<1	1	-	15,700	4	-	5980	<0.04	<1	484	0.5	<1	<10	<10	259
	Count Detects		**7**	**6**	**7**	**7**	**7**	**6**	**6**	**4**	**5**	**7**	**4**	**5**	**2**	**3**	**7**	**7**	**0**	**1**	**0**	**7**
	Average		**1374**	**15**	**50**	**1987**	**0.3**	**24**	**13**	**12705**	**12864**	**51**	**8803**	**7928**	**0.2**	**3**	**650**	**2.0**	**-**	**40**	**-**	**392.4285714**
	50th Percentile		**480**	**8**	**22**	**1970**	**0.2**	**20**	**5**	**15950**	**15700**	**21**	**10115**	**7680**	**0.2**	**3**	**715**	**1.2**	**-**	**40**	**-**	**330**
	90th Percentile		**3502**	**36**	**114**	**2402**	**0.5**	**49**	**32**	**17300**	**16560**	**122**	**10860**	**11060**	**0.4**	**4**	**764**	**4.7**	**-**	**40**	**-**	**563.4**
	Minimum		**60**	**2**	**13**	**1320**	**0.1**	**3**	**1**	**1320**	**1320**	**1**	**3880**	**3880**	**0.1**	**2**	**375**	**0.5**	**-**	**40**	**-**	**258**
	Maximum		**6430**	**52**	**206**	**2540**	**0.7**	**51**	**54**	**17600**	**16600**	**202**	**11100**	**11100**	**0.4**	**4**	**805**	**6.0**	**-**	**40**	**-**	**813**

Statistical Summary

Statistic	Electrical Conductivity (Field)	pH (Field)	Temperature (Field)	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS) (Filtered)	Calcium	Chloride	Fluoride	Magnesium	Potassium	Sodium	Sulfate (as SO4)	Total Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3) (Filtered)
Number of Results	144	126	78	125	71	125	125	125	125	125	125	125	125	70
Number of Detects	144	126	78	125	71	125	125	65	125	125	125	125	124	70
Minimum Concentration	7	4.93	0	5	0	5	3.4	0	5	2.23	5	5	<1	0
Minimum Detect	7	4.93	2	5	1	5	3.4	0.022	5	2.23	5	5	4	1
Maximum Concentration	11230	8	19	10100	8770	730	1190	6	540	278	2060	5870	377	138
Maximum Detect	11230	8	19	10100	8770	730	1190	6	540	278	2060	5870	377	138
Average Concentration	4459	6.1	14	3925	2743	292	411	0.46	207	57	616	2141	126	70
Median Concentration	3555	6.07	16.7	2860	1410	256	216	0.25	132	41.814	466	1760	118	120
Standard Deviation	3485	0.52	6.9	3265	3718	215	410	0.86	180	57	591	1801	99	66
Number of Guideline Exceedances	105	104	0	91	13	0	99	60	0	0	0	83	0	0
Number of Guideline Exceedances(Detects Only)	105	104	0	91	13	0	99	11	0	0	0	83	0	0

Statistic	Aluminium	Arsenic	Barium	Boron	Cadmium	Chromium	Copper	Iron	Iron (Filtered)	Lead	Manganese	Manganese (Filtered)	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Vanadium (Filtered)	Zinc
Number of Results	125	125	125	125	125	125	125	92	107	125	100	105	125	125	125	125	125	125	115	125
Number of Detects	111	104	125	115	82	81	86	92	107	82	100	105	71	76	125	92	55	63	60	120
Minimum Concentration	2	0	5	0	0	0	0	0	3	0	3	3	0	0	3	0	0	0	0	2
Minimum Detect	2	1	5	5	0.1	1	1	3	3	1	3	3	0.05	1	3	0.2	ND	1	ND	2
Maximum Concentration	16600	124	695	5070	7	129	191	121000	121000	202	28300	28300	4	12	1940	12.6	<1	50	<10	1810
Maximum Detect	16600	124	695	5070	7	129	191	121000	121000	202	28300	28300	4	12	1940	12.6	ND	50	ND	1810
Average Concentration	698	8.8	91	1217	0.85	11	10	19969	21923	14	7717	7454	0.18	1.7	625	1.4	0.44	9.2	4.2	331
Median Concentration	55	4	27	233	0.1	1	1	8300	11400	1	3172.5	2963.333333	0.02	0.5	650.4286	0.25	0.5	5	5	89
Standard Deviation	2394	19	186	1356	1.8	26	32	26566	28272	35	8711	8834	0.61	2.4	622	2.7	0.17	13	1.8	499
Number of Guideline Exceedances	0	86	39	59	11	57	56	69	85	58	42	40	31	40	63	20	70	0	0	18
Number of Guideline Exceedances(Detects Only)	0	86	39	59	11	57	56	69	85	58	42	40	31	40	63	20	0	0	0	18

APPENDIX D HYDROGRAPHS

Figure D-1. Water Levels Over Time - Cross Gradient
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983

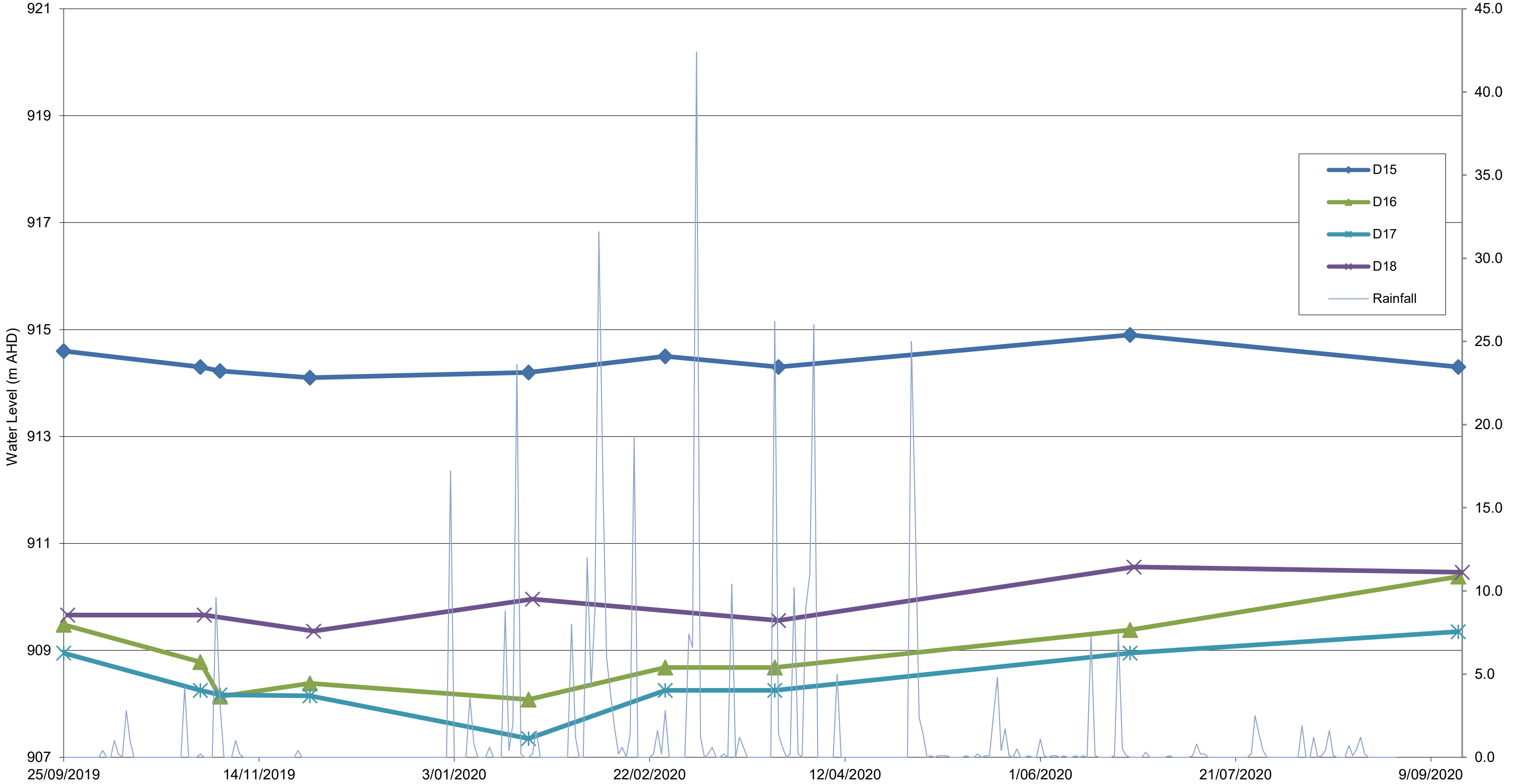


Figure D-2. Water Level Over Time - Up Gradient / Adjacent to MPAR
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983

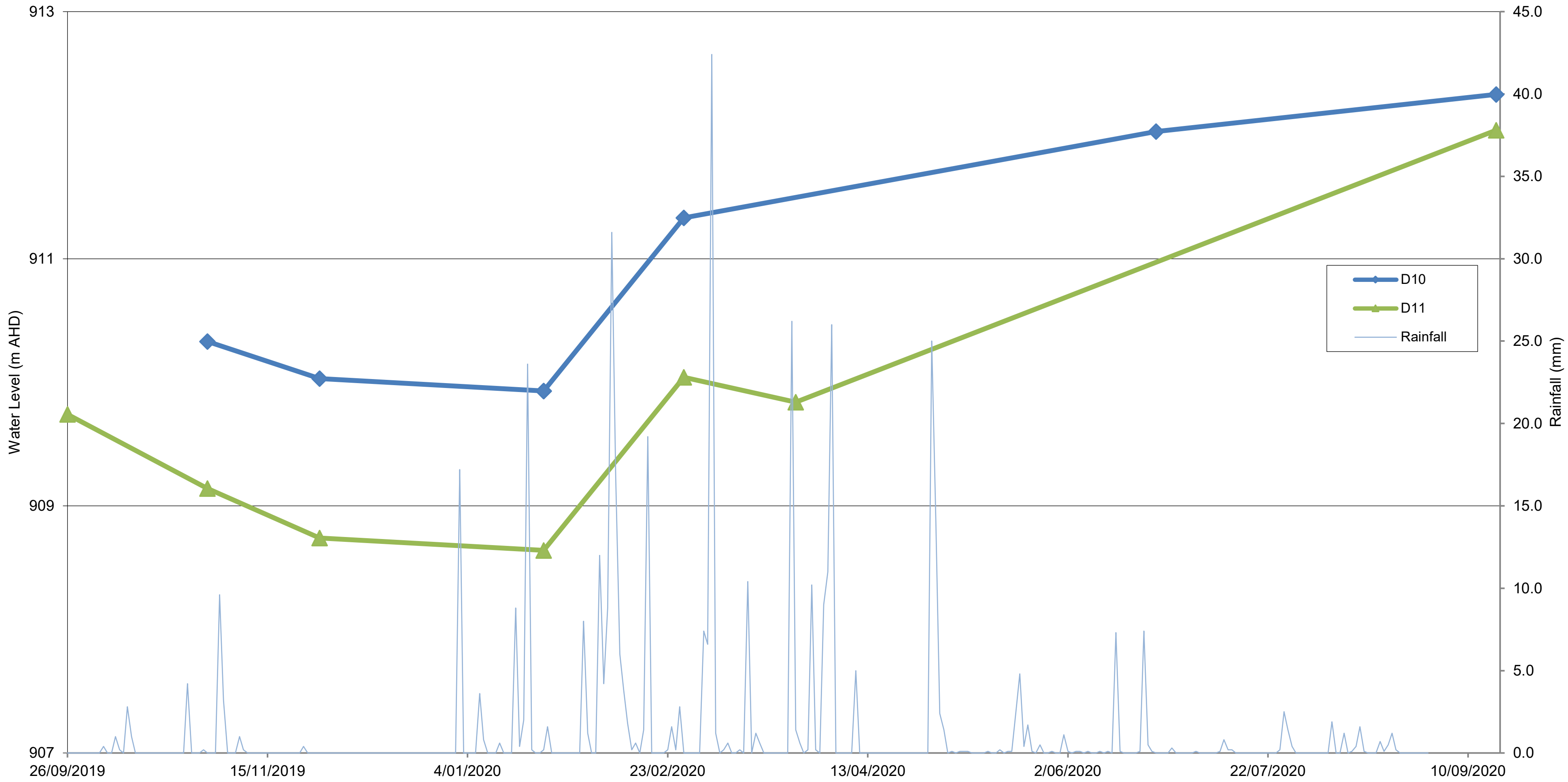


Figure D-3. Water Level Over Time - Adjacent to LNAR
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983

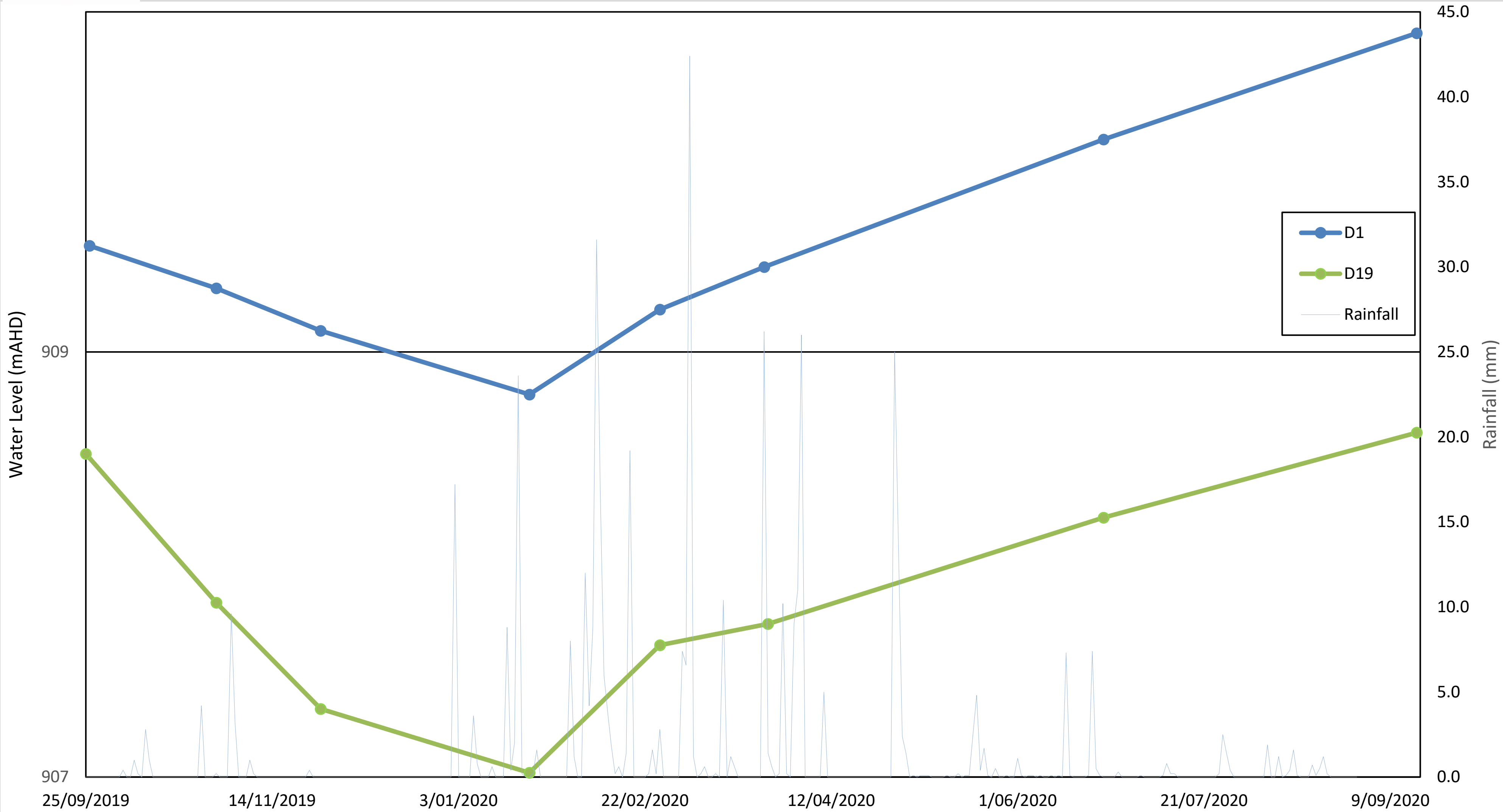
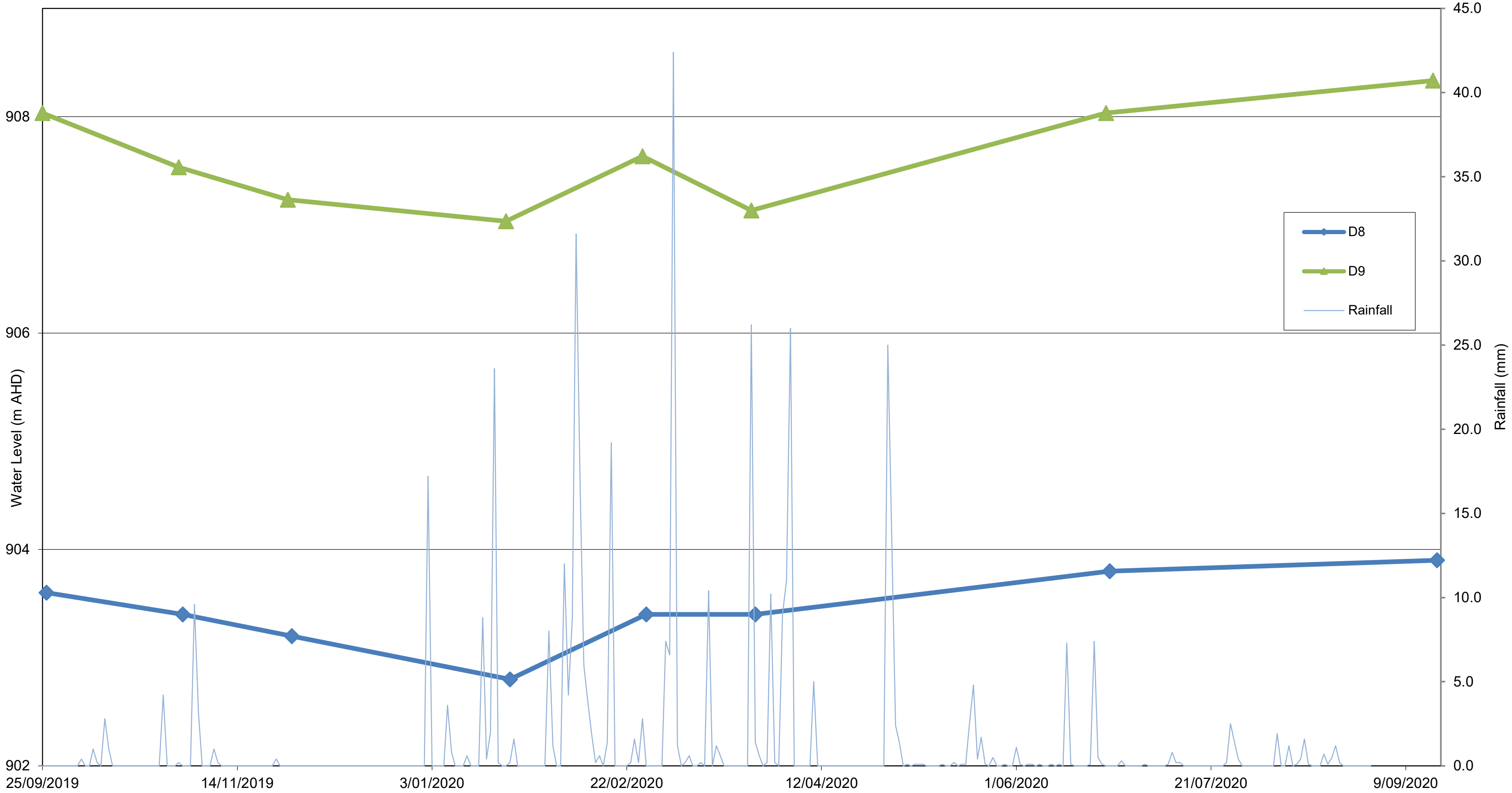
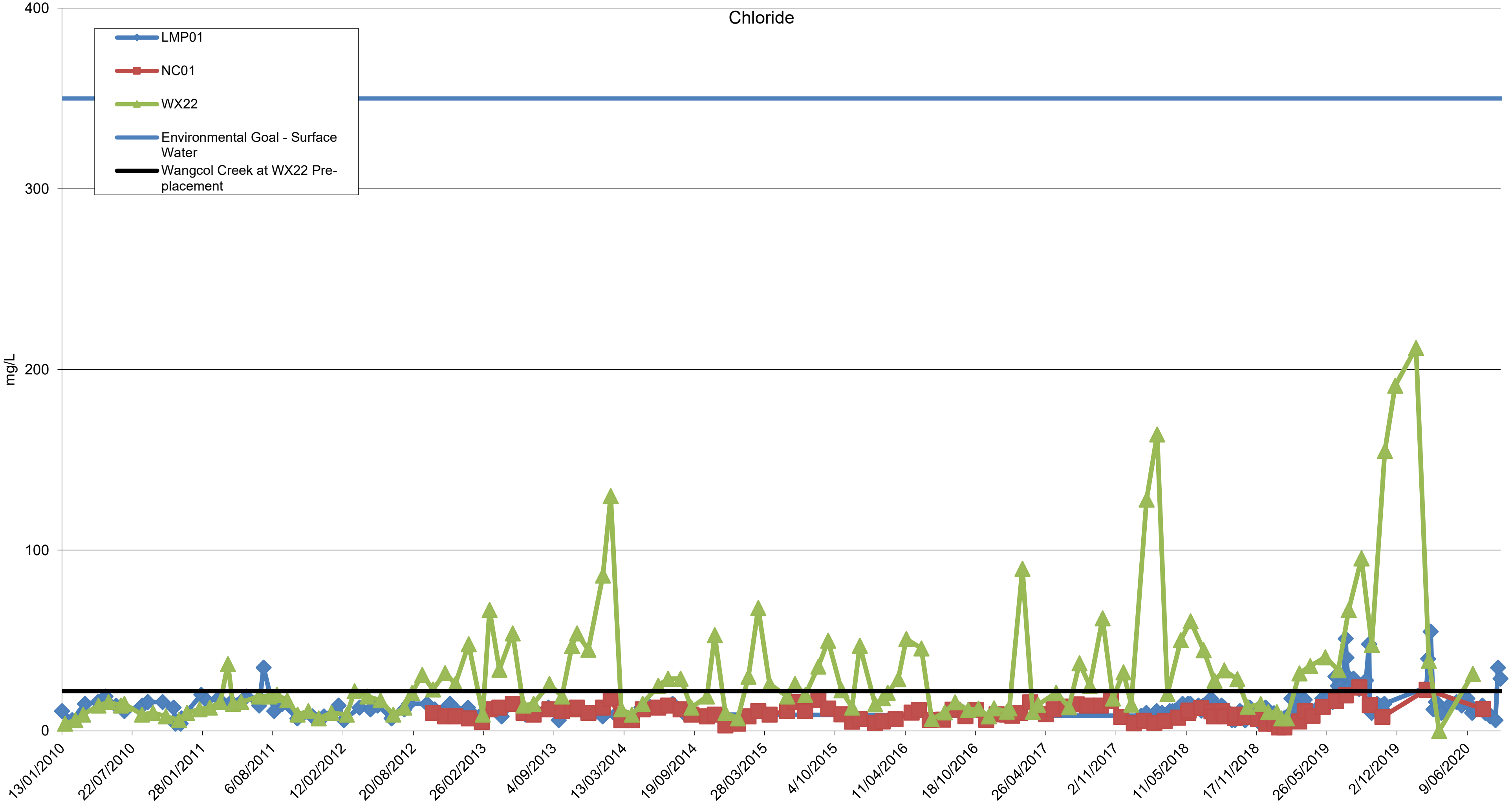


Figure D-4. Water Levels Over Time - Adjacent to Neubecks Creek
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983



APPENDIX E TREND GRAPHS – SURFACE WATER

Figure E-1. Chloride Concentrations Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983



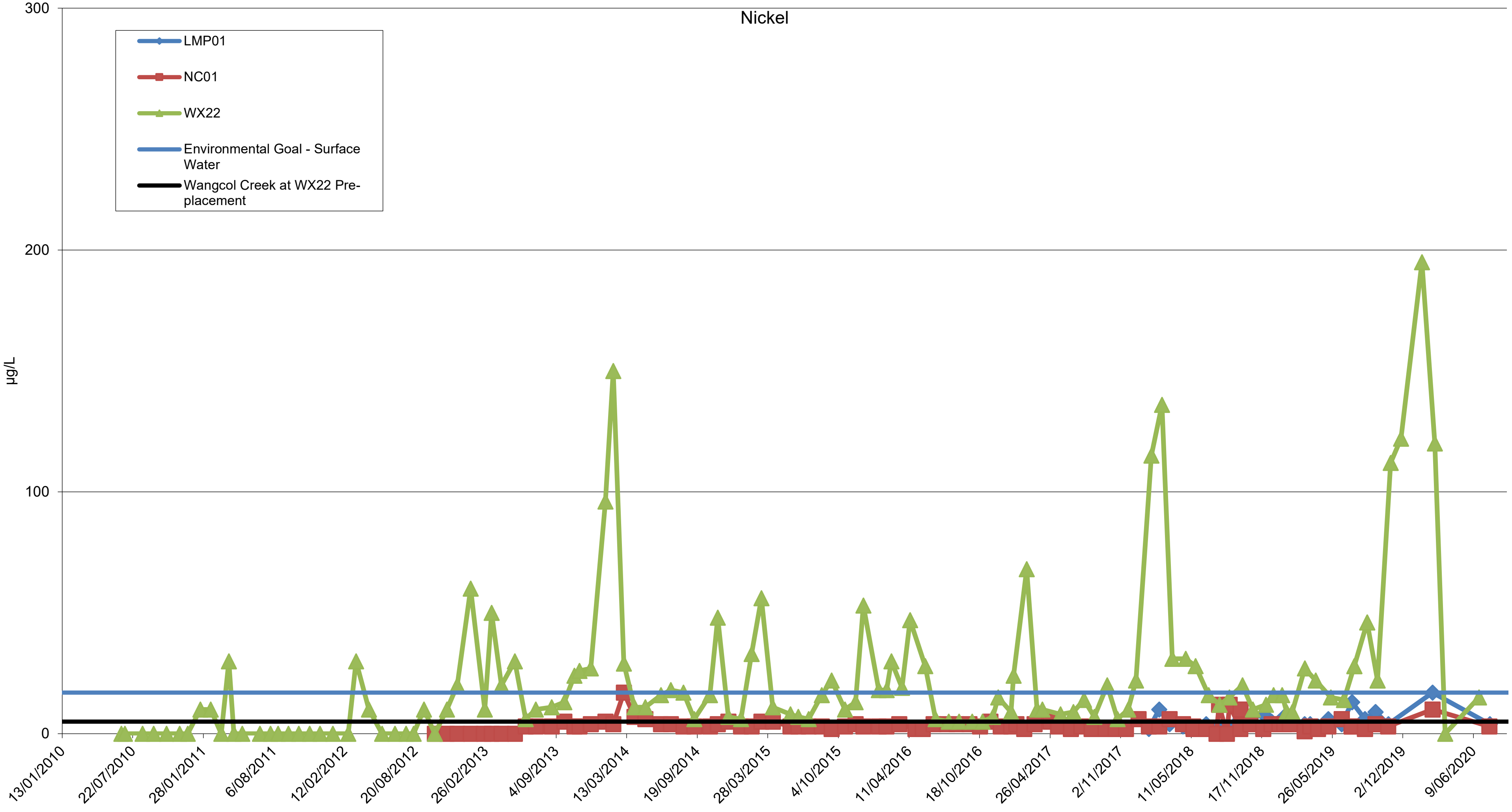

Nickel
300
200
100
0
µg/L
LMP01
NC01
WX22
Environmental Goal - Surface Water
Wangcol Creek at WX22 Pre-placement
13/01/2010
22/07/2010
28/01/2011
6/08/2011
12/02/2012
20/08/2012
26/02/2013
4/09/2013
13/03/2014
19/09/2014
28/03/2015
4/10/2015
11/04/2016
18/10/2016
26/04/2017
2/11/2017
11/05/2018
17/11/2018
26/05/2019
2/12/2019
9/06/2020

Figure E-3. Sulfate Concentrations Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983

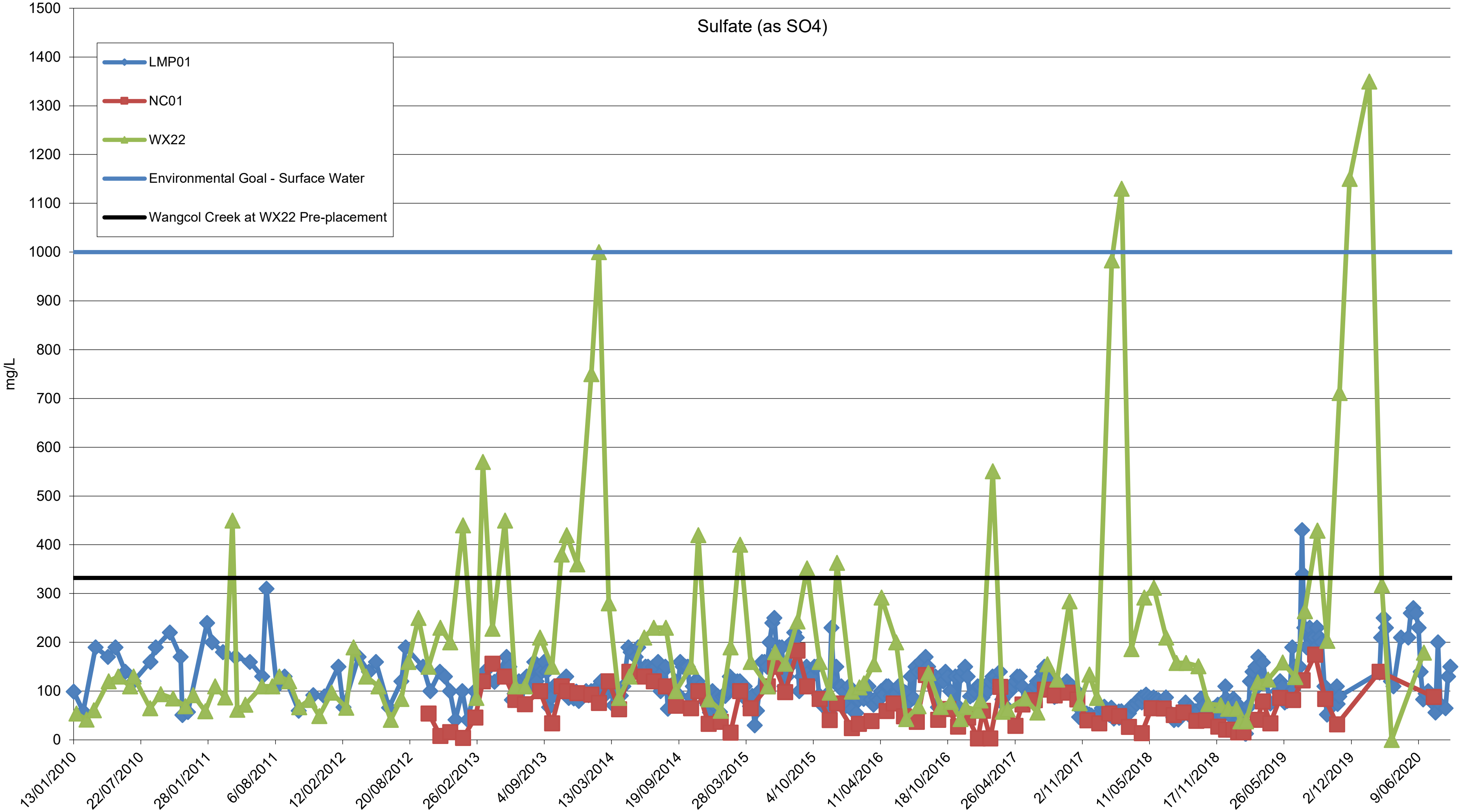
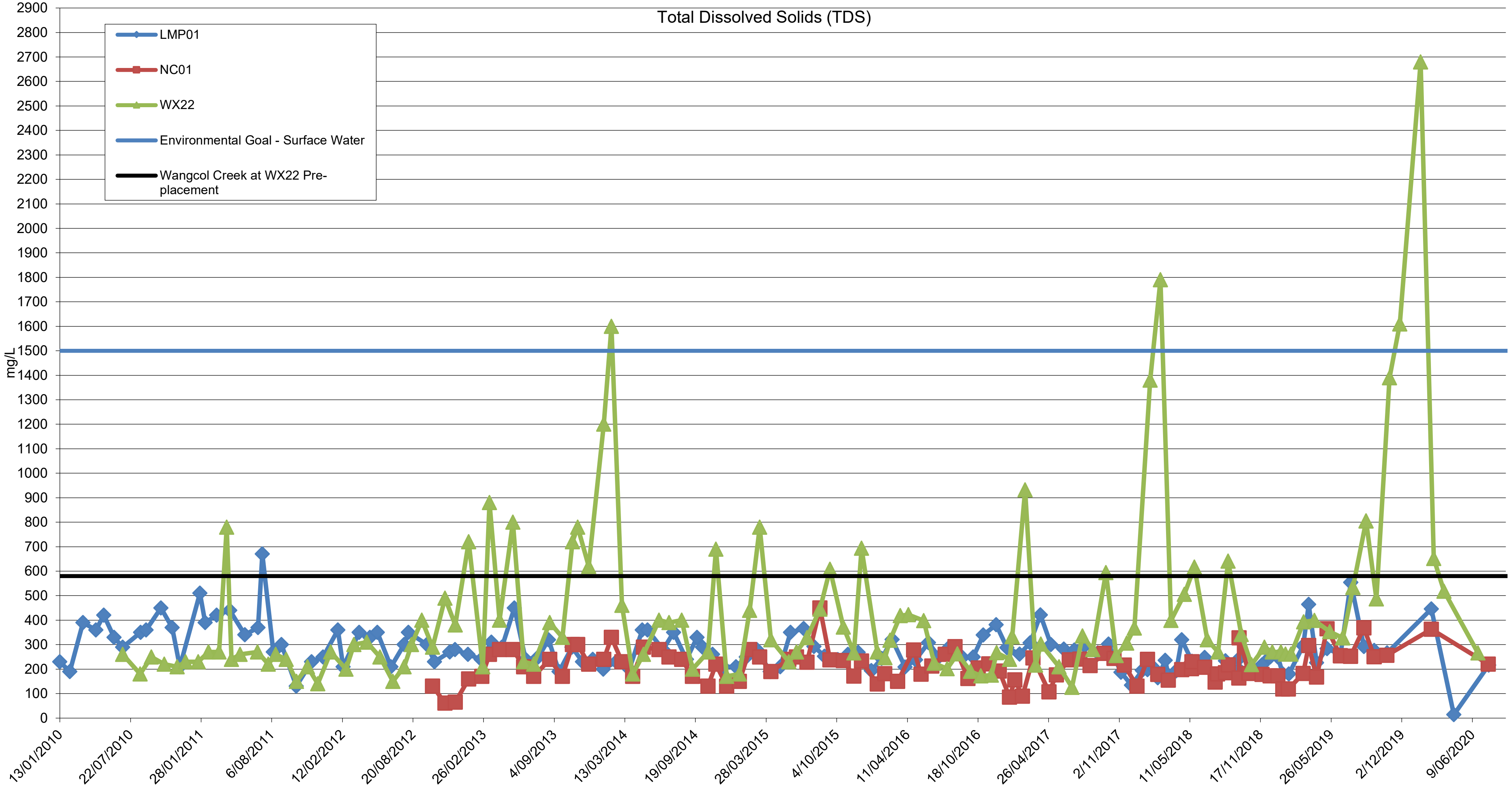


Figure E-4. TDS Concentrations Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983



APPENDIX F TREND GRAPHS - GROUNDWATER

ERM

Figure F-1. Boron Concentrations Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983

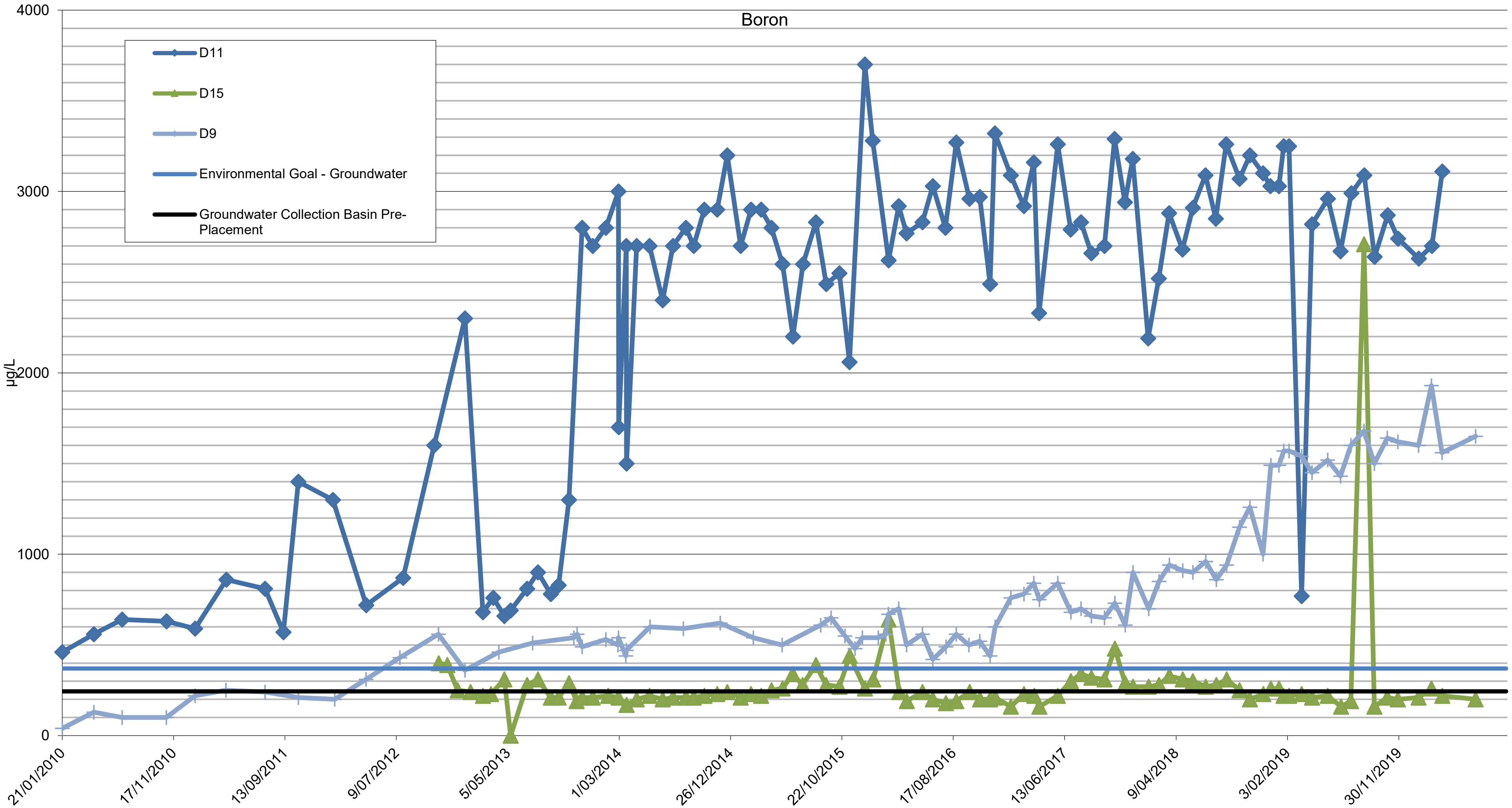


Figure F-2. Chloride Concentrations Over Time Lamberts North Ash Placement Water Quality Monitoring Annual Water Quality Monitoring Report 2019/20

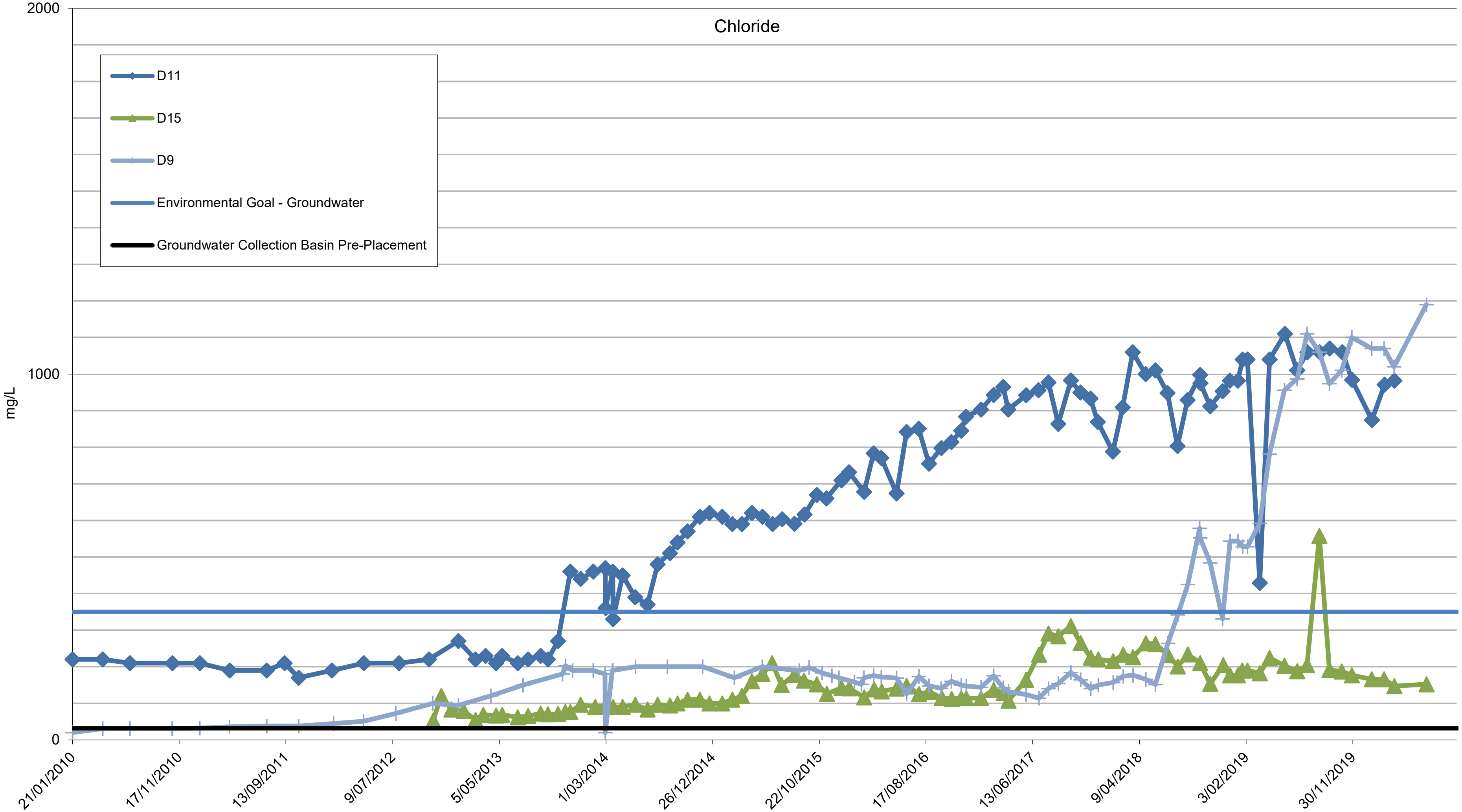
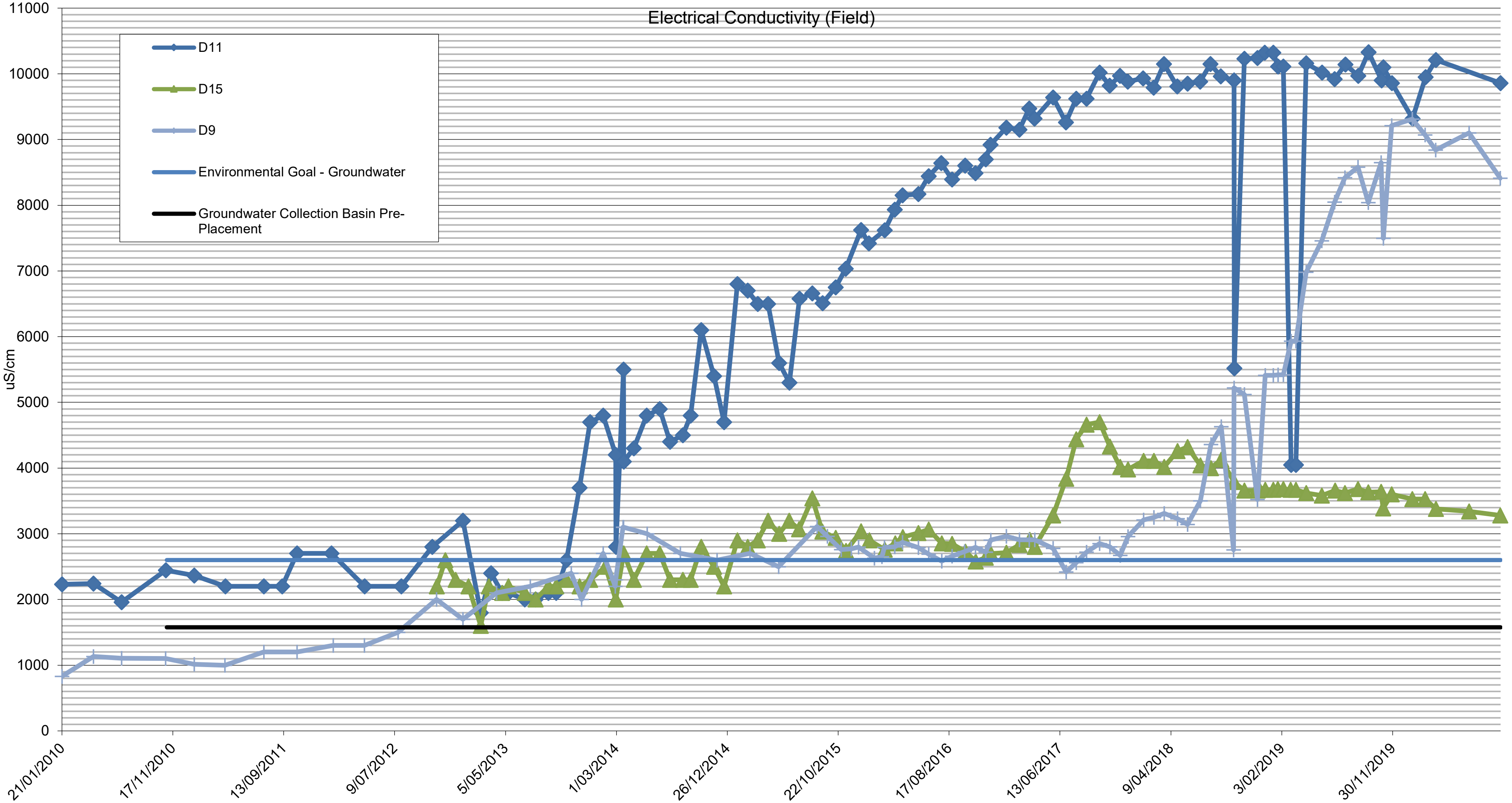


Figure F-3. EC Concentrations Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983



Figuree F-4. Iron - Filtered Concentrations Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983

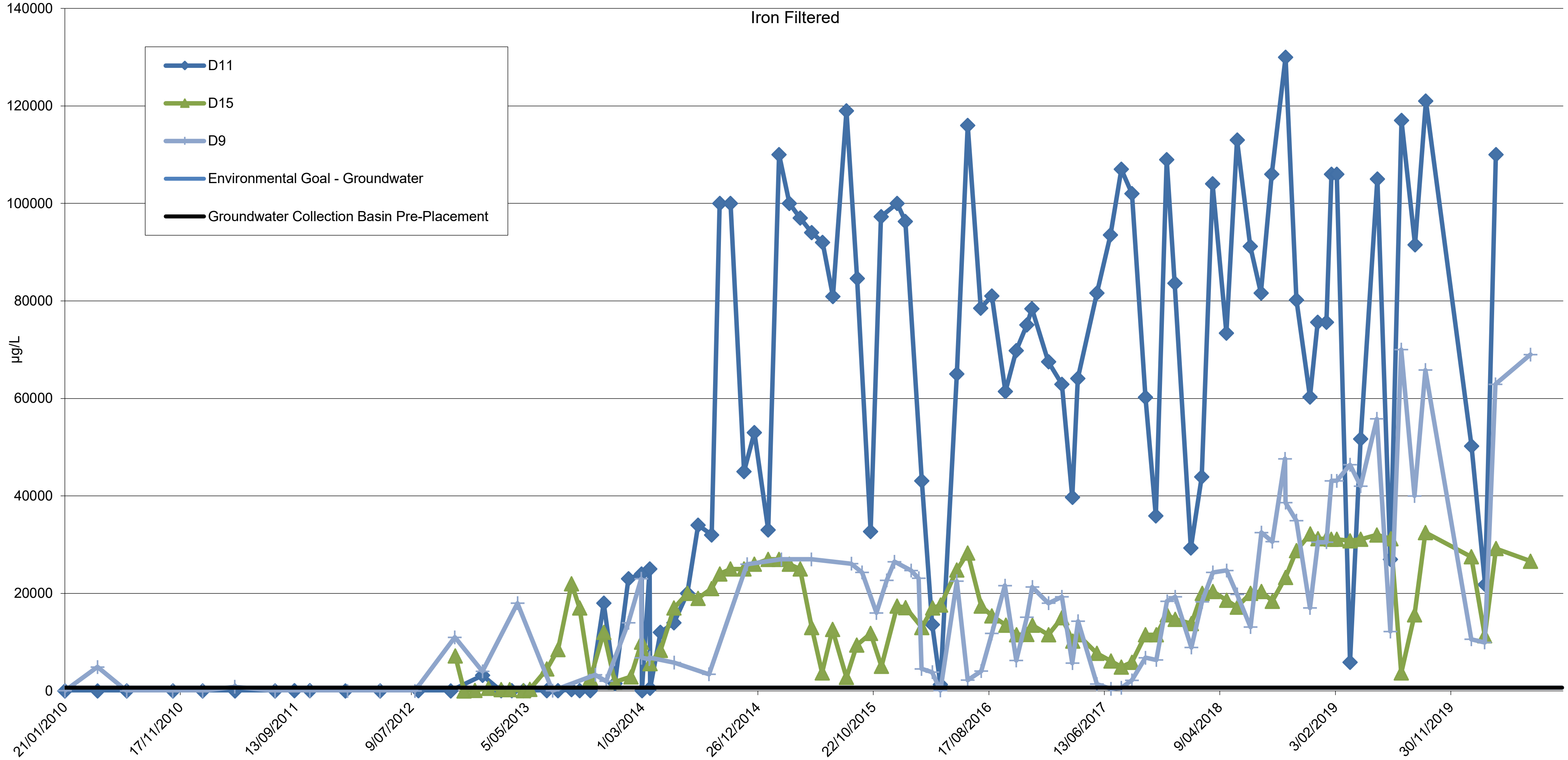
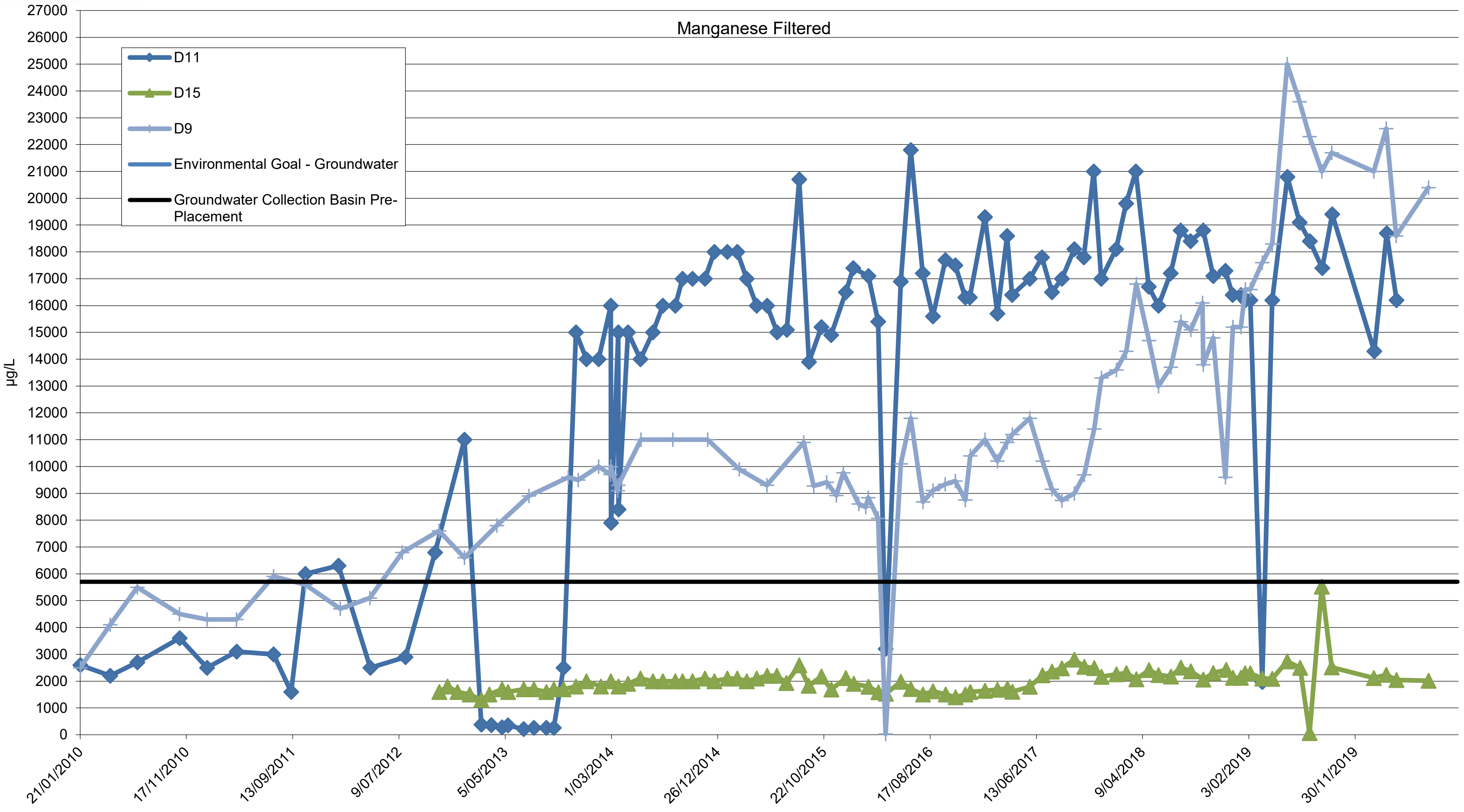


Figure F-5. Manganese - Filtered Concentrations Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983



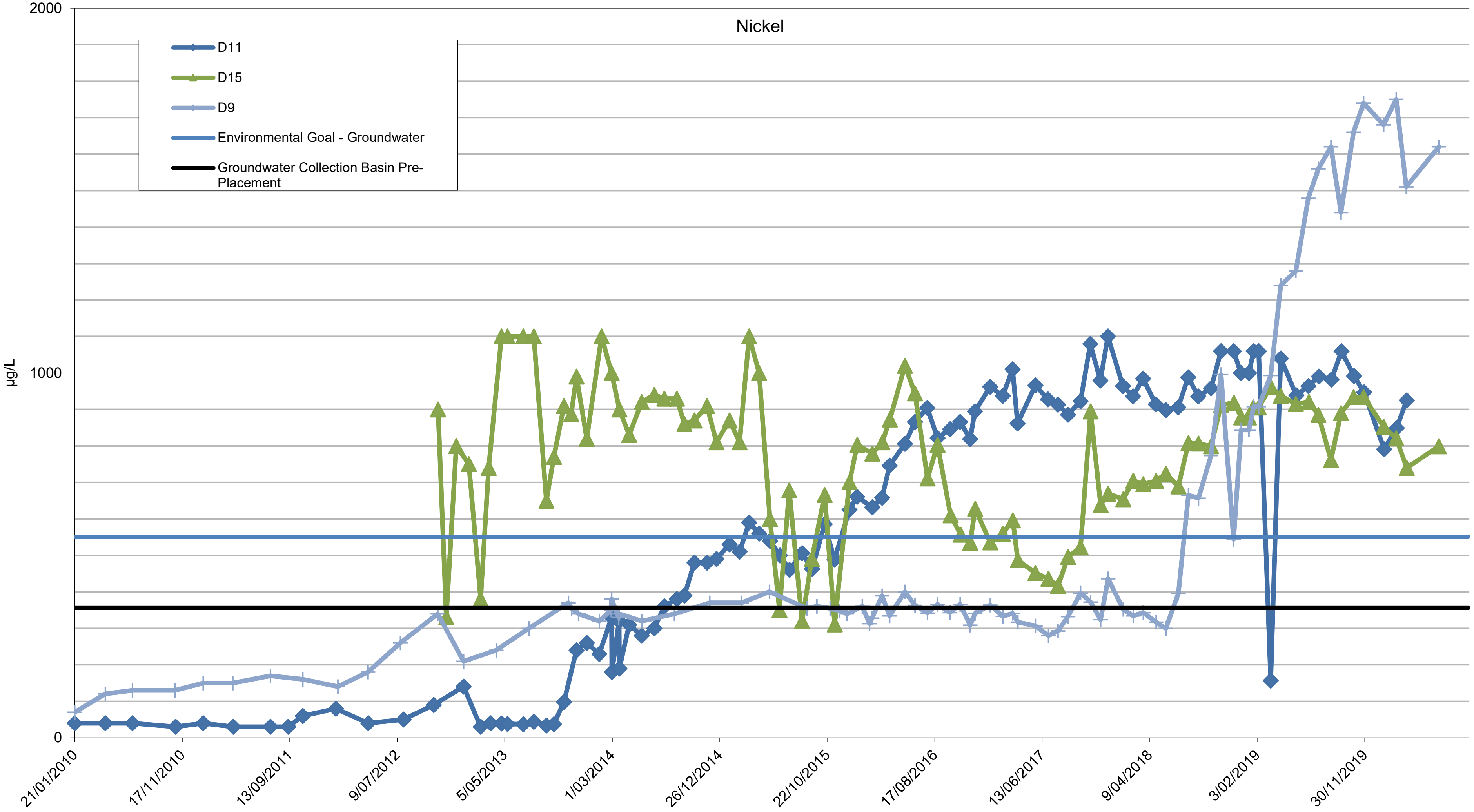

Nickel
D11
D15
D9
Environmental Goal - Groundwater
Groundwater Collection Basin Pre-Placement
µg/L
2000
1000
0
21/01/2010
17/11/2010
13/09/2011
9/07/2012
5/05/2013
1/03/2014
26/12/2014
22/10/2015
17/08/2016
13/06/2017
9/04/2018
3/02/2019
30/11/2019

Figure F-7. Sulfate Concentrations Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20

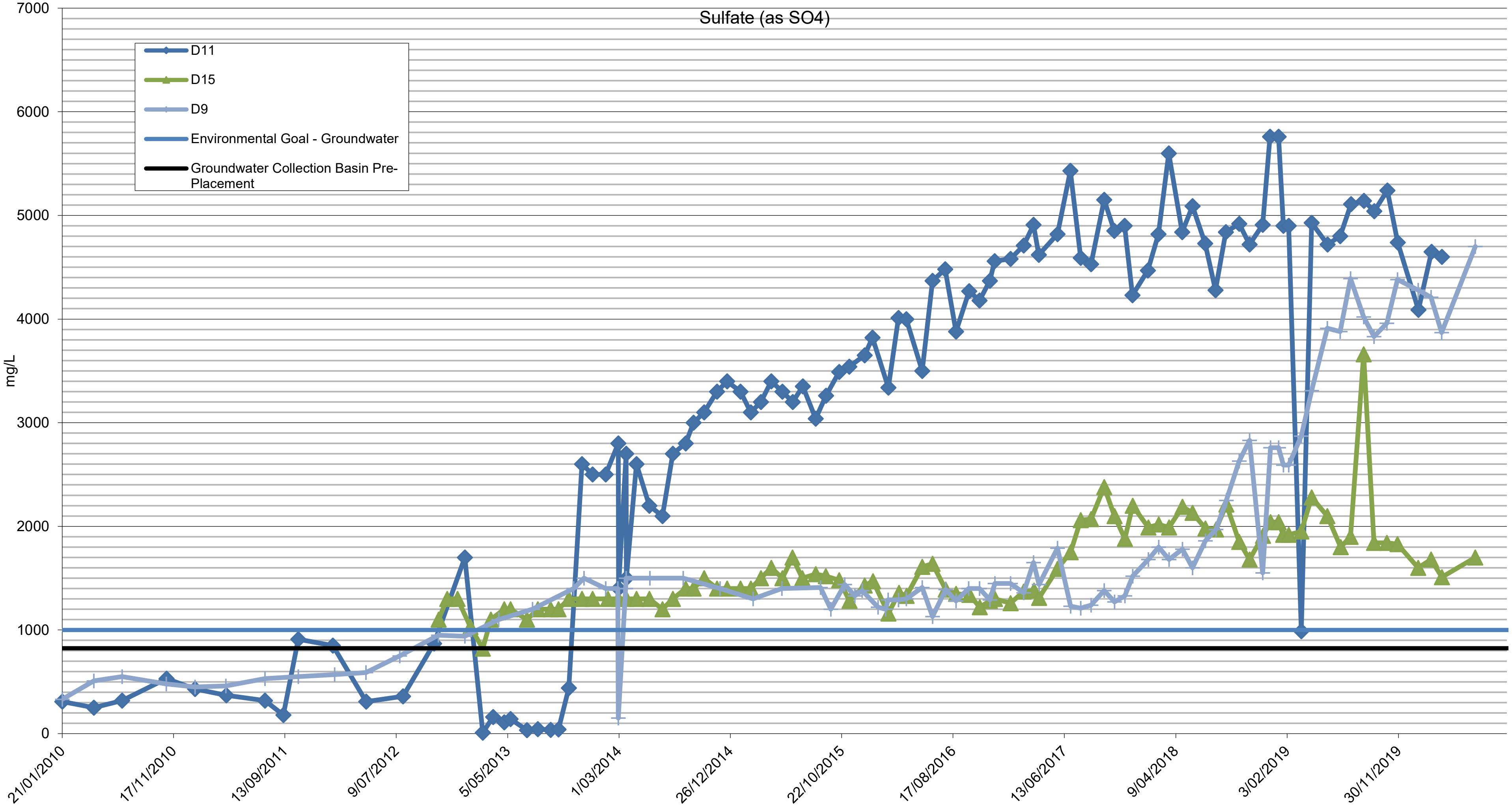
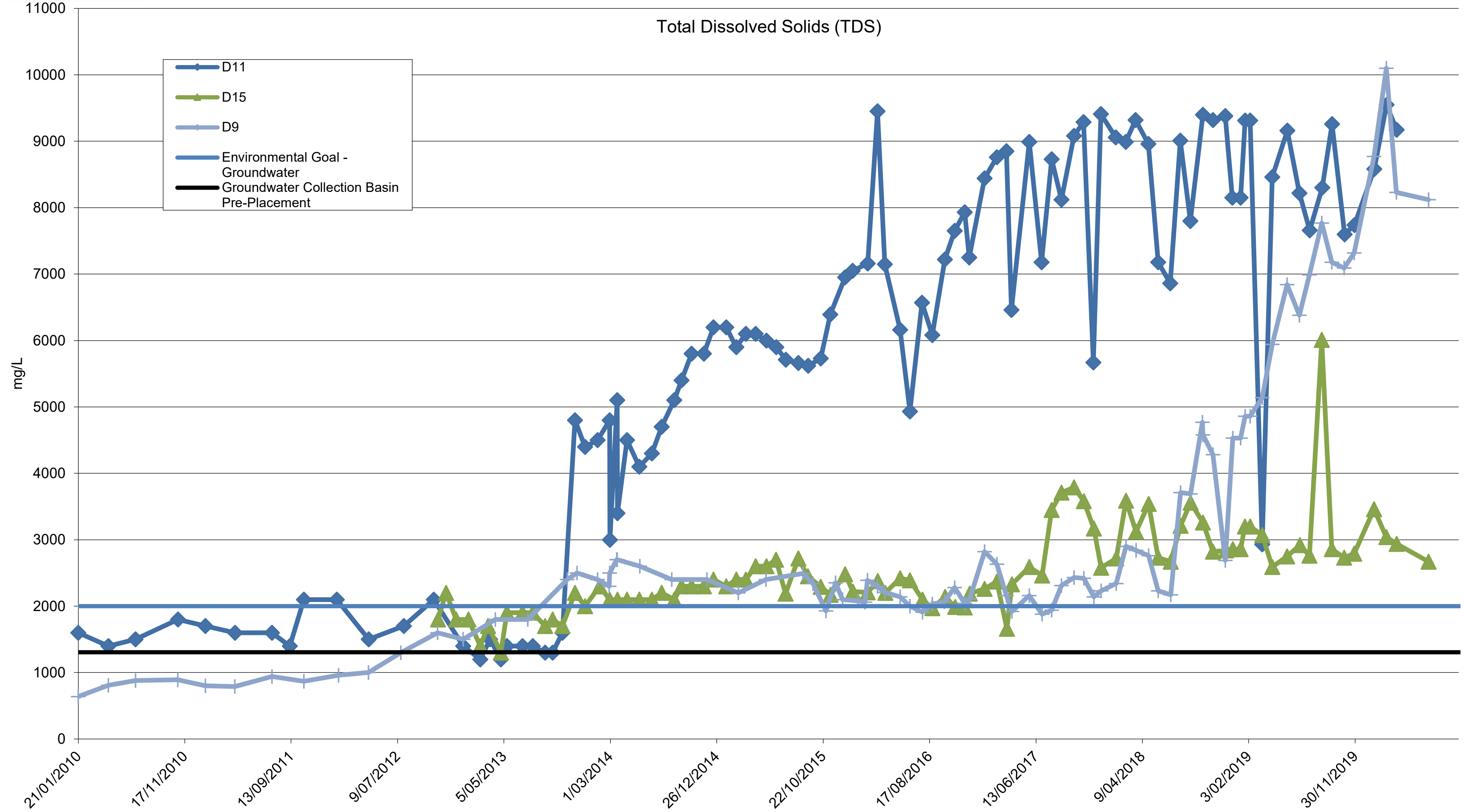


Figure F-8. TDS Levels Over Time
Lamberts North Ash Placement Water Quality Monitoring
Annual Water Quality Monitoring Report 2019/20
553983



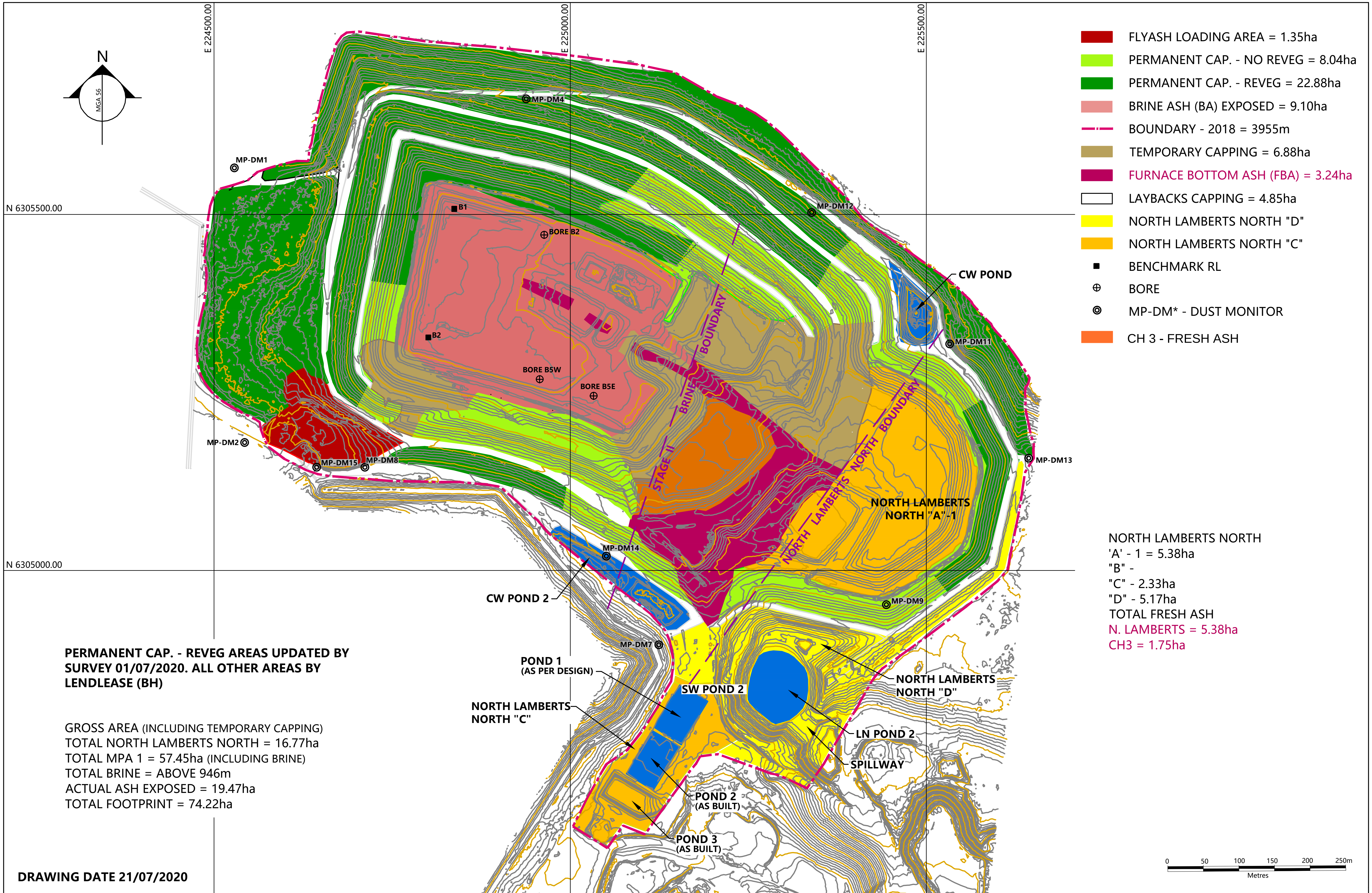
APPENDIX G MT PIPER CLIMATE DATA

Month	Sep-19			Oct-19			Nov-19			Dec-19		
Measurement	Min	Max	Rain	Min	Max	Rain	Min	Max	Rain	Min	Max	Rain
Date	°C	°C	mm	°C	°C	mm	°C	°C	mm	°C	°C	mm
1	-2.4	17.4	0.2	3.8	19.5	0.0	6.1	28.9	0.0	5.6	22.2	0.0
2	1.2	16.8	0.0	1.2	22.1	0.0	9.9	28.1	0.0	6.5	12.2	0.0
3	2.9	21.1	0.0	3.0	24.1	0.0	13.5	22.8	9.6	6.5	21.0	0.0
4	1.4	21.2	0.0	6.2	25.6	0.0	8.5	20.2	3.2	11.4	23.3	0.0
5	2.6	22.3	0.0	9.3	19.0	0.4	4.6	17.4	0.0	11.4	27.0	0.0
6	1.9	24.7	3.8	10.0	28.9	0.0	2.4	22.9	0.0	9.7	27.0	0.0
7	3.0	7.3	1.6	8.9	26.3	0.0	11.8	22.0	0.0	10.8	27.4	0.0
8	2.8	9.7	0.6	4.1	15.8	1.0	6.1	21.2	1.0	8.4	27.3	0.0
9	1.5	8.5	0.6	-0.2	17.0	0.2	3.9	13.3	0.2	9.6	32.3	0.0
10	-4.7	14.0	0.0	0.6	16.6	0.0	5.3	19.5	0.0	10.7	36.0	0.0
11	-4.3	18.1	0.0	5.8	12.6	2.8	2.7	24.7	0.0	11.6	32.7	0.0
12	-3.4	18.7	0.0	5.9	12.5	1.0	6.9	27.8	0.0	13.4	29.1	0.0
13	-1.9	21.5	0.0	2.1	17.0	0.0	6.2	18.6	0.0	11.6	27.1	0.0
14	2.2	20.4	0.0	7.2	23.4	0.0	5.4	23.6	0.0	NA	15.4	0.0
15	-0.9	23.4	0.0	4.9	26.6	0.0	6.0	25.0	0.0	NA	NA	0.0
16	3.2	23.1	0.0	5.3	26.6	0.0	4.2	24.3	0.0	NA	30.9	0.0
17	0.7	9.0	33.2	6.6	18.0	0.0	6.2	23.7	0.0	10.5	28.1	0.0
18	4.7	11.0	0.8	2.9	21.2	0.0	7.9	25.1	0.0	8.2	33.1	0.0
19	9.1	18.4	0.6	1.3	20.3	0.0	6.9	30.4	0.0	13.9	36.4	0.0
20	10.5	20.2	0.0	0.2	19.7	0.0	8.7	29.5	0.0	12.3	32.8	0.0
21	9.2	20.9	3.8	0.3	23.4	0.0	6.7	34.2	0.0	12.6	38.7	0.0
22	3.0	17.8	5.8	2.9	26.7	0.0	16.8	32.9	0.0	11.7	22.8	0.0
23	0.0	13.3	0.2	4.0	27.1	0.0	14.7	32.0	0.0	11.9	26.2	0.0
24	-2.8	15.2	0.0	5.2	28.1	0.0	13.1	23.0	0.4	10.9	27.7	0.0
25	-2.1	18.5	0.0	8.6	28.1	0.0	11.4	27.9	0.0	13.6	26.6	0.0
26	2.9	18.1	0.0	9.8	21.9	4.2	7.4	26.5	0.0	9.8	31.0	0.0
27	-0.5	18.9	0.0	0.2	20.9	0.0	2.1	25.4	0.0	10.8	32.4	0.0
28	0.5	17.9	0.0	0.8	22.4	0.0	5.5	29.9	0.0	11.0	34.7	0.0
29	-1.1	18.6	0.0	4.0	27.1	0.0	10.3	30.0	0.0	14.5	35.8	0.0
30	0.5	16.5	0.0	7.7	26.9	0.2	9.2	26.1	0.0	13.6	35.9	0.0
31				8.6	29.6	0.0				16.3	35.8	0.0

Min	-4.6999998	7.30000019	0	-0.2	12.5	0	2.0999999	13.3000002	0	5.5999999	12.1999998	0
Max	10.5	24.7000008	33.2000007	10	29.6000042	4.20000006	16.7999992	34.2000008	9.60000019	16.2999992	38.7000008	0
Average	1.32	17.42		4.55	22.42		7.68	25.23		11.03	28.96	
Total			51.20			9.80			14.40			0.00

Month	Jan-20			Feb-20			Mar-20			Apr-20			May-20			Jun-20		
Measurement	Min	Max	Rain	Min	Max	Rain	Min	Max	Rain	Min	Max	Rain	Min	Max	Rain	Min	Max	Rain
Date	°C	°C	mm	°C	°C	mm	°C	°C	mm	°C	°C	mm	°C	°C	mm	°C	°C	mm
1	13.8	35.9	0.0	21.2	38.6	0	11.5	28.2	0	10.8	22.6	0	3	6	2.4	0	13	1.1
2	16.0	33.1	17.2	19.8	36.7	8	11.9	30.7	0	12.9	17.1	9	4	8	1.4	2	5	0.1
3	16.8	36.6	0.0	14.1	26.6	1.2	14.8	17.1	7.4	13.3	16.9	11	0	13	0	-2	11	0
4	18.1	38.4	0.0	10.8	21.4	0	14.7	18.4	6.6	8.9	16.7	26	-2	15	0.1	-1	13	0.1
5	12.8	34.6	0.0	12.4	24	0	15.4	17	42.4	7.6	15.3	0	3	16	0	-3	14	0.1
6	12.7	25.0	0.0	13.9	17.4	12	14.5	23	1.2	5.1	14.4	0	1	17	0.1	-4	12	0
7	16.4	30.9	3.6	14.4	18.8	4.2	12.3	20.1	0	6.3	14.1	0	2	16	0.1	-3	12	0.1
8	15.3	34.2	0.8	15	18.5	8.8	11.8	18.9	0.2	9.3	13.8	0	5	19	0.1	2	13	0
9	16.2	23.4	0.0	14.4	17.8	31.6	11.9	17.7	0.6	10.9	14.4	0	5	18	0	6	12	0
10	17.0	35.9	0.0	13.5	24.8	16.8	8.9	19.7	0	8.8	15.1	5	0	10	0	7	15	0.1
11	13.6	29.3	0.0	13.4	25.5	6	8	20.7	0	6.6	16.8	0	-4	13	0	2	15	0
12	11.6	19.8	0.6	15.2	25.5	3.8	10.5	20.4	0.2	2.8	19.2	0	-3	14	0	5	13	0.1
13	12.6	25.0	0.0	16.7	23.5	1.8	5.2	23.6	0	1.8	19.5	0	0	11	0.1	8	16	0
14	14.5	28.0	0.0	13.8	26.1	0.2	8.1	14.3	10.4	2.3	22.5	0	-2	12	0	5	11	7.3
15	11.0	28.9	0.0	12.9	28.7	0.6	7.7	16.4	0	5.9	24	0	0	14	0	0	13	0.1
16	15.1	23.4	8.8	16.3	21.8	0	9.5	14.9	1.2	10.1	21.7	0	4	14	0.2	3	13	0
17	15.0	18.4	0.4	14.8	19.7	1.4	9.6	19.5	0.6	7.1	18	0	1	15	0	0	13	0
18	14.4	19.5	2.0	13.1	28.4	19.2	8.3	24	0	3.4	18.5	0	3	14	0.1	6	14	0
19	14.4	19.3	23.6	9.9	18.5	0	7.5	28.7	0	1.4	17.7	0	6	16	0.1	0	15	0
20	12.9	28.4	0.2	7.4	25.1	0	12.8	27.8	0	4.4	17.3	0	6	14	2.5	2	13	0.1
21	10.2	26.8	0.0	13.9	22.8	0	5.9	25.6	0	6.9	18.8	0	3	14	4.8	4	12	7.4
22	10.3	31.9	0.0	13.9	19.4	0	11.7	24.2	0	3.9	18	0	2	9	0.4	3	7	0.5
23	12.4	33.7	0.2	14	18	0.2	10.9	18.3	0	1.1	19.4	0	5	9	1.7	3	7	0.1
24	18.9	28.8	1.6	11.8	24.2	1.6	12.1	20.7	0	5.8	20.3	0	3	13	0.1	3	9	0
25	18.4	25.9	0.0	12.2	26	0.2	9.9	20.2	26.2	2.8	20.5	0	1	12	0	3	8	0
26	16.7	32.7	0.0	11.1	24.5	2.8	10.3	14.3	1.4	5.7	19.5	0	8	12	0.5	-3	12	0
27	NA	33.1	0.0	8.5	25.2	0	8.6	15.4	0.6	3.6	18.8	0	5	14	0	1	10	0
28	NA	NA	0.0	5.9	27	0	7.9	17.9	0	12.9	18.3	0	1	15	0	3	11	0.3
29	NA	NA	0.0	9	25	0	13.2	21.6	0.2	11.8	20	25	0	3	0.1	0	12	0
30	NA	36.1	0.0				10.4	18.1	10.2	4	13.6	14	0	0	0	1	13	0
31	15.9	39.5	0.0				8.8	23.3	0.2				0	0	0			
Min	10.1999998	18.3999996	0	5.9	17.4	0	5.2	14.3	0	1.1	13.6	0	-4	0	0	-4	5	0
Max	18.8999996	39.5	23.6000005	21.2	38.6	31.6	15.4	30.7	42.4	13.3	24	26	8	19	4.8	8	16	7.4
Average	14.56	29.53		13.22	24.12		10.47	20.67		6.61	18.09		1.94	12.13		1.77	11.90	
Total			59.00			120.40			109.60			90.00			14.80			17.50

APPENDIX H ASH REPOSITORY SURVEY AND PLACEMENT PLANS



NOTES:

AREAS BY LENDLEASE

Disclaimer: CEH Survey Pty. Ltd. do not guarantee the accuracy or completeness of this plan and are not liable for any loss or damage which the user may suffer resulting from the use of this plan.

No.	AMENDMENT	DATE	DRAWN	CHECK'D	AUTH'D

CEH SURVEY
CONSULTING LAND, ENGINEERING AND MINING SURVEYORS
"Astrolabe" 1 Rutherford Lane, LITHGOW 2790
ABN: 68 056 544 551 Office: (02) 6351 2281
Email: survey@ceh.com.au Website: www.ceh.com.au

SCALE: 1 : 5000 (A3)

CLIENT: LEND LEASE SERVICES PTY LTD

LOCALITY: MOUNT PIPER

LGA: LITHGOW

PLAN: **LEND LEASE SERVICES PTY LTD**
MOUNT PIPER ASH EMPLACEMENT
SURVEY: FEBRUARY 2020

SURVEYOR:	DRAWN:	DATE:	PLAN No.
T.H./B.N./L.B.	G.M./D.M.	21-07-2020	MPA0220 (As surveyed)

CEH Job No. - 3/841

PLAN No. MPA0220 AS SURVEY

N

CEH SURVEY
CONSULTING LAND, ENGINEERING AND MINING SURVEYORS

"Astrolabe" 1 Rutherford Lane,
LITHGOW 2790
ABN: 88 056 544 561 Office: (02) 6351 2281
Email: survey@ceh.com.au Website: www.ceh.com.au

DATE	29-07-2020
AMENDED	
SURVEYOR	TH/BN
DRAWN	TH
CHECKED	

LEND LEASE SERVICES PTY. LTD.
MOUNT PIPER - ASH PLACEMENT
SURVEY : 29th AUGUST 2020

SCALE - 1:3500 DATUM: MGA (ZONE 56)

DRAWING No:
MPA0720
(as surveyed)

CCAD6 JOB & DWG:
MPA0720 - MPA0720 as survey

APPENDIX I PROJECT APPROVAL REQUIREMENTS

Project Approval Document	Consent requirements	How addressed by this report
Project Approval 09_0186	E15. 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 the Sydney Catchment Authority, 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 operation of the project and for a minimum of 5 years following project completion 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 Groundwater Management Plan as per condition D3(b); 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 D3(b) of this approval.	Refer to Section 6.4 of OEMP
Project Approval 09_0186	E16. The Proponent shall prepare and implement a surface water quality monitoring program to monitor the impacts of the ash placement activities on Neubecks Creek and Lamberts Gully. The Program shall be developed in consultation with the DPI (Fisheries) and the 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 existing water quality monitoring sites as described in the document referred to under condition A1b); b) monitoring at surface water discharge points from Lamberts Gully Creek; c) monitoring at surface water discharge points into Neubecks Creek; d) wet weather monitoring with a minimum of two events recorded within the first 12 months operation of the project; 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, monitoring of dissolved oxygen, turbidity, sulfate, salinity, boron, manganese, iron chloride, total phosphorus and total nitrogen.	Refer to Section 6.5 of OEMP
Operational Environmental Management Plan	Section 6.4.3.1 Groundwater Monitoring Program - Guidelines	Refer to Section 4 of this report
	Section 6.4.3.2 Groundwater Monitoring Program – Water Quality Criteria	Refer to Appendix C and Section 6
	Section 6.4.4 Monitoring (Table 6-13 – Monitoring Schedule)	Refer to Sections 6.2
	Section 6.4.4 Monitoring (Table 6-14 Procedures and Protocols for Monitoring)	Refer to Appendix C and Sections 5.2 and 5.3
	Section 6.4.4 Monitoring (Table 6.15 Contingency plan for events at Lamberts North that have the potential to pollute or contaminate groundwater sources of water.)	Refer to Sections 6.6 and 6.7
	Section 6.4.4 Monitoring (Table 6-16 Investigating protocol)	Refer to Sections 6.6, 6.7 and 7
	Section 6.4.4 Monitoring (Table 6-17 Reporting Requirements, Item 2)	This report
	Section 6.5.5 (Table 6-21 Monitoring measures – regarding Surface Water Quality Monitoring)	Refer to Section 5 and Appendix B of this report
	Section 6.5.5 (Table 6-22 Reporting, Item 5)	This report

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India	South Korea
Indonesia	Spain
Ireland	Sweden
Italy	Switzerland
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ERM's Sydney Office
Level 15 309 Kent Street
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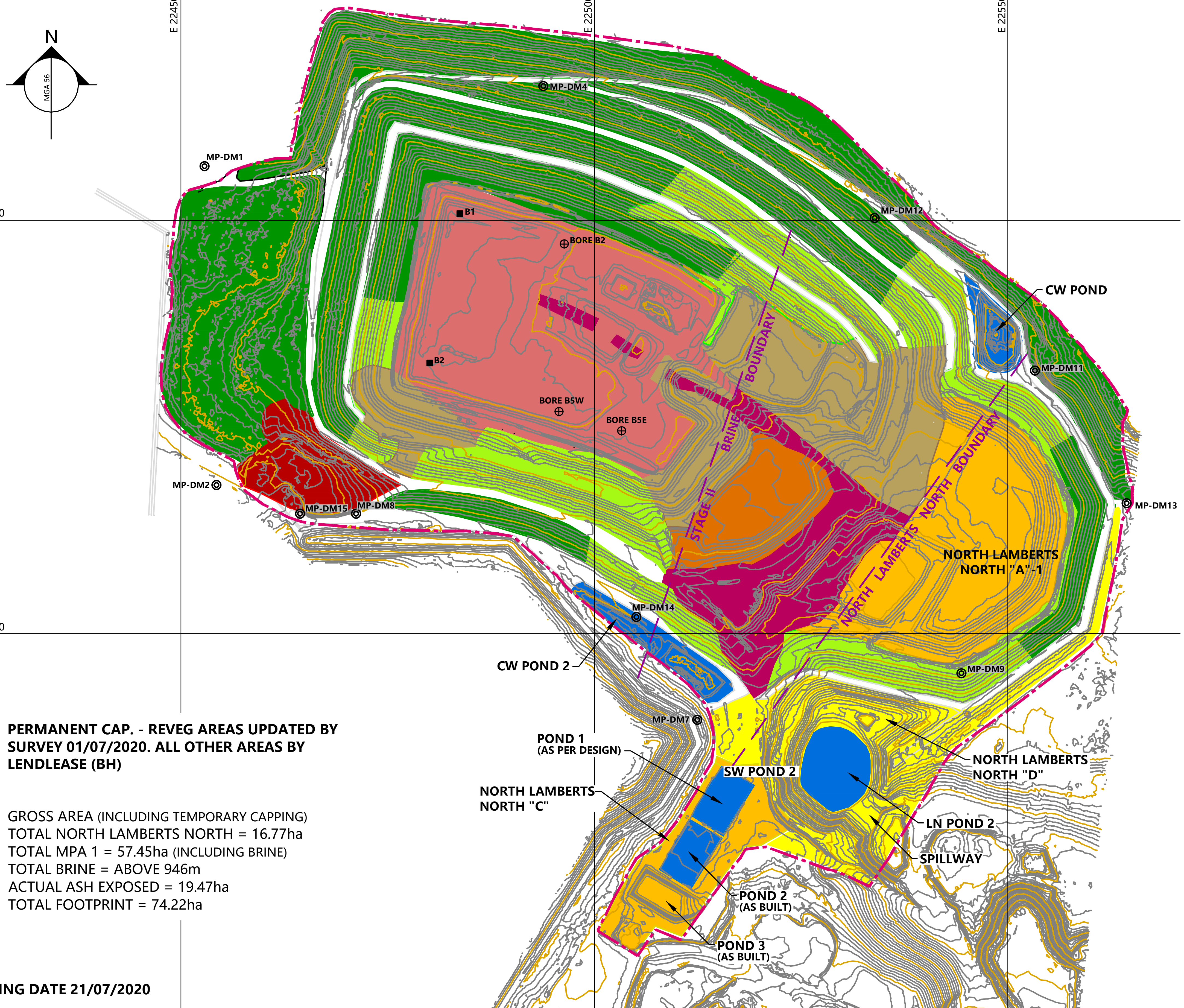
Appendix E Mt Piper Ash Repository & Lamberts North Rehabilitation Plan



FLYASH LOADING AREA = 1.35ha
PERMANENT CAP. - NO REVEG = 8.04ha
PERMANENT CAP. - REVEG = 22.88ha
BRINE ASH (BA) EXPOSED = 9.10ha
BOUNDARY - 2018 = 3955m
TEMPORARY CAPPING = 6.88ha
FURNACE BOTTOM ASH (FBA) = 3.24ha
LAYBACKS CAPPING = 4.85ha
NORTH LAMBERTS NORTH "D"
NORTH LAMBERTS NORTH "C"
BENCHMARK RL
BORE
MP-DM* - DUST MONITOR
CH 3 - FRESH ASH

NORTH LAMBERTS NORTH
'A' - 1 = 5.38ha
"B" -
"C" - 2.33ha
"D" - 5.17ha
TOTAL FRESH ASH
N. LAMBERTS = 5.38ha
CH3 = 1.75ha

PERMANENT CAP. - REVEG AREAS UPDATED BY SURVEY 01/07/2020. ALL OTHER AREAS BY LENDLEASE (BH)

GROSS AREA (INCLUDING TEMPORARY CAPPING)
TOTAL NORTH LAMBERTS NORTH = 16.77ha
TOTAL MPA 1 = 57.45ha (INCLUDING BRINE)
TOTAL BRINE = ABOVE 946m
ACTUAL ASH EXPOSED = 19.47ha
TOTAL FOOTPRINT = 74.22ha

DRAWING DATE 21/07/2020

NOTES:
AREAS BY LENDLEASE

Disclaimer:
CEH Survey Pty. Ltd. do not guarantee the accuracy or completeness of this plan and are not liable for any loss or damage which the user may suffer resulting from the use of this plan.

No.	AMENDMENT	DATE	DRAWN	CHECK'D	AUTH'D

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ABN: 68 056 544 551 Office: (02) 6351 2281
Email: survey@ceh.com.au Website: www.ceh.com.au

SCALE: 1 : 5000 (A3)

CLIENT: LEND LEASE SERVICES PTY LTD
LOCALITY: MOUNT PIPER
LGA: LITHGOW

PLAN: **LEND LEASE SERVICES PTY LTD**
MOUNT PIPER ASH EMPLACEMENT
SURVEY: FEBRUARY 2020

SURVEYOR: T.H./B.N./L.B.
DRAWN: G.M./D.M.
DATE: 21-07-2020
PLAN No. MPA0220 (As surveyed)

CEH Job No. - 3/841
PLAN No. MPA0220 AS SURVEY

Appendix F Lamberts North Ash Repository Internal Audit

Lamberts North Ash Repository Internal Audit

May 2020

<table>
<tr><th colspan="2">Audit Report</th></tr>
<tr><td>Audit Summary</td><td>

An internal audit of EANSW compliance with the obligations of rehabilitation requirements detailed in the Lamberts North Ash Placement Project – Operation Environmental Management Plan 2019.
The site inspection of capped areas at Lamberts North confirmed the successful establishment of a cover crop species across the batter slopes.
Two Opportunities for Improvement were identified during the Audit.
Audit Findings items are summarised in the adjacent table, and are detailed within the report.

<table>
<tr><th colspan="3">Audit Findings (see Audit Criteria overleaf, for full description)</th></tr>
<tr><td>NC-H</td><td>Non-compliance – High</td><td>0</td></tr>
<tr><td>NC-M</td><td>Non-compliance – Medium</td><td>0</td></tr>
<tr><td>NC-L</td><td>Non-compliance – Low</td><td>0</td></tr>
<tr><td>NC-A</td><td>Administrative non-compliance</td><td>0</td></tr>
<tr><td>C</td><td>Compliant</td><td>9</td></tr>
<tr><td>NA</td><td>Not Assessed</td><td>0</td></tr>
<tr><td>O</td><td>Observation</td><td>2</td></tr>
</table>
</td></tr>
<tr><td>Auditor</td><td>Antony Nolan</td></tr>
<tr><td>Audit Date</td><td>May 2020</td></tr>
<tr><td>Audit Type</td><td>Internal Audit</td></tr>
<tr><td>Audit Method</td><td>Interview Brett State Manager NSW, Lend Lease, Joe Pappalardo Contract Administrator EnergyAustralia</td></tr>
<tr><td>Audit Scope</td><td>Lamberts North Ash Placement Project – Operation Environmental Management Plan (Rehabilitation of Lamberts North Section 6.73)</td></tr>
<tr><td>Audit Limitations</td><td>Broad and limited depth audit:
- based on presence and absence of required documentation,</td></tr>
<tr><td>Audit Documents</td><td>
<table>
<tr><th>Document Title</th><th>Document Reference</th></tr>
<tr><td>Lamberts North Ash Placement Project – Operation Environmental Management Plan 2019 (Rehabilitation of Lamberts North Section 6.73)</td><td></td></tr>
</table>
</td></tr>
<tr><td>Audit Criteria</td><td>
<table>
<tr><th>Risk Level</th><th>Colour Code</th><th>Description</th></tr>
<tr><td>High</td><td>NC-H</td><td>Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence.</td></tr>
<tr><td>Medium</td><td>NC-M</td><td>Non-compliance with:
Potential for serious environmental consequences, but is unlikely to occur; or
Potential for moderate environmental consequences, but is likely to occur.</td></tr>
<tr><td>Low</td><td>NC-L</td><td>Non-compliance with:</td></tr>
</table>
</td></tr>
</table>

			• Potential for moderate environmental consequences, but is unlikely to occur; or • Potential for low environmental consequences, but is likely to occur.
	Administrative non-compliance	**NC-A**	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	**C**	The intent and all elements of the requirement of the regulatory approval have been complied with.
	Not Assessed	**NA**	Not assessed.
	Observation	**O**	Observation, based on identified inconsistency or opportunity for improvement.

Revegetation and revegetation measures

Aspect	Management and mitigation measures	Status	Comments
1.	Landscape rehabilitation and revegetation shall be progressive, and will be initiated as soon as practicable and/or as after final capping.	C	Sections of completed final batter along LN were capped with soil and seeded in 2019/2020.
2.	Areas that have been capped will be defined on a plan in preparation for revegetation.	C	As detailed in the monthly report for the ash facility.
3.	The ash will be capped with a minimum of 0.75m mine overburden or other. The soil capping shall be conditioned to facilitate revegetation. If capping material does not contain stockpiled topsoil or is inappropriate to foster revegetation, appropriate soil conditioning methods shall be implemented. These may include the addition of organic matter through compost products such as green-waste or a cover crop such as annual grass species. Excavated Natural Material (ENM) or Virgin ENM and / or soil amendment products as defined by the EPA waste Classification Guideline dated 2014 may be used if required.	C	A minimum of 0.75m of soil material has been placed over the ash. LL adopt shallow ripping to 150mm and use of multi-grow soil fertiliser to support cover crop species.
4.	Erosion and sediment control measures will generally conform with, or exceed the relevant requirements of managing urban stormwater, soils and construction (Landcom, 2004).	C	Control measures are maintained on an ongoing basis. Runoff water is stored in LN Pond 2.
5.	Works, rehabilitation and revegetation will be concentrated on the north east face during the initial ash placement stages in order to screen operations and establish growing vegetation as quickly as possible.	C	Recent works were situated along the north east face.
6.	Experimentation and adaptation of successful practices will be key strategies to manage the successful establishment of primary vegetation on batters and benches.	C	Successful methods used previously include, shallow ripping to 150mm, leaving large rocks and use of multigrow fertiliser.
7.	A revegetation strategy plan will be developed to establish a method to achieve permanent groundcover that conserves the soil and is sustained with minimal intervention. This will be Strategy will follow the principles and recommendations provided in Section 6.7.4.3 of this plan. Note: The revegetation strategy shall ensure that locally native species endemic to the Lithgow Local Government Area are used in revegetated areas (where possible and feasible depending on soil conditions). Species selection shall be carried out using a qualified expert i.e. Ecologist, botanist or agronomist.	O	Review confirmed revegetation species used are generally adopted from the species lists within the OEMP. Requirement to formalise the current approach into a dedicated revegetation strategy.
8.	New batters shall be rehabilitated as soon as practically possible using capping material sourced from onsite materials and stockpiles.	C	Compliant. Low ash placement volumes during 2019-2020 has limited the development of final batter slopes requiring revegetation works.
9.	Concave slope profiles will be developed where possible to mimic natural slopes and minimise erosion.	C	Slope profiles are generally compliant.
10.	The benches will be sloped inwards to minimise down slope run off and will have a rough surface to slow and spread water movement.	C	Additional measures include retention of rocks in the batter and install laybacks with 2% grade.

Monitoring requirements

No.	Monitoring measures	Status	Comment
1.	A monitoring program will be developed in conjunction with the revegetation procedure (Table 6-33 #6) commence once the first revegetation area has been planted.	O	The first revegetation area was sown in the 2019/2020 reporting year. The monitoring program to be developed.

Figure 1 – Revegetation works along north east batter

Figure 2 – Revegetation works along north east batter

Appendix G Annual Summary of Lend Lease Compliance

Summary of Contractor compliance at Lamberts North

	September 2019	October 2019	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020	May 2020	June 2020	July 2020	August 2020
Ash Moisture **Fresh Water 18-20%**	C	C	C	C	C	C	C	C	C	C	C	C
Compaction Testing **Dry density ratio 95%** **Fresh ash acceptable 93%**	C	C	C	C	C	C	C	C	C	C	C	C
Landform Stability **No slumping or movement**	C	C	C	C	C	C	C	C	C	C	C	C
Weather station operational	C	C	C	C	C	C	C	C	C	C	C	C
Irrigation system Operational	C	C	C	C	C	C	C	C	C	C	C	C
Internal dust deposition gauges **Insoluble solids = 4 g m^{-2} month**	C	C	C	C	C	C	C	C	C	C	C	C
Ash Contaminated Water contained within site boundary	C	C	C	C	C	C	C	C	C	C	C	C
Geotechnical vibrating wire piezometers Stack stability	C	C	C	C	C	C	C	C	C	C	C	C
No Community complaint	C	C	C	C	C	C	C	C	C	C	C	C

Appendix H Annual EnergyAustralia Community Sponsorships and Donations

Recipient	Reason	Month / Year
Ironfest	Community Event	April 2019
Sea Bees	Fishing Event Lake Lyell	April 2019
Mingaan Aboriginal Corporation	Support local event	May 2019
Lithgow City Council	Lithglow Event	May 2019
St Josephs	Mothers Day Fete	May 2019
Lithgow Golf Club	Mt Piper Plate Event	May 2019
Wallerawang/Lidsdale Progress Assn	New Years Eve Fireworks	July 2019
Lithgow Public School	Books in Homes Program	July 2019
Rydal Village Association	Daffodils at Rydal	July 2019
Hartley Historic Association	Back to Hartley 2019	July 2019
Lithgow High School	Presentation Day	August 2019
Lithgow City Council	Halloween	August 2019
Barton Park Giant Tree Arboretum	Projects at the Arboretum – Lake Wallace	August 2019
Lithgow Bears RLFC	Active Kids Sports Program	August 2019
Bathurst Centacare	Cooking Classes for Disadvantaged Families in Community	August 2019
Lithgow District Car Club	Security Fencing Yvonne Martin Memorial Motorsport Park	August 2019
Dry July	Matching Staff Donation	September 2019
Rydal Show Society	Rydal Show	November 2019
St Josephs School Portland	Presentation Day	November 2019
Legacy	Matching staff donation	November 2019
Lithgow & District Community Nursery	Assistance with propagation/provision of plants for local environment	November 2019
Capertee Public School	Presentation Day	November 2019
Lithgow Public School	Presentation Day	November 2019
Portland Central School	Presentation Day	November 2019
St Patricks School	Presentation Day	November 2019
Wallerawang Public School	Presentation Day	November 2019
Zig Zag Public School	Presentation Day	November 2019
LINC Communities & Kids	Carers Pamper Day	November 2019
LINC	Hub Homework Centre	November 2019
Dymocks Childrens Charities	Books for School Library	November 2019
Life Education	Healthy Harold	November 2019
Marathon Health	Taxi Vouchers/Moibilising Mental Health	November 2019
Portland District Sports Club	Updating toilet facilities	November 2019

Wallerawang Central Acclimatisation Society	Gone Fishing Day – Lake Wallace	November 2019
Lithgow Junior Cricket	Purchase equipment	November 2019
Oxfam Australia	Matching Staff donation	November 2019
Jeans for Genes	Matching Staff Donation	November 2019
La Salle Academy Lithgow	Presentation Day	December 2019
Lithgow Show Society	Lithgow Show	December 2019
Cooerwull Public School	Presentation Day	December 2019
Cullen Bullen Public School	Presentation Day	December 2019
Hampton Public School	Presentation Day	December 2019
Meadow Flat Public School	Presentation Day	December 2019
Lithgow Swimming Club	Twilight Swimming Meet	December 2019
The Longest Day	Matching Staff Donation	December 2019
Movember	Matching Staff Donation	December 2019
Starlight Children's Foundation	Matching Staff Donation	December 2019

Appendix I Wangcol Creek Ecological Monitoring Program

Wangcol Creek Ecological Monitoring Program

Wangcol Creek EMP Autumn 2013 to Autumn 2020

59919010

Prepared for

EnergyAustralia NSW

6 November 2020

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Executive Summary

Introduction and Background

EnergyAustralia NSW (EnergyAustralia) operates Mount Piper Power Station (MPPS), near Lithgow NSW. On 16 February 2012, EnergyAustralia was granted approval for the construction and placement of ash at the Lamberts North Ash Placement Project (the Project). The Project provides a storage area for ash produced from the burning of coal after the previous storage area (Ash Area 1) reached capacity.

The 2010 Environmental Assessment for the Project identified several aspects of construction and ash placement that may affect the aquatic ecology of nearby Wangcol Creek, located just north of the Project site. The primary effect identified was that on water quality, via potential changes to Electrical Conductivity (EC) and concentrations of heavy metals. The approval conditions required an Ecological Monitoring Program (EMP) be established, aimed at detecting potential impacts to aquatic biota and habitat in Wangcol Creek and informing management decisions taken to mitigate, minimise and / or ameliorate any impacts. Construction of the Project commenced in February 2013 and ash placement on the Project site commenced in September 2013.

Cardno (NSW/ACT) Pty Ltd, formerly Cardno Ecology Lab, was commissioned by EnergyAustralia to undertake the autumn 2020 monitoring component of the EMP. In accordance with the EMP, previous sampling was undertaken by Cardno or other specialist consultants in spring (November) 2012, autumn (May) 2013, spring (December) 2013, autumn (May) 2014, spring (November) 2014, spring (December) 2015, spring (December) 2016, autumn (May) 2018 and most recently in autumn (May) 2020.

The 2020 monitoring consisted of surveys of aquatic habitat, water quality and macroinvertebrate assemblages (using the AUSRIVAS protocol) by Cardno on 20 May 2020 at the following sites:

> Control NCR1 on Wangcol Creek upstream of the Project area;

> Impact NCR2 on Wangcol Creek adjacent to the Project area;

> Control NCR3 on Wangcol Creek upstream of the Project area; and

> Control A16 on the Coxs River at Lidsdale downstream of the confluence with Wangcol Creek; and

The primary objectives of this monitoring were to:

> Assess whether any impacts to the aquatic ecology of Wangcol Creek were detected at NCR2 in autumn 2020 and determine whether any such impacts were attributable to the Project; and,

> Provide recommendations on actions, if any, that may be required to minimise, mitigate or ameliorate any impacts to the aquatic environment that may have occurred, and on any refinements to subsequent monitoring events that would improve the efficacy of the EMP.

Indicators of Aquatic Ecology

The following biotic indices were derived from the macroinvertebrate data collected in autumn 2020 and compared with those from previous autumn surveys in 2013, 2014 and 2018, with the aim to determine the presence of any impact using Permutational Analysis of Variance (PERMANOVA):

> Total number of taxa;

> Number of pollution sensitive Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa;

> OE50 Taxa Score (a biotic index of aquatic habitat and water quality); and

> SIGNAL2 Index (a biotic index of water pollution).

Changes in the structure of macroinvertebrate assemblages in all samples collected in autumn of 2013, 2014, 2018 and 2020 were also explored using graphical multivariate techniques. In addition to the *in-situ* water quality data, long-term water quality and water discharge data from Wangcol Creek and local rainfall data sourced from EnergyAustralia, the Bureau of Meteorology, and WaterNSW were examined to aid in the interpretation of macroinvertebrate data.

Identified Impacts

There was evidence to suggest a reduction in the number of EPT taxa occurred at NCR2 between autumn 2018 and autumn 2020 that could be associated with the Project. This reduction followed elevations in electrical conductivity and elevated concentrations of several metals in Wangcol Creek at this location, apparently following a few months of low rainfall and flow. Although a reduction was observed at this site, examination of trends in this indicator at other sites (albeit not always statistically significant) and of the associated taxa (rare taxa, the occurrence of which is difficult to relate to such impacts) suggests that this finding may be due to natural variation unrelated to the project. In any case, the observed small magnitude of the reduction in this indicator relative to other sites does not raise concern for aquatic ecology in Wangcol Creek at present. No such changes were detected in any other of the biotic indices (number of taxa, SIGNAL2 Scores, OE50 Taxa Score and multivariate assemblage structure) considered.

The complex interaction that exists between the various types of disturbances (e.g. those to habitat, water quality and flow) experienced in Wangcol Creek make any changes to macroinvertebrate assemblages difficult to distinguish from those that could be due to the Project. Nevertheless, the EMP does add value to the wider monitoring program, and it is expected that any large magnitude and / or cumulative impacts to aquatic biota would be detected, allowing appropriate management actions to be implemented. Recent changes to the monitoring of aquatic ecology, including the addition of further control sites, will assist in identifying any future impacts, were they to occur, and inform future impact minimisation and remediation efforts.

Recommendations

1. Further monitoring should be undertaken as planned in spring of 2020. This will maximise the validity of comparisons among data collected following Project commencement and between these data and baseline data collected in spring 2012. Data from this survey will allow more confident conclusions to be made on the presence and duration of any potential impact in Wangcol Creek following the changes in water quality observed here in January 2020.
2. Three replicate AUSRIVAS samples should continue to be collected from each site during all future surveys. This will provide a measure of the variation present in each indicator at each site, thereby, improving the ability to detect any future impact by enabling the use of appropriate statistical analysis.

At this stage no Project specific mitigation, impact minimisation or ameliorate actions are recommended. Such actions may be appropriate and may be recommended following more definitive assessments of the presence or absence of an impact that will be undertaken in subsequent monitoring reports and following the recommendations described above.

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Appendices

Tables

Figures

1 Introduction

1.1 Background

EnergyAustralia NSW (EnergyAustralia) operates Mount Piper Power Station (MPPS), near Lithgow, NSW. MPPS comprises two 700 MW steam turbine generators and produces power through the burning of coal sourced from local coal mines. On 16 February 2012, EnergyAustralia was granted approval for the Lamberts North Ash Placement Project (the Project) by the Department of Planning and Infrastructure (DP&I). The Project provides a facility for the storage of ash produced from MPPS following Ash Area 1 reaching its ash storage capacity. The Project includes construction activities and the delivery, placement, and capping of ash, the rehabilitation of the site and ongoing management. Construction began in February 2013 and ash placement began in September 2013.

The Environmental Assessment for the Project (SKM 2010) identified several aspects of construction and ash placement that could affect the aquatic ecology of Wangcol Creek, which flows in an easterly direction just north of the Project. Potential effects included, but were not limited to:

> Impacts to water availability flowing into Wangcol Creek due to changes to on-site water usage and changes to run-off caused by reductions in catchment area;

> Changes to the flood regime of Wangcol Creek due to the modification of the landform of the area to accommodate the ash placement facility; and

> Impacts to the water quality of Wangcol Creek, such as changes to electrical conductivity and metal concentrations, due to the mobilisation of sediment and other contaminants during construction and operation.

Condition B7 of the Conditions of Approval (CoA) for the Project required that an Ecological Monitoring Program (EMP) (GHD 2014a) be designed, aimed at detecting potential impacts to the aquatic ecology of Wangcol Creek due to the Project, and informing management decisions taken to mitigate, minimise and / or ameliorate any impacts that were detected. The EMP would incorporate baseline and ongoing (for at least 5 years after ash capping) monitoring of the ecological health of Wangcol Creek, and implementation of management measures to address any ecological impacts that were identified. The EMP formed part of the Construction Environmental Management Plan (CEMP), and subsequent Operational Environmental Management Plan (OEMP) for the Project. EnergyAustralia NSW commissioned Cardno (NSW/ACT) Pty Ltd (Cardno) (formerly the Cardno Ecology Lab) to undertake the 2019 monitoring in accordance with the EMP. This was planned originally to be undertaken in late November / early December 2019, though due to bush fire risk at that time, the survey was postponed to autumn 2020 and was undertaken on 20 May 2020.

1.2 Current Study

The specific objectives of the current study were to:

> Sample indicators of ecological health in Wangcol Creek potentially affected by the Project and at unaffected control sites on the creek and on the Coxs River in autumn 2020;

> Compare the findings with those of previous studies also undertaken in autumn as part of the EMP;

> Assess whether any impacts to the aquatic ecology of Wangcol Creek occurred since the last autumn survey (in May 2018) and determine whether any such impacts were attributable to the Project; and

> Provide recommendations on actions, if any, that may be required to minimise, mitigate or ameliorate any impacts to aquatic ecology that may have occurred and on any refinements to subsequent monitoring events that would improve the efficacy of the EMP.

Following the recommendations made following the 2015 study (Cardno Ecology Lab 2015a), monitoring incorporated sampling of AUSRIVAS edge habitat only with no sampling of AUSRIVAS riffle habitat undertaken (**Section 2.1**). Sampling also included an additional reference site on Wangcol Creek upstream of any potential impact that may be experienced due to the Project. In addition, this monitoring incorporated the recommendations made previously in the review of the EMP by Cardno Ecology Lab in 2014 (Cardno Ecology Lab 2014a) (**Section 2.2**).

2 Previous Studies

2.1 Monitoring

In accordance with the EMP, baseline aquatic ecology sampling was undertaken at two sites on Wangcol Creek in spring 2012 (GHD 2014b). Further sampling at these sites was done in autumn 2013 (GHD 2014c), spring 2013 (GHD 2014d), autumn 2014 (GHD 2014e) and spring of 2014 (Cardno Ecology Lab 2015a), 2015 (Cardno 2016 (**Table 2.1**).

Table 2-1 Timing of aquatic ecology surveys undertaken for the Wangcol Creek EMP and the respective report reference. The timing of key Project activities and the respective monitoring phase is also identified.

Monitoring Phase	Sampling Date	AUSRIVAS Season	Report Reference
Preparation of EMP	n/a	n/a	GHD (2014a)
Baseline	8 Nov 2012	Spring 2012	GHD (2014b)
Commencement of Construction – February 2013			
During Construction	6 May 2013	Autumn 2013	GHD (2014c)
Commencement of Ash Placement – September 2013			
During Ash Placement	12 Dec 2013	Spring 2013	GHD (2014d)
	22 May 2014	Autumn 2014	GHD (2014e)
	19 Nov 2014	Spring 2014	Cardno Ecology Lab (2015a)
	14 Dec 2015	Spring 2015	Cardno (2016a)
	1 to 2 Dec 2016	Spring 2016	Cardno (2017)
	9 and 11 May 2018	Autumn 2018	Cardno (2018)
	11 December 2018	Spring 2018	Cardno (2019)
	20 May 2020*	Autumn 2020	Current study

*Planned originally for spring 2019

These reports included background information on the aquatic ecology of Wangcol Creek and present the results of AUSRIVAS sampling and the assessment of aquatic habitat at these sites. The reports assessed whether impacts to the aquatic ecology of Wangcol Creek may have occurred following the baseline study. No impacts attributable to the Project were identified in data collected following the start of construction in autumn 2013 (GHD 2014c). GHD (2014d and e) suggested that impacts to macroinvertebrates may have occurred following the commencement of ash placement in spring 2013 and autumn 2014, respectively. However, the review did not find any conclusive evidence of this (**Section 2.2**).

2.2 EMP Review

Cardno Ecology Lab reviewed the EMP following a request by EnergyAustralia in late 2014. The review included the EMP and monitoring undertaken from spring 2012 to autumn 2014. The aim was to examine the suitability and efficacy of the EMP and recommend any appropriate amendments to future monitoring to help ensure the objectives of the OEMP are met with respect to aquatic ecology. The specific objectives, scope, identified issues and detailed recommendations of the critical review are detailed in Cardno Ecology Lab (2014).

The following associated recommendations were made:

> Based on its location with respect to Project activities, NCR1 on Wangcol Creek has been re-classified as a control site;

> Results from an ongoing *in situ* and *ex situ* water quality monitoring program are used to aid in the interpretation of macroinvertebrate data;

> As construction activities commenced in February 2013 and prior to the autumn 2013 sampling event in May 2013, data from May 2013 is treated as post-baseline data;

> The statistical approach has been revised following the re-classification of NCR1 as a control site and confirmation that sampling in autumn provides post-baseline data.

These were incorporated into the current study as appropriate. It is acknowledged that as the current sampling was undertaken in autumn, there is no comparative data from before the commencement of works. Nevertheless, data from the current study allows assessment of the occurrence of an impact in 2018 via examination of trends in the various indicators at the control and impact sites between autumn of 2013, 2014 and 2018.

2.3 Previous Surveys

Cardno Ecology Lab (2015a) undertook the spring 2014 monitoring following the implementation of the amendments to the EMP (**Section 2.2**). This included a re-assessment of all data collected during the EMP. The findings provided some limited evidence that changes in macroinvertebrates occurred at the impact site (NCR2) on Wangcol Creek in autumn 2013 that could be associated with the commencement of construction of the Project. These included a reduction in the total number and the number of relatively pollution sensitive Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa, a lower OE50 Taxa Score and a change in the structure of the macroinvertebrate assemblage observed at this site. However, appropriate statistical tests, which would provide strong evidence of the presence or absence of an impact, could not be performed in the absence of autumn baseline data. There was also evidence of a subsequent recovery in most of these indicators, and data from NCR2 in autumn 2013 were comparable with those collected further downstream at the sites on the Coxs River sampled during this season as part of the separate Coxs River Biological Monitoring Program (Cardno Ecology Lab 2015b).

Examination of long-term water quality data provided by EnergyAustralia indicated relatively great variation in the location, timing and magnitude of several indicators. There was some indication that the elevated concentration of zinc that occurred near NCR2 just prior to the autumn 2013 survey may have contributed to potential changes in macroinvertebrates occurring there. However, as macroinvertebrates will almost certainly respond to the combined effect of several elevated indicators as well as several other environmental cues (such as drought and flood events) operating in the creek, it was unclear how much of the variation in macroinvertebrate data is explained by levels of zinc and other measures of water quality. The taxa absent from NCR2 in autumn 2013 (i.e. generally those that are pollution tolerant), together with the presence of some pollution sensitive taxa, suggested that other factors, such as changes to habitat quality due to habitat fragmentation following reduced flow, may also influence macroinvertebrates in Wangcol Creek. The cause of elevations in electrical conductivity (EC) in Wangcol Creek, such as those observed around the time of ash placement on the Project site (GHD 2014d) and which was unclear at the time of the review, was attributed to rainfall and flow patterns in the creek, rather than any impacts due to the Project (Aurecon 2014).

The following additional recommendations made in Cardno Ecology Lab (2015a), aimed at further improving the robustness and cost effectiveness of the EMP, were incorporated into the current study:

> As no autumn baseline data is available, sampling in spring is preferred. Though no baseline data collected in autumn is available, surveys in autumn would, however, allow assessment of any changes that may manifest in autumn only;

> Due to the paucity of AUSRIVAS data collected from riffle habitat (following frequent low flows during sampling), sampling of riffle habitat (when present) should cease and effort be re-directed to collection of two replicate AUSRIVAS edge samples at each site, thereby improving the ability to detect any future impact by enabling the use of appropriate statistical analysis; and

> Establishment of an additional control site on Wangcol Creek and on the Coxs River, upstream of any potential impact that may be experienced due to the Project. While no baseline data would be available from these sites, control data collected here during future surveys would improve the power of statistical tests and aid in the detection of an impact occurring in the future. This site was surveyed in spring 2015 and spring 2016, but monitoring has since discontinued due to very low water levels following persistent low rainfall.

> Where appropriate, the more specific recommendations provided in Cardno Ecology Lab (2014a) aimed at improving the overall robustness of the study have also been implemented.

The findings of the spring 2015 monitoring did not provide any evidence of an impact due to the Project (Cardno 2016). None of the PERMANOVA tests undertaken on data collected from NCR1 and NCR2 in spring of 2013 and 2015 indicated a change that could otherwise be due to a Project related impact. There was also no conclusive evidence of any change in spring 2016 data that would suggest an impact due to the Project (Cardno 2017). None of the statistical tests indicated any change through time at NCR2 that could be due to a Project related impact. Surveys in autumn 2018 (Cardno 2018) and spring 2018 (Cardno 2019) also provided no evidence of an impact of the Project on aquatic ecology.

3 Existing Information

3.1 Environmental Context

Wangcol Creek (also known as Neubecks Creek) flows in an easterly direction north of the Project site (**Figure 3.1**). It is a naturally ephemeral creek (though it may appear perennial due to ongoing discharge from industries within its catchment). It has two main tributaries: a western arm which arises in the southwest of Ben Bullen State forest, several kilometres northwest of the Project, and a northern arm which arises in Blackmans Flat a few kilometres northwest of the Project site. These two tributaries join just north of the Castlereagh Highway and to the northwest of the Project site before joining the Coxs River at Blue Hole, a flooded historic quarry, approximately 2 kilometres north of Lidsdale. Other tributaries of Wangcol Creek include Lamberts Gully, which flows north into Wangcol Creek from the southeast of the Project Area. The Project includes ash placement over Huons Gully, which otherwise would have flowed into Wangcol Creek upstream of Lamberts Gully. Several un-named drainage lines also traverse the area.

Wangcol Creek is situated in a substantially disturbed catchment in which water quality, quantity and drainage patterns are influenced by surrounding historical and current mining operations (Ivanhoe Colliery, Commonwealth Open Cut Coal Mine, Angus Place Coal Mine, Kerosene Vale Mine, and Pine Dale Coal Mine), power generation (Mount Piper and Wallerawang Power Stations) and agricultural land practices. The creek has also been re-aligned several times to facilitate nearby mining practices.

3.2 Aquatic and Riparian Habitat

The riparian vegetation of the Wangcol Creek Catchment consists primarily of cleared land with some disturbed native regrowth. The section of creek in the vicinity of Blackmans Flat is almost devoid of native riparian vegetation except for scattered trees and occasional patches of *Leptospermum* sp. (Centennial Coal 2012). Some more established mixed native and invasive trees and shrubs (e.g. willow (*Salix alba*) and blackberry (*Rubus* sp.)) are present along the main channel of the creek in the vicinity of the Project.

Adjacent to the Project, Wangcol Creek consists of faster flowing riffle and deeper slower flowing pools (GHD 2014a). The substratum generally consists of sand, coarse gravel, cobbles and rock. In places there are large deposits of fine sediment.

3.3 Water Quality

3.3.1 Environmental Assessment

Water quality in Wangcol Creek was reviewed as part of the Environmental Assessment for the Project (SKM 2010). The review examined water quality data collected from four previously established water quality monitoring sites located on the creek in the vicinity of the Project (**Figure 3.1**):

> LDP6 (MPPS Licensed Discharge Point 1): located upstream of the Project and the previous ash storage area (Ash Area 1). This site has previously been referred to as LDP01;

> WX22: Wangcol Creek gauging station, located adjacent to the Project;

> Site 2: Springvale Coal monitoring site located immediately upstream of the confluence with Lamberts Gully; and

> Site 3: Springvale Coal monitoring site located immediately downstream of the confluence with Lamberts Gully.

Data were available from LDP6 and WX22 for the period 2000 to 2009 and from Sites 2 and 3 (2000 to 2007). Data were compared with Australian Guideline Default Trigger Values (DTVs) (ANZECC/ARMCANZ 2000) for upland rivers in south eastern NSW. The findings are summarised as follows:

> Electrical Conductivity (EC) often exceeded the upper DTV (350 µs/cm) and was recorded as high as 1333 µs/cm at LDP6 and 1200 µs/cm at Site 3;

> pH was within lower and upper DTVs (6.5 to 8.0); and

Figure 3-1 Aerial image identifying the location of the Project (Lamberts North), the previous ash depository (Ash Area 1), Wangcol Creek, the Coxs River, aquatic ecology monitoring sites and long-term water quality monitoring sites. Note CR0 was not sampled in the current study due to low water level.

> Concentrations of metals (aluminium, sliver, arsenic, cadmium, chromium, manganese, copper and zinc) were above the trigger value for 95% protection of freshwater ecosystems at one or more sites.

Additional water quality data from WX22 collected by EnergyAustralia from 2008 to 2012 were presented in GHD (2014a). These data indicated that nickel, boron, copper and lead in Wangcol Creek can also exceed DTVs at times.

3.3.2 Ash Area 1 Monitoring

Aurecon (2014) reviewed water quality data as part of the ongoing monitoring associated with Stages 1 and 2 of the previous Ash Area 1 placement area. This included surface water quality data collected at LDP6, WX22 and NC01 (on Wangcol Creek upstream of the Project site and the confluence with Lamberts Gully) prior to (October 2012 to August 2013), and following (September 2013 to August 2014) ash placement on the Project site. The findings are summarised as follows:

> Median EC ranged from 310 to 640 µs/cm and was often above the upper DTV for upland creeks (noting that Aurecon (2014) used DTVs for lowland rivers) at LDP6 and WX22 before, and after, ash placement and at NC01 following ash placement;

> pH ranged from 7.0 to 7.8 and was within the DTVs at each site before, and after, ash placement;

> Turbidity ranged from 2.3 to 26 ntu and was slightly above the upper DTV at LDP6 before ash placement; and

> Concentrations of heavy metals and indicators of water quality measured following ash placement were compared with locally derived guidelines (90th percentile of pre-placement data). While the concentrations of several metals (including barium, nickel and zinc) exceeded these local guidelines, it was noted that exceedances could not be attributed to the Project due to the confounding influence of groundwater flow from historic mine workings and Ash Area 1.

It was also noted that elevated ECs and concentrations of metals observed in Wangcol Creek were due to preceding periods of low rainfall and flow. Relatively high ECs and concentrations of nickel at WX22, compared with those at LDP6 and NC01, were attributed to inflows from MPPS via Huon Gully. Elevated concentrations of zinc at WX22 were most likely due to local mine water seepage during dry weather.

Groundwater from the Project area flows eastward towards Huons Gully, then into Wangcol Creek (Aurecon 2014). Groundwater from the Ash Area 1 area may also flow eastward through the Project area and into Wangcol Creek via Huons Gully, and potentially northeast towards Wangcol Creek. This pattern of groundwater flow prevented the identification of suitable water quality tracers that could be used to identify potential leachates from the ash deposited on the Project site and discriminate them from those associated with Ash Area 1.

3.4 Aquatic Biota

There is little publicly available information on the aquatic biota of Wangcol Creek. GHD (2014a) reviewed the findings of a 1993 aquatic flora and fauna survey of Wangcol Creek by the former Department of Water Resources (DWR 1994). The findings of this review are summarised in **Sections 3.4.1** and **3.4.2**. Additional information on macroinvertebrates in Wangcol Creek and the wider upper Coxs River Catchment is summarised from the findings of SCA Sydney Drinking Water Catchment Audits (GHD 2013). The findings of an ecotoxicology study in the northern arm of Wangcol Creek (Battaglia *et al*. 2005) are also summarised in **Section 3.4.2.1**.

3.4.1 Flora

The review of DWR (1994) provided by GHD (2014a) noted the following observations of aquatic flora in Wangcol Creek:

> Emergent aquatic flora is relatively diverse, with common species including tall spikerush (*Eleocharis sphacelata*), spikerush (*Eleocharis acuta*), jointed rush (*Juncus articulatus*), common reed (*Phragmites australis*) and cumbungi (*Typha orientalis*);

> Submerged aquatic flora was sparse and consisted of green algae (*Chara* sp., *Nitella* sp., *Spirogyra* sp. and *Rhizoclonium* sp.);

> A smothering effect due to the presence of fine sediments in the creek was offered as an explanation of the low diversity of submerged aquatic flora;

> Dense beds of tall spikerush and cumbungi were present in some sections of creek, reducing water flow in these sections.

3.4.2 Fauna

3.4.2.1 Aquatic Macroinvertebrates

The review of DWR (1994) suggested that Wangcol Creek supported a diverse macroinvertebrate community, dominated by true flies (Order: Diptera), caddisflies (Order: Trichoptera), damselflies and dragonflies (Order: Odonata) and beetles (Order: Coleoptera).

More recent surveys of AUSRIVAS edge habitat in Wangcol Creek adjacent to the Project and at other nearby sites on the Coxs River were undertaken as part of the SCA Sydney Drinking Water Catchment Audits (GHD 2013). The results of the 2009 survey on Wangcol Creek indicated the aquatic habitat here was severely impaired (AUSRIVAS Band C) relative to reference condition. The aquatic habitat at sites on the Coxs River upstream and downstream of the confluence with Wangcol Creek sampled in 2009 ranged from severely impaired to significantly impaired (AUSRIVAS Band B) relative to reference condition. Further monitoring at a subset of these sites in 2011 also indicated that the aquatic habitat was severely to significantly impaired. Long term sampling undertaken at A16 (also included in the EMP, see **Section 4.2**) on the Coxs River downstream of the confluence with Wangcol Creek from 2001 to 2012 indicated that the condition of aquatic habitat ranged generally from severely impaired to equivalent to reference condition (AUSRIVAS Band A). In 2002, the macroinvertebrate assemblage at this site was richer than expected under the AUSRIVAS model (Band X). While the habitat condition at A16 appears to have declined from 2009 to 2012, there appears to have been a general improvement across the Upper Coxs River sub-catchment through that time (GHD 2013).

It was noted in GHD (2014a) that the macroinvertebrate assemblages at most of the sites sampled in the Coxs River catchment (at least prior to 2010) were dominated by pollution-tolerant taxa, and that analyses indicated that the invertebrate assemblages and individual taxa were influenced by EC in the river.

A study by Battaglia *et al*. (2005) indicated that the abundance and diversity of macroinvertebrate fauna in Wangcol Creek was much lower than two reference creeks (Megalong Creek and Jocks Creek) and attributed this difference to acid mine drainage (AMD) from previous mining activities within the area. The study found a strong correlation between water quality (concentrations of several analytes, including nickel and zinc, were found to be greater in Wangcol Creek than in the reference creeks) and macroinvertebrate data. The study also concluded that poor water quality impacted on macroinvertebrate assemblages within the creek, rather than the quality of the sediment from the creek bed.

3.4.2.2 Fish

The DWR (1994) review indicated three species of fish occurring in Wangcol Creek during the DWR (1994) survey, these were:

> The native mountain galaxias (*Galaxius olidus*), which represented over 90 % of the fish caught;

> The native flathead gudgeon (*Philypnodon grandiceps*); and

> The non-native wild goldfish (*Carassius auratus*).

It was noted that the low diversity and abundance of the fish assemblage in Wangcol Creek compared with other nearby freshwater streams suggested fish habitat quality in the creek was poor.

Topographical maps show several crossings that may represent significant barriers to fish movement through the creek. Such structures would impact fish populations by reducing longitudinal connectivity and habitat availability, and could cause population fragmentation.

3.5 Summary

Wangcol Creek is situated in a heavily disturbed and modified catchment. It has experienced substantial environmental stress due primarily to nearby historic and current coal mining activities, power generation and land clearing practices and continues to do so. Poor water quality (primarily elevated EC and concentrations of heavy metals) due to discharged process water, groundwater flow from historic mine workings, increased sedimentation due to run-off from nearby roads and other impermeable surfaces and the removal of native vegetation are likely the major contributing factors to the generally depauperate macroinvertebrate and fish assemblages supported by the creek. SKM (2010) noted that there is sufficient data from the on-going monitoring and the modelling studies undertaken as part of previous and current studies to suggest that the main contribution to elevated water quality indicators in Wangcol Creek is historic coal mining activities rather than Ash Area 1 or the operation of MPPS. The findings of the review of water quality data collected before and after ash placement on the Project site by Aurecon (2014) suggested a complex interaction between the various water quality impacts in Wangcol Creek (Aurecon 2014), which would also be affected by local rainfall patterns and water flow in the creek.

The 2010 audit (DECCW 2010) indicated that as a whole the Upper Coxs River sub-catchment was under a high level of stress, due to inflows from the sewage treatment plants, inflows of urban stormwater, runoff from roads and grazing lands, regulation of flows by dams, extraction of surface and ground water, occurrence of barriers to fish passage, geomorphological disturbance from past and present mining and licenced discharges from nearby power stations and coal mines. Despite these observations, Wangcol Creek does support aquatic biota and habitat of ecological value. While the riparian strip has been impacted by historic vegetation clearing, channel realignments and includes exotic species, it is relatively intact along the main channel of the creek and would be an important source of woody debris and bank stabilisation. The creek also supports several native macrophytes which provide habitat for macroinvertebrates and fish and may also be important in nutrient cycling, limit the magnitude and duration of elevated concentrations of nutrients and help prevent eutrophication due to excess nutrients.

Monitoring programs such as that included in the EMP that aim to detect the potential impact on the aquatic ecology of Wangcol Creek due to specific activities (such as the Project) must take into consideration the various impacts the creek has experienced, now and in the past, and patterns of rainfall and flow. While any potential impact due to the Project would only be one of several types of disturbance that the creek currently experiences, the effect of cumulative impacts is also important.

4 Methodology

4.1 Study Rationale

The primary aim of the study is to identify changes in the selected indicators of aquatic ecology at the impact site that are in a different direction, or of a different magnitude, to those at the control sites. Any such changes would be related to variation in environmental (such as water quality) data in an attempt to explain the pattern of changes and explore the potential cause of any impact.

The methods utilised in this survey and described in **Sections 4.2** to **4.6** are based on those prescribed in the EMP (GHD 2014a) and incorporate the modifications and additions described in the review of the EMP (Cardno Ecology Lab 2014a) (**Sections 2.1** and **2.2**).

4.2 Study Sites

The following sites were sampled by Cardno 20 May 2020, which was within the autumn AUSRIVAS sampling season (**Figure 3.1**):

> Control NCR1 located on Wangcol Creek upstream of Huons Gully and the Project area. While this site is situated on a section of Wangcol Creek which has, and continues to be, impacted by other disturbances, it is not expected to experience any impact due to the Project (**Section 2.2**);

> Impact NCR2 located on Wangcol Creek downstream of Huons Gully and adjacent to the Project area;

> Control NCR3 located on Wangcol Creek between the Northern Arm and Huons Gully upstream of the Project area. A control site could not be established farther upstream because the habitat there was unsuitable (consisting of a wide channel with dense aquatic vegetation or a narrow, re-sectioned channel with minimal riparian vegetation) and would not be expected to provide comparable control data for NCR2;

> Control A16 located on the Coxs River approximately 5 km downstream of the ash placement (this site is an ongoing Sydney Catchment Authority (SCA) macroinvertebrate monitoring site); and

Note that the control site on the Coxs River (A16) is located downstream of the impact site and could conceivably experience impacts due to the Project. It is considered unlikely that such impacts would occur because A16 is located some distance downstream and receives substantial flows from the upper Coxs River. The latitude and longitude of each site are presented in **Appendix A**.

4.3 Timing

The timing of the current and previous sampling undertaken at each site is presented in **Table 4.1**.

Table 4-1 The timing and number of AUSRIVAS edge and riffle habitat samples collected at each of the Wangcol Creek EMP aquatic ecology monitoring sites during 2012 to 2018

Date	AUSRIVAS Season	NCR1		NCR2		NCR3	A16		CR0
AUSRIVAS Habitat		Edge	Riffle	Edge	Riffle	Edge	Edge	Riffle	Edge
8 Nov 2012	Spring 2012	1	1	1	1		1	1	
6 May 2013	Autumn 2013	2		1	1				
12 Dec 2013	Spring 2013	2		2			1	1	
22 May 2014	Autumn 2014	2		2					
19 Nov 2014	Spring 2014	1		1			1	1	
14 Dec 2015	Spring 2015	2		2		2	2		2
1 to 2 Dec 2016	Spring 2016	2		2		2	2		2
9 and 11 May 2018	Autumn 2018	2		2		2	2		
11 December 2018	Spring 2018	3		3		3	3		

20 May 2020	Autumn 2020	3	3	3	3

Note, only autumn data have been examined in the current report (**Section 2.1**). Riffle habitat was not sampled due to absence of this habitat during low flows. Monitoring was not undertaken at CR0 in autumn 2018 and spring 2018 due to low water level, and monitoring here has now ceased due to persistent low water level.

4.4 Field Sampling

4.4.1 Aquatic Habitat

Aquatic habitat was assessed using methods in the NSW AUSRIVAS Manual (Turak *et al.* 2004). Descriptions of physical habitat included visual assessments of streambed composition, aquatic and riparian vegetation, potential disturbance and sketches of the river profiles.

The condition of aquatic habitat was assessed using the Reference Condition Selection Criteria (RCSC) categories developed by the Queensland Government (QLD DNRM 2001), as per the requirements of the EMP (**Appendix B**). This assessment rates the level of influence (from 1 to 5, with 1 being a very major impact and 5 an indiscernible impact) that a watercourse experiences from several potential anthropogenic disturbances in relation to the selection of reference aquatic ecology monitoring sites. The condition of aquatic habitat was also assessed using a modified version of the Riparian, Channel and Environmental (RCE) Inventory method (Peterson 1992; Chessman *et al.* 1997). This assessment involves evaluation and scoring of the characteristics of the adjacent land, the condition of riverbanks, channel and bed of the watercourse, and degree of disturbance evident at each site (**Appendix C**). The maximum score (52) indicates a stream with little or no obvious physical disruption and the lowest score (13), a heavily channelled stream without any riparian vegetation, can be considered to be in poor condition.

Digital photographs were taken looking upstream and downstream at each site to provide a record of aquatic habitat present at the time of sampling and to aid in the site descriptions.

4.4.2 Water quality

During field sampling, water quality was measured *in situ* with a YSI 6920 water quality probe and meter that were calibrated prior to sampling. Water quality was measured before aquatic fauna were sampled to avoid disturbance to the waterway. The following variables were recorded between 10:00 and 15:00 on the day of sampling:

> Temperature (°C);

> Electrical Conductivity, EC (µs/cm);

> pH;

> Dissolved oxygen, DO (mg/L and % saturation);

> Turbidity (ntu).

Duplicate readings of each variable were taken in accordance with Australian Guidelines (ANZECC/ARMCANZ 2000).

These water quality data were intended to provide information on environmental conditions at the time of sampling for aquatic ecology. Long term trends in water quality data collected by other specialists were also examined (**Section 4.6.1**).

4.4.3 AUSRIVAS Macroinvertebrates

Aquatic macroinvertebrates associated with edge habitats were sampled using the AUSRIVAS rapid assessment methodology (RAM) (Turak *et al*. 2004). Three replicate edge samples were collected with dip nets (250 µm mesh) over a period of 3 to 5 mins from a total of 10 m of habitat within a 100 m reach of the river at each site. The dip net was used to agitate and scoop up material from vegetated river edge habitats. Where the habitat was discontinuous, patches of habitats with a total length of 10 m were sampled over the 100 m reach. Each RAM sample was rinsed from the net onto a white sorting tray from which live animals were removed ("picked") using forceps and pipettes. Each tray was picked for a minimum period of forty minutes, after which they were picked at ten-minute intervals either until no new specimens had been found or total of 60 minutes (i.e. the initial 40 minutes plus up to another 20 minutes) had elapsed. Care was taken to collect cryptic and fast-moving animals in addition to those that were conspicuous and / or slow-moving. The animals collected at each site were placed into a labelled jar containing 70% alcohol in water. The aim of the live picking is to pick as many macroinvertebrate taxa as possible. There is no set minimum or maximum number of animals to be collected, however, at least 20 chironomids were collected where possible to help ensure that an adequate representation of all subfamilies was obtained.

Environmental variables, including alkalinity, modal river width and depth, percentage boulder or cobble cover, and latitude and longitude were recorded in the field. These variables were required for running the AUSRIVAS predictive model for edge habitat. Distance from source, altitude, and land-slope were determined from appropriate topographic maps. Mean annual rainfall was sourced from the regional precipitation maps presented in the AUSRIVAS Sampling and Processing Manual (Turak *et al*. 2004).

4.5 Laboratory Methods

AUSRIVAS samples were sorted under a binocular microscope (at 40 X magnification) and identified to Family level with the exception of Oligochaeta and Polychaeta (Class), Ostracoda (Subclass), Nematoda and Nemertea (Phylum), Acarina (Order) and Chironomidae (Subfamily). Up to ten animals of each family were counted, in accordance with the latest AUSRIVAS protocol (Turak *et al*. 2004).

4.6 Data Analysis

4.6.1 Water Quality and Hydrological Data

Water quality data were compared with the Australia, New Zealand Environment Conservation Council default trigger values (DTVs) for physical and chemical stressors for slightly disturbed upland rivers in southeast Australia (ANZECC/ARMCANZ 2000). The sites on Wangcol Creek and the Coxs River are at an altitude of 885 to 920 m and thus are classified as upland watercourses by ANZECC/ARMCANZ (2000). For metal data, guidelines for 95% protection of species for slightly to moderately disturbed ecosystems were utilised. While Wangcol Creek is probably more accurately described as a heavily modified system, guidelines for slightly to moderately disturbed systems are applied to these systems as a precautionary measure (ANZECC/ARMCANZ 2000).

EC and pH data collected from LDP6, NC01 and WX22 (**Figure 3.1**) by EnergyAustralia between 12 January 2014 and June 2020 were examined to aid in the interpretation of macroinvertebrate data. Concentrations of nickel and zinc (metals identified as exceeding locally derived guidelines following ash placement on the Project site (Aurecon 2014) (**Section 3.3.2**) and aluminium and boron (previous examination of these data suggested elevated concentrations of this metal occurred around the time of the aquatic ecology survey in spring 2014 (Cardno Ecology Lab 2015a)) recorded from these sites from January 2014 to September 2017 provided by EnergyAustralia were examined to aid the interpretation of macroinvertebrate data. Previous examination of data for four other metals of potential concern (barium, copper (Cu-F), iron (Fe-F) and manganese (Mn-F) (Cardno Ecology Lab 2015) suggested an increase in concentrations above background levels at one or more sites prior to the spring 2015 aquatic ecology survey (Cardno 2016). EC and the concentration of boron, nickel and zinc appeared elevated at WX22 (adjacent to the ash placement and NCR2) in early 2018 a few months prior to the current survey. Boron also appeared to be elevated at LDP1 and NC01 at this time.

Local monthly rainfall data obtained from the Bureau of Meteorology (BOM) station at Lidsdale (approximately 5 to 6 km south east of the aquatic ecology monitoring sites on Wangcol Creek) (BOM 2020) and monthly discharge data from NOW station 212055 (NOW 2016) from January 2012 to 1 July 2020 are also presented.

This cursory examination of water quality data has been undertaken in an attempt to explain any patterns in macroinvertebrate data. More detailed assessment of impacts to water quality in Wangcol Creek due to the Project will be undertaken by other specialist consultants.

4.6.2 Macroinvertebrate Indicators

The AUSRIVAS protocol uses an internet-based software package to determine the environmental condition of a waterway based on predictive models of the distribution of aquatic macroinvertebrates at reference sites (Coysh *et al.* 2000). The ecological health of the river was assessed by comparing the macroinvertebrate assemblages collected in the field (i.e. 'observed') with macroinvertebrate assemblages expected to occur in reference waterways with similar environmental characteristics. The data from this study were analysed using the NSW models for pool edge habitat sampled in autumn. The AUSRIVAS predictive model generates the following indices:

> OE50Taxa Score – The ratio of the number of macroinvertebrate families with a greater than 50% predicted probability of occurrence that were actually observed (i.e. collected) at a site to the number of

macroinvertebrate families expected with a greater than 50% probability of occurrence. OE50 taxa scores provide a measure of the impairment of macroinvertebrate assemblages at each site, with values close to 0 indicating an impoverished assemblage and values close to 1 indicating that the condition of the assemblage is similar to that of the reference rivers.

> Overall Bands derived from OE50Taxa scores which indicate the level of impairment of the assemblage. These bands are graded as described in **Table 4.2**.

Table 4-2 AUSRIVAS Bands and corresponding OE50 Taxa Scores for AUSRIVAS edge habitat sampled in autumn

Band	Description	Autumn OE50 Score
X	Richer invertebrate assemblage than reference condition	> 1.17
A	Equivalent to reference condition	0.82 to 1.17
B	Sites below reference condition (i.e. significantly impaired)	0.47 to 0.81
C	Sites well below reference condition (i.e. severely impaired)	0.12 to 0.46
D	Impoverished (i.e. extremely impaired)	≤0.11

The SIGNAL2 biotic index (Stream Invertebrate Grade Number Average Level) developed by Chessman (2003) was also used to determine the environmental quality of sites on the basis of the presence or absence of families of macroinvertebrates. This method assigns grade numbers between 1 (highly tolerant of pollution) and 10 (highly sensitive to pollution) to each macroinvertebrate family, based largely on their responses to chemical pollutants. The sum of all grade numbers for that site was then divided by the total number of families recorded in each site to obtain an average SIGNAL2 index. The SIGNAL2 index therefore uses the average sensitivity of macroinvertebrate families to present a snapshot of biotic integrity at a site. SIGNAL2 values are as follows:

> SIGNAL > 6 = Healthy habitat;

> SIGNAL 5 – 6 = Mild pollution;

> SIGNAL 4 – 5 = Moderate pollution; and,

> SIGNAL < 4 = Severe pollution.

The calculation of the SIGNAL2 Index was calculated using un-weighted SIGNAL2 grade data. Weighting SIGNAL2 grades according to abundance may bias the SIGNAL2 Index towards naturally more abundant taxa.

Two other biotic indicators; total taxon richness (the number of macroinvertebrate taxa collected in the sample) and Ephemeroptera, Plecoptera and Trichoptera (EPT) Taxon Richness (the combined number of mayfly, stonefly and caddis fly taxa, respectively, which are considered to be relatively pollution sensitive) were also obtained from AUSRIVAS macroinvertebrate data. The relative contribution of each of the major taxonomic groups (including Trichoptera, Diptera, Coleoptera, Hemiptera, Plecoptera, Odonata, Ephemeroptera, Crustacea and Mollusca) to the total number of taxa present in each sample was also examined visually to provide an indication of any changes that could be indicative of an impact.

4.6.3 Statistical Analysis

4.6.3.1 Interpretation and Data Presentation

The objective of the statistical analyses was to identify differences in the macroinvertebrate indicators at the Impact sites that may differ from those at the Control sites. Statistically significant differences associated with an interactive effect of Survey and Site could provide evidence that an impact may have occurred. Evidence is assessed by examining differences between pairs of Surveys and Sites.

Two PERMANOVA designs were utilised according to the availability of replicate sampling (i.e. two to three AUSRIVAS samples per site). The first included data collected from NCR1 and NCR2 in autumn of 2014, 2018 and 2020 and the second, data from each site sampled in 2018 and 2020 (**Section 4.6.3.2**). The first design enabled changes through time (albeit following commencement of the Project only) at NCR1 and NCR2 to be examined, the second design examined differences among all sites (NCR1, NCR2, NCR3 and A16) sampled (albeit only in 2018 and 2020) to help place any changes at NCR2 in the context of the wider catchment area by comparison with the other control sites (NCR3 and A16). The first design was included so that data from autumn 2014 could be included, as NCR3 had yet to be incorporated into the design. The second design included NCR3 to provide a more precise measure of natural variability, though this site was only sampled in autumn of 2018 and 2020. Including all data in one design would have resulted in an unbalanced dataset, which could complicate interpretation of the results. Differences in univariate indicators and among AUSRIVAS macroinvertebrate assemblages sampled in edge habitat at each site in autumn of each year sampled (2013, 2014, 2018 and 2020) were also explored graphically.

4.6.3.2 Multivariate Analyses

A matrix of differences in the types of taxa between all possible pairs of samples was compiled by calculating their respective Bray-Curtis dissimilarity coefficients. Permutational analysis of variance (PERMANOVA+ in Primer v6) was used to examine spatial differences and temporal changes, and their interaction, in macroinvertebrate assemblage presence / absence data sampled using AUSRIVAS (Anderson *et al*. 2008; Clarke and Gorley 2006). Differences in the levels of factors and interaction terms may be examined by *Post-hoc* permutational t-tests. Only statistical differences with a significance level of $P \leq 0.05$ are considered. Significant differences between groups may arise due to differences between group means, differences in dispersion (equivalent to variance) among groups or a combination of both. Either outcome could be indicative of an impact. Moreover, only significant statistical interactions are potentially indicative of an impact, hence significant main effects are not considered in detail.

Two analytical designs were utilised:

1. Comparison among sites sampled in autumn of 2014, 2018 and 2020 (NCR1 and NCR2 only):
   > Year: A fixed factor with three levels: 2014, 2018 and 2020; and
   > Site: A fixed factor with two levels: NCR1 and NCR2.
2. Comparison among all sites sampled in autumn of 2018 and 2020:
   > Year: A fixed factor with two levels: 2018 and 2020; and
   > Site: A fixed factor with four levels NCR1, NCR2, NCR3 and A16.

Multivariate patterns in data collected from each site during autumn of 2013, 2014, 2018 and 2020 were examined using the Principal Coordinates Analysis (PCoA) routine in PERMANOVA+. This is a generalised form of Principal Components Analysis (PCA) in which samples are projected onto linear axes based on their dissimilarities in a way that best describes the patterns among them using as few dimensions as possible (Clarke and Gorley 2006). The amount of variation 'explained' by each principal axis is indicated and the dissimilarity between data points can be determined from their distances apart on the axes (Anderson *et al*. 2008). Relative differences among samples were also examined using Hierarchical Clustering in PERMANOVA+ in Primer v6.

4.6.3.3 Univariate Analyses

PERMANOVA + was used to examine spatial differences and temporal changes in the number of taxa, OE50 Taxa Scores, SIGNAL2 Indices and the number of EPT taxa. These analyses were based on a Euclidean distance matrix of all possible pairs of samples of the variable of interest and with $P \leq 0.05$. The analytical designs described in **Section 4.6.3.2** were utilised.

As is the case with multivariate analyses, significant differences between groups (e.g. NCR1 and NCR2) may arise due to differences between group means, differences in dispersion (variance) among groups or a combination of both. A potential impact could affect both the magnitude and dispersion of an indicator (e.g. number of taxa). If a statistically significant difference between groups was detected that could be indicative of a mining impact, the proportion of the statistical difference attributable to the difference in variance between pairs of groups would be explored using the PERMDISP procedure to determine whether variances were statistically different. If there is no statistical difference between variances, the statistical difference detected between groups is most likely due to differences between group means. When a statistical difference between variances is detected, the difference between groups could be due to both the difference in variance and the mean between groups.

4.6.3.4 QA/QC Procedures

Data generated in the field were checked for accuracy and completeness before leaving each site. On return to the laboratory, field data sheets were photocopied, entered into spreadsheet format and checked. Spreadsheet files were locked prior to analysis to prevent accidental over-writes or corruption.

In the laboratory, the remains of each macroinvertebrate sample were retained and checked by another staff member to ensure that no animals were missed. A Cardno staff member with appropriate training and experience checked the identifications and counting of samples. These activities were recorded on the Laboratory Management Sheet. Data were entered into an electronic spreadsheet and data for each sample were printed and checked by a second staff member.

5 Results

5.1 Aquatic Habitat

5.1.1 NCR1

As for previous surveys undertaken by Cardno, the aquatic habitat at control location NCR1 upstream of the Project in 2020 appeared relatively undisturbed (**Plate 1a** and **b**). There was no evidence of recent channel re-alignments or re-sectioning, and several mature trees, albeit including some invasive willows, were present on both banks. This vegetation would help stabilise banks, thereby minimising erosion and associated increases in sedimentation. It would also be a source of woody debris which provides habitat for fish and macroinvertebrates. The upstream section of the site consisted of a large pool which was bordered by dense beds of cumbungi. The downstream section consisted of a channel approximately 1 m in width with loose cobble and pebble substratum. Some flow was present at the time of sampling. Rushes (*Juncus* sp.) were common along this section.

5.1.2 NCR2

While the section of Wangcol Creek at the impact site NCR2 (**Plate 1c** and **d**) also did not appear to have been subject to recent modification, the banks just downstream of the site had been re-sectioned and reinforced. Riparian vegetation consisted primarily of grasses and a few isolated trees. The absence of substantial bank stabilising vegetation likely explains the bank slumping and erosion present throughout the site. The channel consisted of loose material covered with fine sediment / diatom layer. A concrete gauging station / ford situated through the centre of the site acted as a small weir.

5.1.3 A16

The relatively steep banks, uniform bank profile and absence of any trees and other substantial riparian vegetation at A16 (**Plate 1e** and **f**) suggest that this section of the Coxs River has been re-aligned and / or re-sectioned. Bank slumping was present, though bank material was somewhat stabilised by grasses. The channel consisted primarily of loose cobbles and pebbles and moderate water flow was present at the time of sampling.

5.1.4 NCR3

The aquatic habitat at NCR3 (**Plate 2a** and **b**) was very similar to that at NCR2. The riparian vegetation within a few metres of the creek was relatively undisturbed with several large trees and grasses. There was no evidence of bank or channel modifications.

5.1.5 RCE Scores

General observations of aquatic habitat at each site were supported by the results of the RCE inventory. The total RCE scores for Sites NCR1, NCR2, NCR3 and A16 were 36, 25, 36 and 33, respectively (**Appendix D**). These scores were the same as those recorded for these sites in previous surveys. The low score for NCR2 was due primarily to the relatively poor condition of the riparian vegetation, unstable banks and the absence of in-stream habitat (e.g. large woody debris). A16 also scored relatively low in categories associated with the condition of riparian vegetation, compared with NCR1 and NCR2, though it did score relatively highly in categories associated with channel form, riffle / pool sequence and channel substratum.

The results of the Reference Condition Selection Criteria (RCSC) assessment reflected the disturbed nature of the local and catchment wide environment (**Appendix D**). Each site scored 1 to 2 (indicative of major influences) in categories associated with the influence of major extractive industry, alteration of riparian vegetation, and point-source wastewater discharge. Influence from intensive agriculture and major dams / weirs was not apparent at any site.

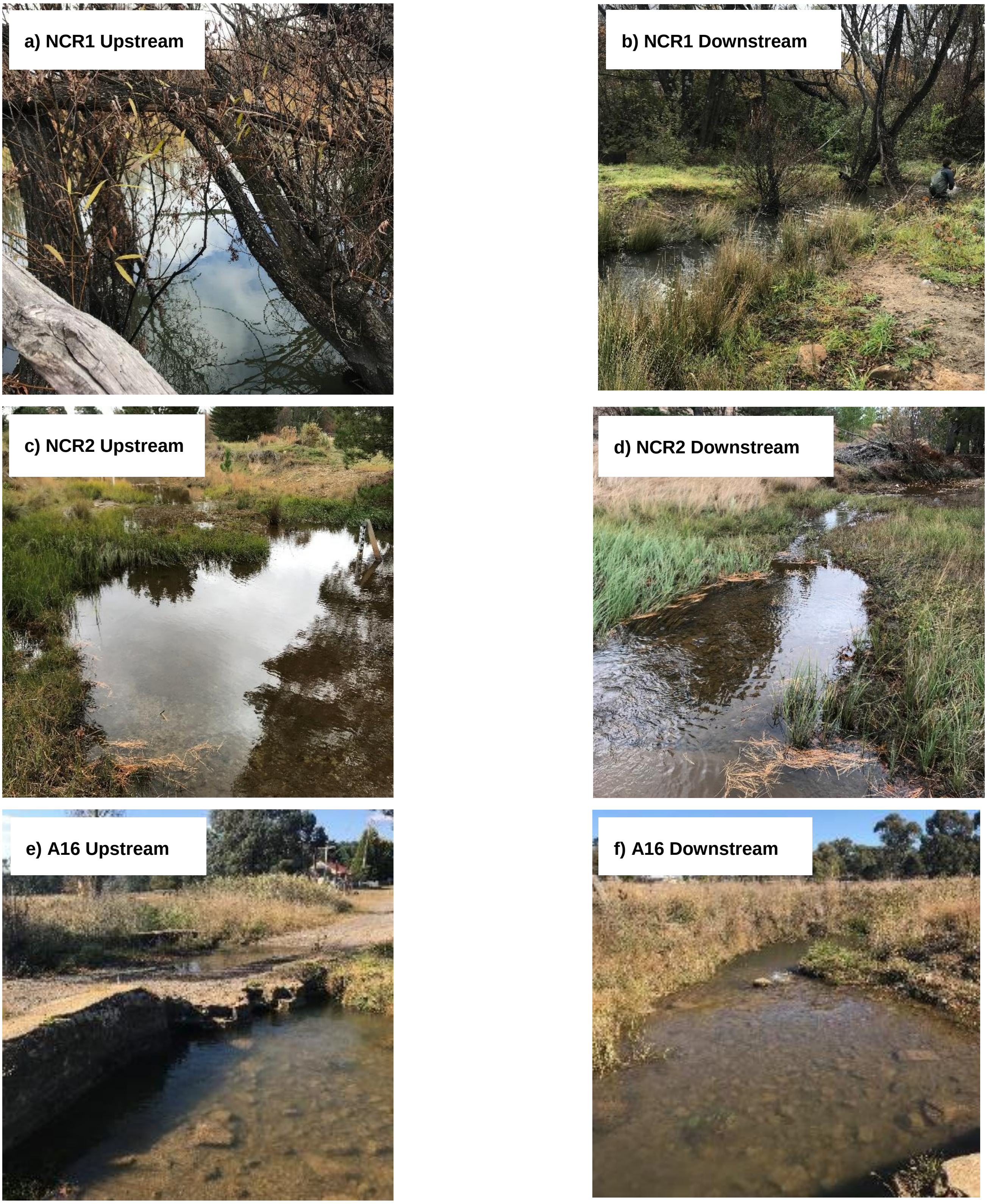


Plate 1: Photographs of NCR1 looking a) upstream and b) downstream, NCR2 looking c) upstream and d) downstream and A16 looking e) upstream and f) downstream.

Plate 2: Photographs of NCR3 looking a) upstream and b) downstream.

5.2 Water Quality and Hydrology

5.2.1 Autumn 2020 Water Quality

The mean values for each water quality indicator for each site measured in autumn 2020 (NCR1, NCR2 and NCR3 on Wangcol Creek and A16 on Coxs River) are presented in **Appendix E**. The results are summarised as follows:

> Temperature ranged from 8.8 °C to 9.7 °C on Wangcol Creek and was 11.7 °C on Coxs River;

> EC ranged from 567 µS/cm to 600 µS/cm on Wangcol Creek and was 1,130 µS/cm on Coxs River. It was above the upper DTV at each site;

> pH ranged from 7.4 to 7.5 on Wangcol Creek and was 7.4 Coxs River. It was within DTVs on each occasion;

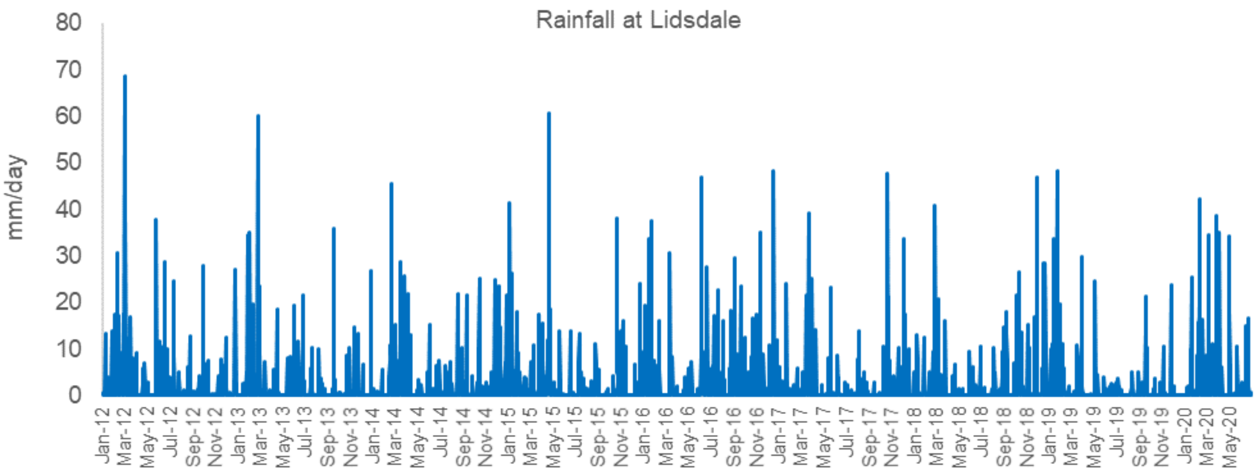
> ORP ranged from 20.8 mV to 31.4 mV on Wangcol Creek and was 32.5 mV on Coxs River;

> Dissolved oxygen ranged from 74.9 % to 85.5 % and was below the lower DTV on Wangcol Creek. Dissolved oxygen was 95.2 % and within DTVs on Coxs River; and.

> Turbidity was within DTVs at NCR1 and NCR3 (17.5 ntu and 4.6 ntu, respectively) and was below the lower DTV at NCR2 and A16 (0.6 ntu and 0.7 ntu, respectively).

5.2.2 Long Term Data

Daily discharge data from NOW station 212055 (WX22) from January 2012 to 1 July 2020 on Wangcol Creek (WaterNSW 2020) are presented in **Figure 5-1**. Examination of rainfall from BOM station 063132 at Lidsdale indicated that greater discharge events in Wangcol Creek followed periods of greater rainfall. EC data (**Figure 5-2a**) suggests that EC measured at WX22 was more variable than that at NC01 and LDP6 and that it appears associated with the amount of local rainfall and thus discharge experienced in Wangcol Creek with elevated ECs tending to occur following periods of low rainfall and discharge, and low ECs tending to occur following periods of high rainfall and discharge. The high EC recorded at WX22 in April 2017, January 2018 and January 2020 followed relatively low rainfall. The EC measured further upstream at LDP6 and NC01 (up to 880 µS/cm) was far lower, and less variable, than at WX22 (up to 3,040 µS/cm) and appears less influenced by rainfall and discharge. This pattern was similar, but less pronounced, in EC data prior to January 2014 (Cardno Ecology Lab 2015a). The EC at each site was often above the upper DTVs (350 µS / cm).



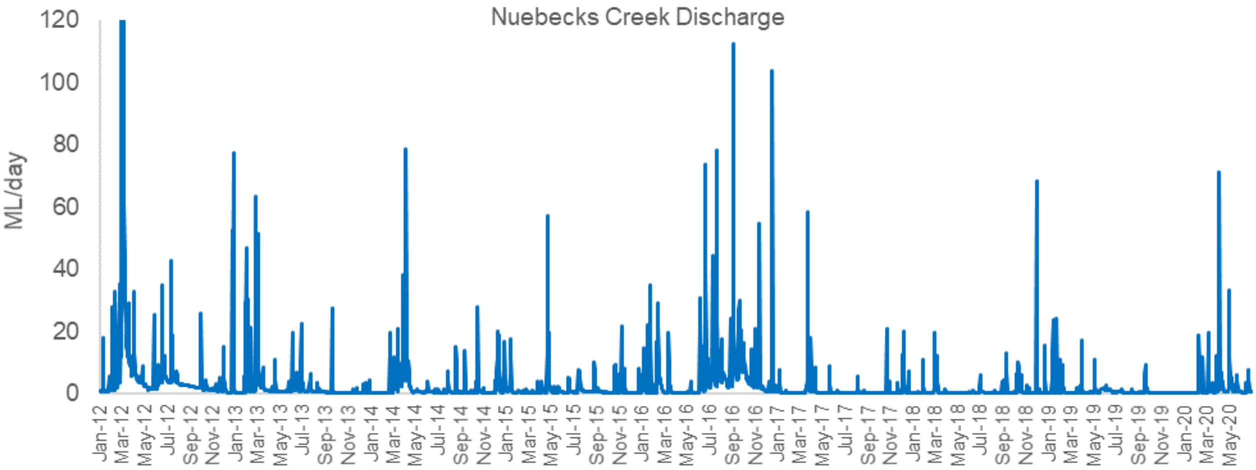
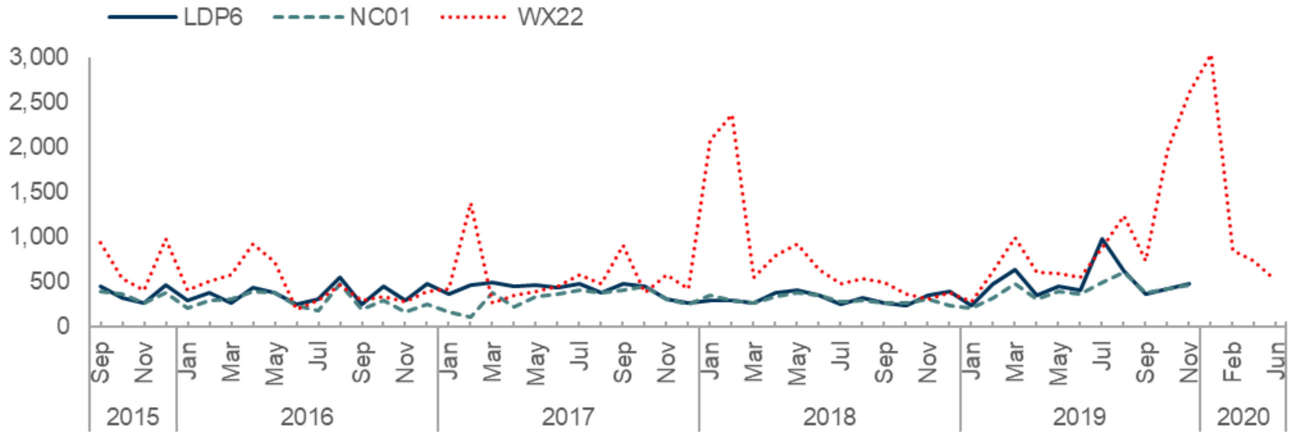


Figure 5-1 Daily rainfall at BOM Lidsdale station 063132 and daily discharge at NSW DPI (Water) station 212055 at WX22 on Wangcol Creek, January 2012 to 30 June 2020. The peak discharge in March 2012 was reported as 2,841 ML/day (NOW 2015). To enable easy interpretation of the other discharge data, the Y axis scale is limited to 120 ML/day

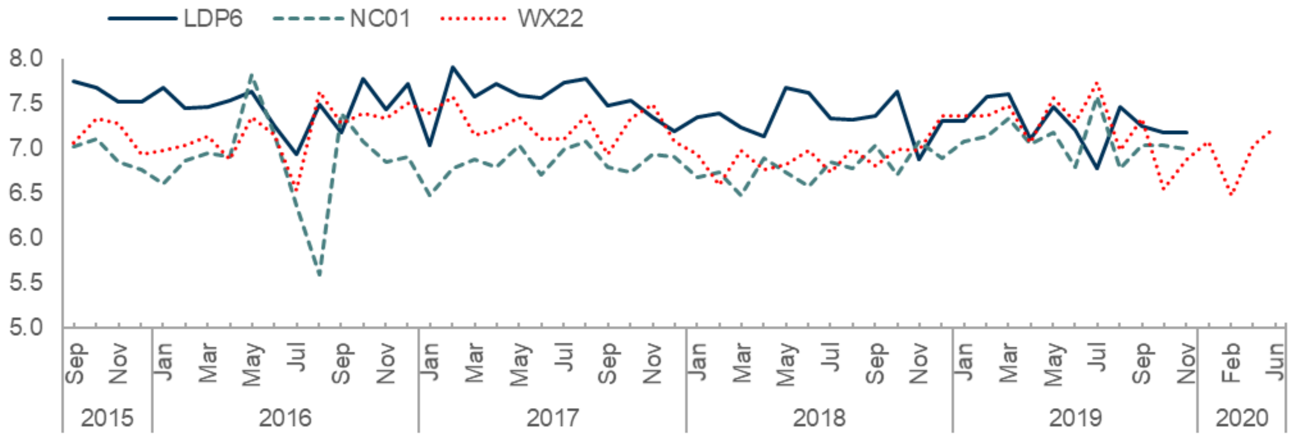
The autumn 2013 and 2014 surveys were undertaken following relatively substantial rainfall and discharge within the previous few months, and correspondingly low ECs at WX22 (below approximately 1,000 µS/cm) (Cardno 2018). The autumn 2018 and autumn 2020 surveys were undertaken following a relatively smaller amount of rainfall and discharge in Wangcol Creek and correspondingly greater EC at WX22 (over 2,000 µS/cm and 3,000 µS/cm, respectively). pH at LDP6, NC01 and WX22 largely remained within DTVs (pH 6.5 to 8.0) (**Figure 5-2b**). On occasion, there was a relatively large difference among the pH measured at each site, sometimes ± 1 pH unit. The pH at LDP6 was generally greater than that at NC01 and WX22.

Figure 5-2c, **Figure 5-3a-c** and **Figure 5-4** present the concentrations of a selection of heavy metals (those identified previously as exceeding local guidelines or identified as potentially elevated prior to the aquatic ecology surveys (**Section 4.6.1**)) measured at LDP6, NC01 and WX22 on Wangcol Creek between January 2014 and June 2020. Concentrations of boron, nickel and zinc appeared to be elevated at WX22 adjacent to the ash placement area during January to February of 2018 and January to February 2020. Boron also appeared to be elevated upstream of here (at NC01 and LDP1) at this time. Concentrations of zinc, aluminium and copper were elevated above guidelines at LDP1 and NC01 on occasion, with boron, nickel, zinc all above the guideline value at LDP6 in January 2020. Copper was also elevated at LDP6 in July 2019. Further analyse and interpretation of these data as part of the Lamberts North Water Quality Assessment.

a) Electrical Conductivity (ANZECC/ARMCANZ (2000) DTVs = 30 µS/cm to 350 µS/cm)



b) pH (ANZECC/ARMCANZ (2000) DTVs = 6.5 to 8.0)



c) Boron (ANZECC/ARMCANZ (2000) 95 % Species Protection Trigger Value = 0.37 mg / L)

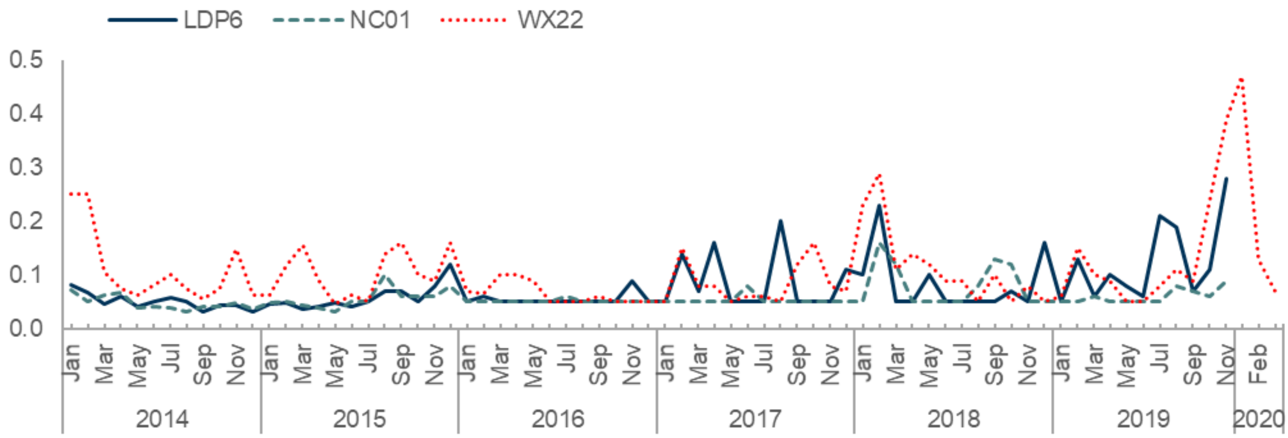
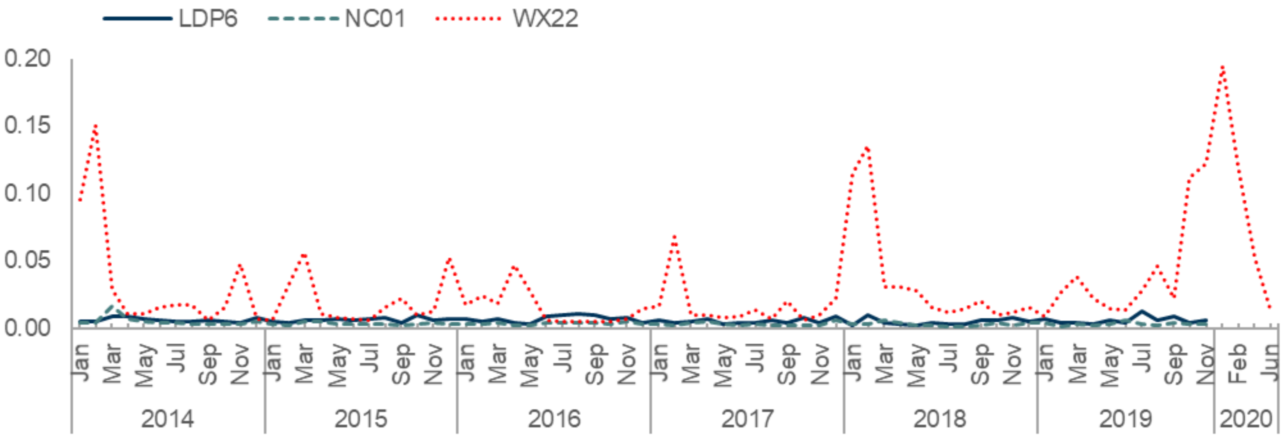
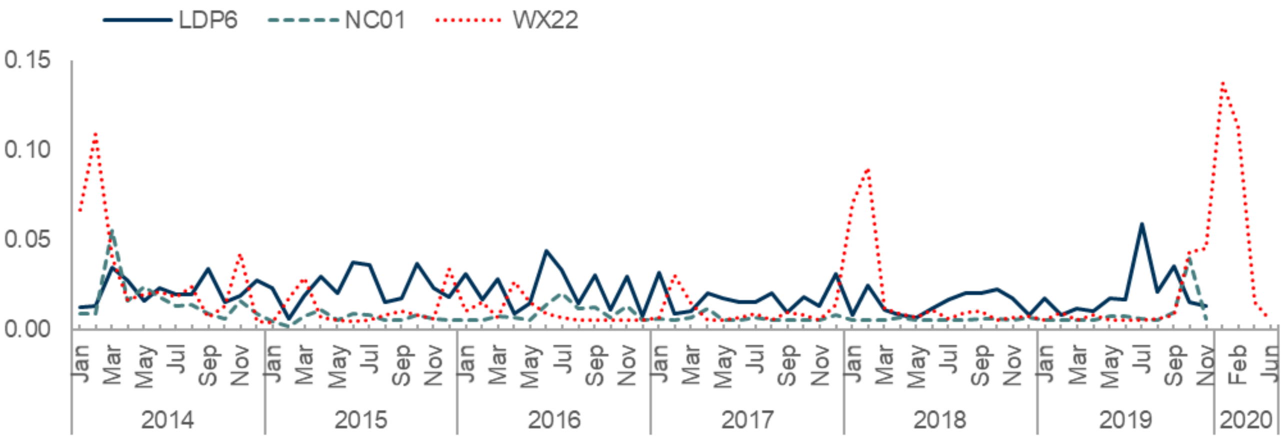


Figure 5-2 a) Electrical conductivity (EC), b) pH and c) concentration (mg / L) of boron measured at LDP6, NC01 and WX22 on Wangcol Creek by EnergyAustralia from January 2014 to June 2020.

a) Nickel (ANZECC/ARMCANZ (2000) 95 % Species Protection Trigger Value = 0.011 mg / L)



b) Zinc (ANZECC/ARMCANZ (2000) 95 % Species Protection Trigger Value = 0.008 mg / L)



c) Aluminium (ANZECC/ARMCANZ (2000) 95 % Species Protection Trigger Value = 0.055 mg / L)

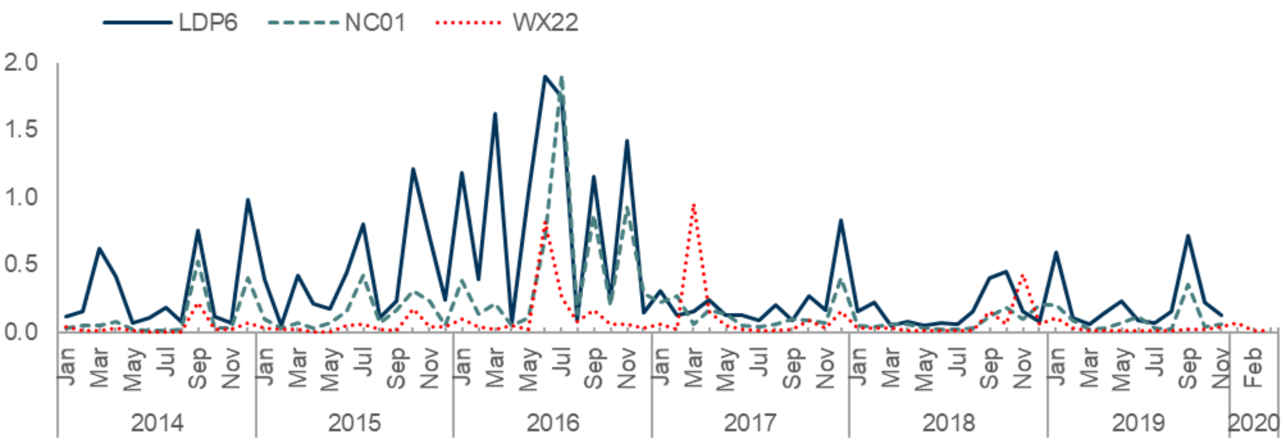


Figure 5-3 Concentrations (mg / L) of a) nickel, b) zinc and c) aluminium measured at LDP6, NC01 and WX22 on Wangcol Creek by EnergyAustralia from January 2014 to June 2020.

Copper (ANZECC/ARMCANZ (2000) 95 % Species Protection Trigger Value = 0.0014 mg/L)

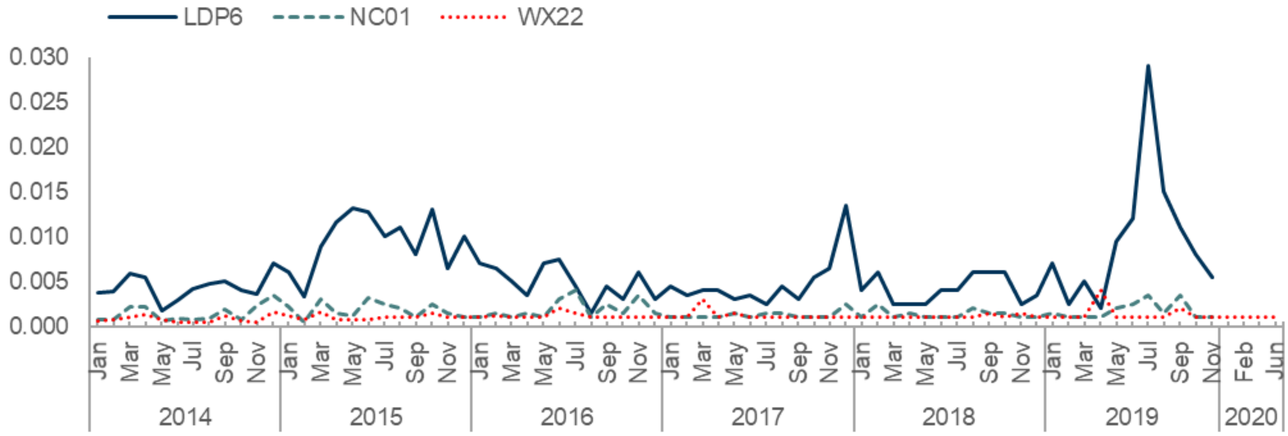


Figure 5-4 Concentrations (mg / L) of copper measured at LDP6, NC01 and WX22 on Wangcol Creek by EnergyAustralia from January 2014 to June 2020.

5.3 AUSRIVAS Macroinvertebrates

5.3.1 General Findings

5.3.1.1 Identified Taxa

A total of 42 taxa were identified from the 12 samples collected in autumn 2020 (**Appendix F**). Over the course of the EMP, a total of 61 macroinvertebrate taxa have been identified from the 27 edge samples collected in autumn. Out of the 57 taxa assigned a SIGNAL2 grade, 42 were assigned a grade of 5 or lower, indicating that the majority of taxa are moderately to very tolerant of pollution. Seven taxa (Elmidae, Dixidae, Conoesucidae, Calamoceratidae, Leptophlebiidae, Philopotamidae and Gripopterygiidae) have a SIGNAL2 grade of 7 to 9, indicating they are sensitive to pollution. Leptophlebiidae were found at NCR2 during each survey and at NCR1 in 2013, 2014 and 2020 but not 2018. The other taxa were less common, though Dixidae were found at NCR1 and NCR2 during at least one survey.

The most common taxa identified from edge samples (those identified from 14 (roughly half) or more of the 27 samples from Wangcol Creek and Coxs River) included Dytiscidae (diving beetles), Leptophlebiidae (mayflies), Chironomidae (non-biting midge) (consisting of the subfamilies: Chironominae, Orthocladiinae and Tanypodinae), copepods, and Corixidae (backswimmers). Leptophlebiidae are pollution sensitive, however, the other taxa are pollution tolerant (SIGNAL2 grade 2 to 4). Few taxa appeared restricted to individual sites or separate watercourses. There was some evidence to suggest that Atyidae, may not occur at A16. It should be noted, however, that the presence of pollution tolerant taxa does not necessarily indicate poor water quality, as these taxa would be expected to occur in watercourses with good water quality also.

Eastern gambusia was inadvertently caught in the AUSRIVAS dip net in each sample from Wangcol Creek in 2020. A mountain galaxiid was inadvertently caught in the AUSRIVAS dip net at NCR3 in 2018, though none were found in 2020.

5.3.1.2 Number of Taxa

The number of macroinvertebrate taxa identified from edge samples collected in autumn at NCR1 has ranged from 6 to 24, 6 to 22 at NCR2, 8 to 14 at NCR3 and 11 to 19 at A16 (**Appendix G** and **Appendix H**). No site had consistently more or fewer taxa and there was no strong evidence of trends in these data. Numbers sampled at NCR1 have been comparable to those sampled at NCR2. Numbers sampled at NCR3 and A16 in autumn of 2018 and 2020 were also comparable with numbers at NCR1 and NCR2.

5.3.1.3 Number of EPT Taxa

The number of EPT taxa identified from edge samples collected in autumn at NCR1 has ranged from 0 to 4, 2 to 5 at NCR2, 0 to 1 at NCR3 and 2 to 6 at A16 (**Appendix G** and **Appendix Hb**). Overall, more EPT taxa have been sampled at A16 than at the other sites sampled, and relatively few at NCR3. There are no other obvious trends in these data.

5.3.1.4 OE50 Taxa Score

The OE50 Taxa Score sampled in autumn at NCR1 has ranged from 0.26 to 0.74, 0.30 to 0.90 at NCR2, 0.31 to 0.51 at NCR3 and 0.43 to 0.60 at A16 (**Appendix G** and **H**). OE50 Scores from 0.12 to 0.46 indicate severely impaired habitat (Band C), those from 0.47 to 0.81 indicate significantly impaired habitat (Band B) and those from 0.82 to 1.17 indicate habitat equivalent to reference condition (Band A). These results indicated that on all but one occasion (NCR2 in May 2014) the macroinvertebrate assemblages sampled were less diverse than predicted (i.e. OE50 Taxa Score < 0.82).

5.3.1.5 SIGNAL2 Index

The SIGNAL2 Indices recorded during autumn at NCR1 ranged from 2.5 to 3.8 at NCR1, 3.7 to 5.5 at NCR2, 2.7 to 4.1 at NCR3 and 4.2 to 4.9 at A16 (**Appendix G** and **Appendix Hd**). These are indicative of severe to mild water pollution and suggest that Wangcol Creek and the Coxs River at these sites experience some degree of environmental stress due to poor water quality.

5.3.2 Relative Contribution of Taxonomic Groups

The relative contribution of taxonomic groups in edge samples was relatively consistent among sites and surveys, and there was little evidence of any substantial changes in the relative contribution of taxonomic groups occurring at NCR2 that could be indicative of an impact (**Figure 5-5**).

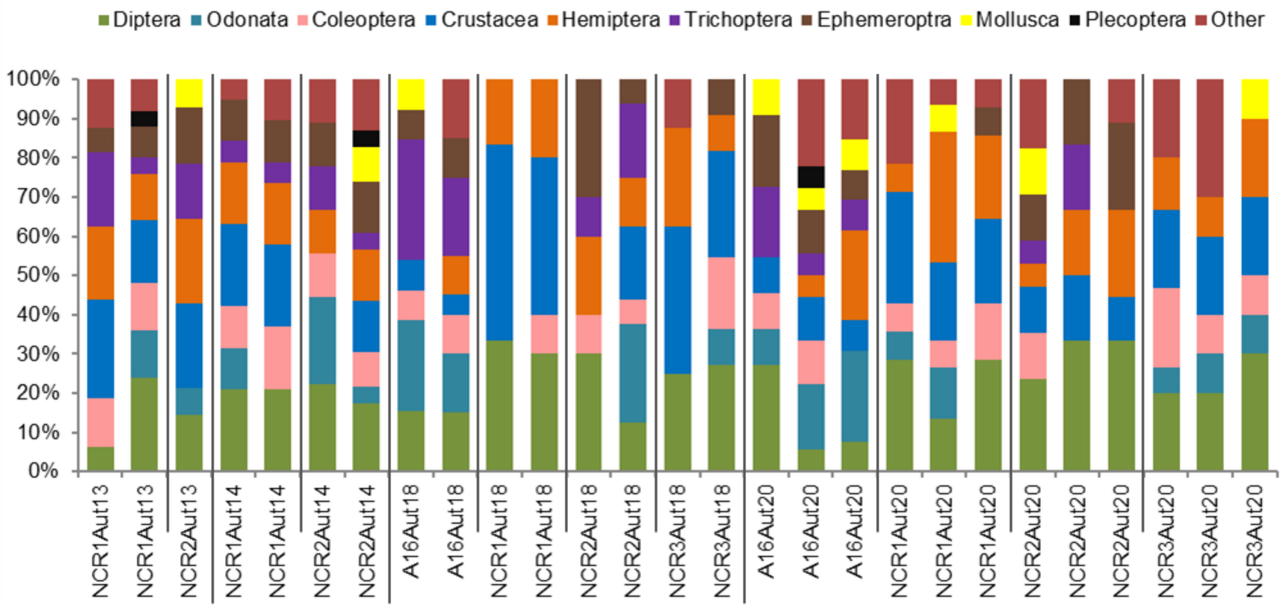


Figure 5-5 Relative contribution of major taxonomic groups identified from AUSRIVAS edge samples collected at NCR1, NCR2 and NCR3 on Wangcol Creek and A16 on the Coxs River during autumn of 2013, 2014, 2018 and 2020.. 'Other' includes taxa in the Families Pyralidae and Dugesiidae, the Order Temnocephalida, Subclasses Oligochaeta and Collembola and the taxonomic group Hydracarina.

5.3.3 Statistical Analyses

One of the PERMANOVA tests (that for number of EPT taxa) undertaken using data collected from NCR1 and NCR2 in autumn of 2014, 2018 and 2020 indicated a statistically significant interaction between Survey and Site (**Table 5-1**).

Examination of the results of the pairwise test for this interaction (**Appendix I**) indicated that this was due to differences between autumn 2014 and autumn 2020 at NCR1, between autumn 2020 and each of autumn 2014 and autumn 2018 at NCR2 and between NCR1 and NCR2 in autumn 2020. Examination of these differences and of **Figure 5-6** indicated fewer EPT taxa were sampled at NCR1 in autumn 2020 than in autumn 2014, and that fewer (none) were sampled in autumn 2018 than in autumn 2014. At NCR2 fewer were sampled in autumn 2020 than in autumn 2018 and autumn 2014. Also, that during autumn 2020 fewer were sampled at NCR1 than at NCR2. Decreases in numbers of EPT taxa at NCR2 after autumn 2014 are unlikely to indicate the presence of an impact, as there was a concurrent decrease in numbers observed at NCR1 (**Section 6.3.2**). The PERMDISP procedure did not indicate any significant difference in variance between the pairs of Sites and Years examined ($t \leq 4.0$, $P \geq 0.1$ in each case).

Table 5-1 Summary of results of PERMANOVA analyses undertaken using AUSRIVAS data collected from NCR1 and NCR2 in autumn of 2014, 2018 and 2020. * = P ≤ 0.05, ** = P ≤ 0.01, *** = P ≤ 0.001, ns = not statistically significant. See Appendix I for full results. RED = term redundant due to significant interactive effect.

Indicator	Source of Variation		
	Survey	Site	Survey x Site
Number of Taxa	*	ns	ns
Number of EPT Taxa	RED	RED	*
OE50 Taxa Score	ns	*	ns
SIGNAL2 Index	ns	ns	ns
Assemblage	***	***	ns

PERMANOVA also detected a significant main effect of Survey for Number of Taxa and OE50 Taxa Score and multivariate assemblage structure and of Site for OE50 Taxa Score and multivariate assemblage structure. Such differences also do not provide evidence of an impact.

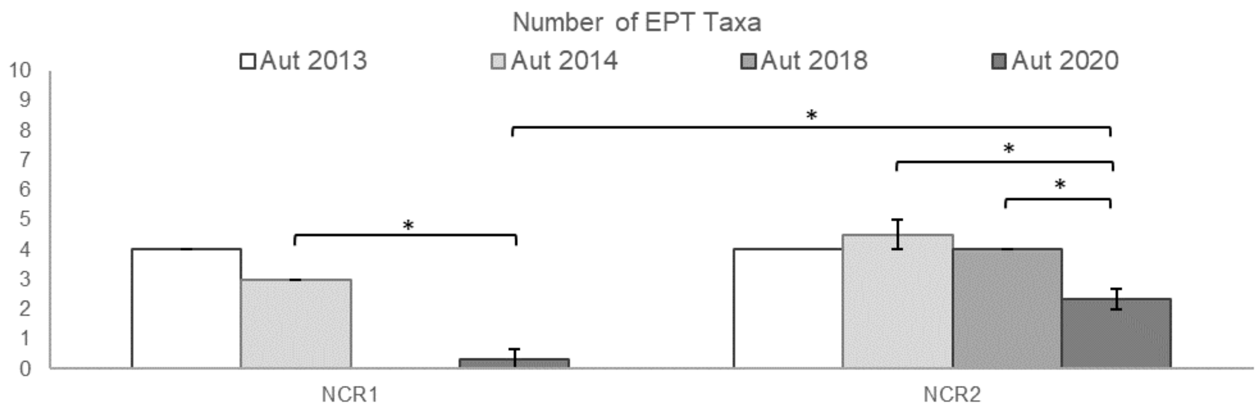


Figure 5-6 Mean (± standard error) number of EPT taxa sampled in autumn surveys at NCR1 and NCR3.

One of the PERMANOVA tests (that for number of EPT taxa) undertaken using data collected from all sites in autumn of 2018 and 2020 indicated a statistically significant interaction between Survey and Site (**Table 5-2**).

Table 5-2 Summary of results of PERMANOVA analyses undertaken using AUSRIVAS data collected from NCR1, NCR2, NCR3, A16 and CR0 in spring of 2015 and 2016. * = P ≤ 0.05, ** = P ≤ 0.01, *** = P ≤ 0.001, ns = not statistically significant. See Appendix I for full results

Indicator	Source of Variation		
	Survey	Site	Survey x Site
Number of Taxa	ns	ns	ns
Number of EPT Taxa	RED	RED	*
OE50 Taxa Score	ns	ns	ns
SIGNAL2 Index	*	ns	ns
Assemblage	***	***	ns

Examination of the results of the pairwise analysed (**Appendix I**) indicated that this was due to differences between A16 and each other site in autumn 2018, between NCR1 and NCR2, NCR2 and NCR3, NCR1 and A16, and NCR3 and A16 in autumn 2020, and between autumn 2018 and autumn 2020 at NCR2. Examination of these differences and of **Figure 5-7** indicated a greater number of EPT taxa at A16 than at each other site in autumn 2018, and a greater number at A16 than NCR1 and NRC3 in autumn 2020. There was also a greater number at NCR2 than at NCR1 and NCR3 in autumn 2020, and a greater number at NCR2 in autumn 2018 than in autumn 2020. The decrease in the number of EPT taxa at NCR2 between autumn 2018 and autumn 2020 provides relatively weak evidence of an impact (**Section 6.3.2**). Examination of the raw data indicated this was associated primarily with fewer trichopterans (caddisfly) sampled at NCR2 in autumn 2018 (Philopotamidae, Ecnomidae and Leptoceridae) than in autumn 2020 (Hydroptilidae and

Hydropsychidae). The PERMDISP procedure did not indicate any significant difference in variance between the pairs of Sites and Years examined (t ≤ 3.1, P ≥ 0.6 in each case).

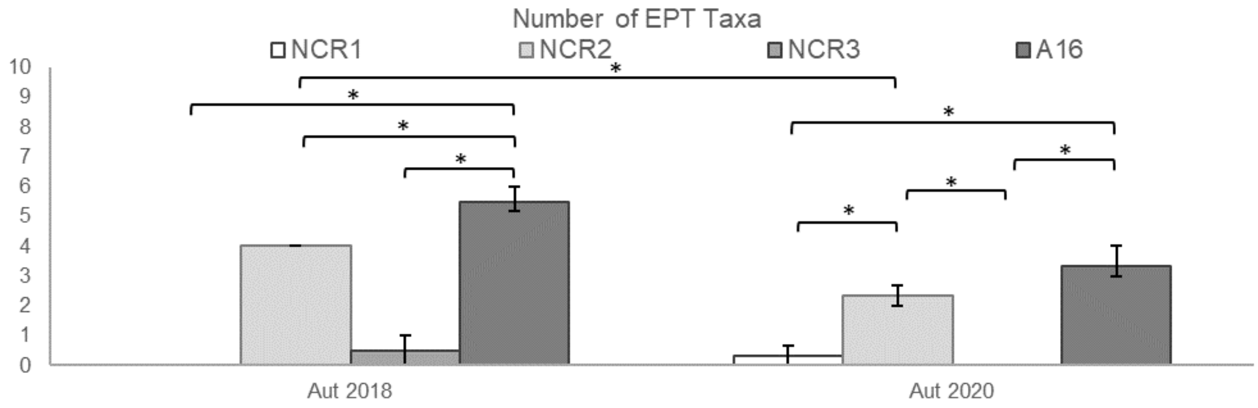


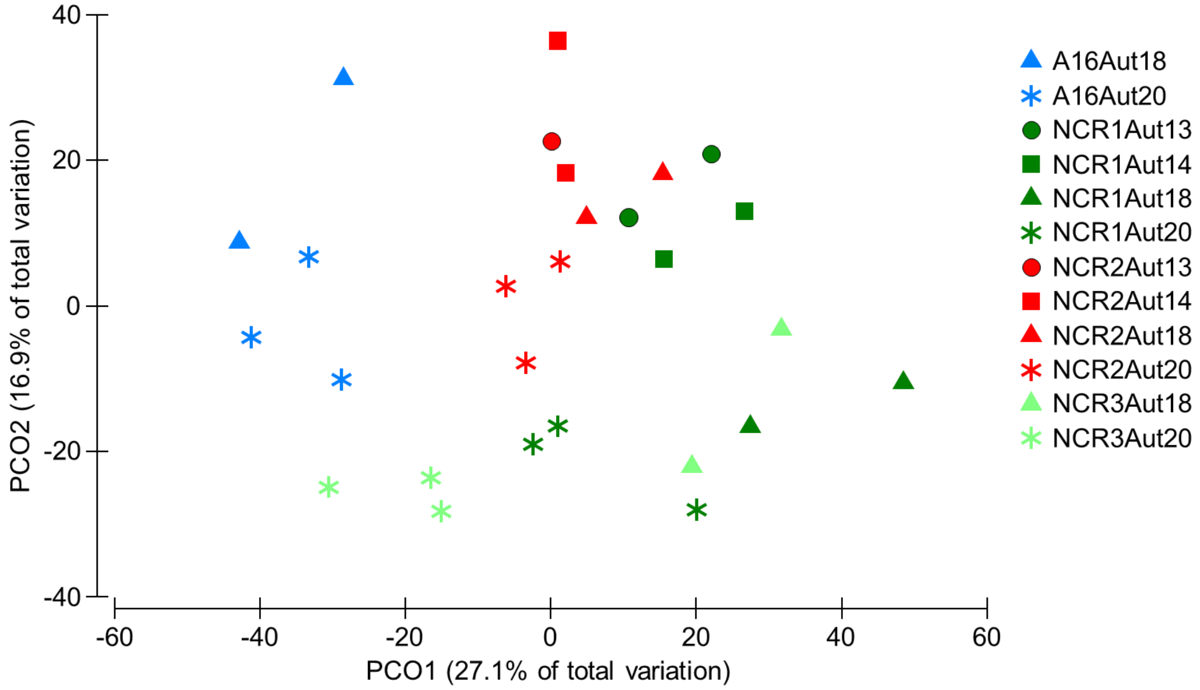
Figure 5-7 Mean (± standard error) number of EPT taxa sampled at all sites in autumn 2018 and autumn 2020.

PERMANOVA also detected a significant main effect of Survey for SIGNAL2 Score and multivariate assemblages structure and of Site for multivariate assemblage structure. Such differences do not provide evidence of an impact.

The PCO undertaken for all edge assemblages sampled during autumn of 2013, 2014, 2018 and 2020 is presented in **Figure 5-8a**. Overall, there was generally little evidence of strong grouping, though some associations were evident. There was evidence to suggest that assemblages at A16 differed from those at each other sites. This is evident in assemblages from A16 tending to group towards the top left of the PCO away from those at the other sites. There was also some evidence to suggest assemblages sampled in 2013 and 2014 differed from those sampled in 2018 and 2020, with assemblages from 2013 and 2014, and from 2018 and 2020 grouping at the top right and bottom left of the PCO, respectively. There was also some evidence that samples collected in 2018 and 2020 were more variable than those sample in 2013 and 2014, with symbols tending to be more dispersed in the later two surveys. This may be at least partly due, however, to a greater number of samples collected in the latter two surveys.

The results of the CLUSTER diagram (**0b**) are generally reflective of the PCO. There was evidence to suggest assemblages sampled in 2013 and 2014 differed from those sampled in 2018 and 2020, and were more similar to each other than assemblages from other surveys. Exceptions were those from A16 and the samples from NCR2 in 2013, which appeared relatively more similar to A16 and NCR3, and one of the samples from NCR2 in 2020, which appeared relatively dissimilar to all other assemblages sampled.

a)



b)

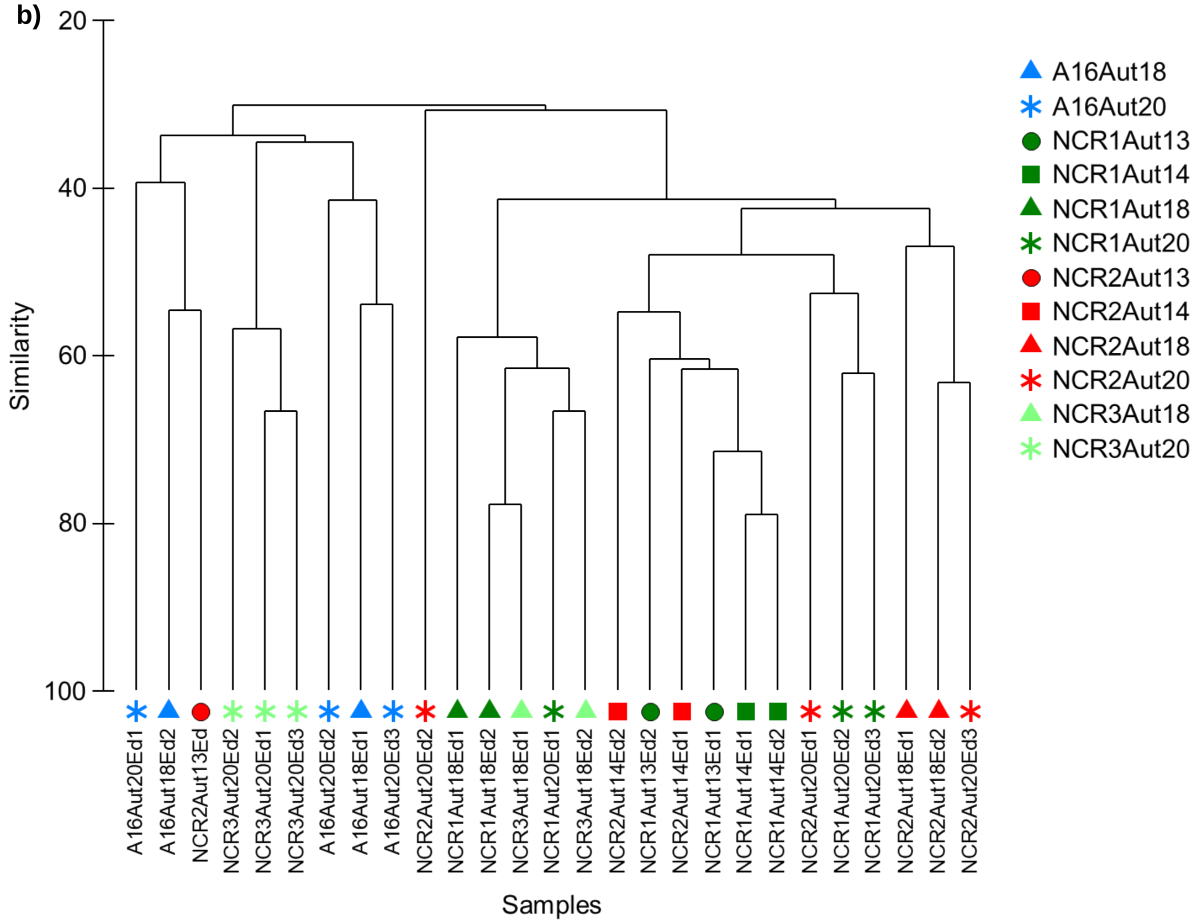


Figure 5-8 a) Principle Component Ordination (PCO) and b) CLUSTER diagram of AUSRIVAS edge macroinvertebrate assemblages sampled using AUSRIVAS at NCR1, NCR2 and NCR3 on Wangcol Creek and at A16 on Coxs River in autumn of 2013, 2014, 2018 and 2020.

6 Discussion

6.1 Aquatic Habitat

The findings of this and previous investigations indicate that aquatic habitat in Wangcol Creek has experienced past degradation due primarily to local industry and historic land clearing. This appears to have been more severe at NCR2, where the condition of the riparian vegetation, creek banks and streambed were poorer compared with that upstream at NCR1 and NCR3. While these sites have experienced impacts in the past, no further direct impacts to aquatic habitat in Wangcol Creek (e.g. creek realignment, vegetation clearing) due to the Project were predicted or have been detected. Although the current condition of aquatic habitat in Wangcol Creek is not attributable to the Project, the differences in habitat observed between NCR2 and monitoring sites further upstream in Wangcol Creek (NCR1 and NCR3) and the upstream monitoring site in the Coxs River could be expected to influence the number and type of macroinvertebrate taxa (and other aquatic biota) found in samples at these sites. There was greater abundance of riparian and aquatic vegetation at NCR1 and NCR3 compared with NCR2 and A16. The additional food and habitat this would afford, could, at least partly, explain any differences in the structure of macroinvertebrate assemblages sampled at these sites, and why assemblages sampled at NCR2 and A16 appear more similar to each other, than the other sites sampled, despite being on different watercourses, at least in spring data collected up until 2016 (Cardno 2017). The presence of the mountain galaxiid in the dip net at NCR3 in spring 2018 also indicates that the creek is providing habitat for native species of fish (Cardno 2019).

6.2 Water Quality and Hydrology

Water quality in Wangcol Creek is influenced by various types of anthropogenic disturbance. This is evident in several indicators (e.g. EC and concentrations of several metals) being in excess of default guidelines for the protection of aquatic life. Aurecon (2014) attributed these impacts to previous and current coal mining and power generation activities, among others. While the Project may also be influencing water quality in Wangcol Creek, it has not been possible to discriminate potential changes in water quality associated with the Project from confounding effects of other pre-existing influences (e.g. groundwater seepage from Ash Area 1). The duration and magnitude of elevated measures of some water quality indicators in Wangcol Creek appear to be influenced by flow, which in turn is influenced by patterns in local rainfall (no major flow controlling impoundments are present on Wangcol Creek). During periods of low rainfall and flow, water in Wangcol Creek likely consists of a series of disconnected pools where evaporation results in increased EC and concentrations of metals (Aurecon 2014). Periods of high rainfall and flow will have a diluting effect, thereby reducing the EC and the concentrations of metals. This process likely explains the variation in measures of water quality observed in Wangcol Creek and the elevations in EC and concentrations of metals observed following low rainfall. Differences in the location, duration and magnitude of elevated measures of water quality in Wangcol Creek will depend on a complex interaction between the characteristic and source of each impact to water quality in Wangcol Creek (e.g. historic and current coal mining activities, power generation and historic land clearing etc.) and local rainfall, discharge and hydrology.

While the relative influence of impacts to water quality from multiple sources in Wangcol Creek remains unclear, the changes that have been observed during the course of the EMP, and variation among sites, would be expected to influence macroinvertebrates (and other aquatic flora and fauna) in the creek. This may have explained the apparent change in biotic indices and structure of the macroinvertebrate assemblage sampled previously at NCR2 in autumn 2013 following the commencement of construction on the Project site (Cardno Ecology Lab 2015a). In any case, elevations in EC at this time were attributed to rainfall and flow patterns in the creek, rather than any impacts due to the Project (Aurecon 2014) (**Section 2.3**). The depauperate macroinvertebrate assemblage sampled previously in Wangcol Creek by Battaglia *et al*. (2005) was attributed to reduced pH (measured at pH 5.1 in Wangcol Creek compared with pH 6.5 to 6.7 in reference creeks), high concentrations of metals, or a combination of these, associated with acid mine drainage (AMD). pH data collected by EnergyAustralia suggest that, while somewhat variable, pH in Wangcol Creek is currently largely within DTVs for the protection of aquatic life.

Measures of water quality sampled in autumn 2020 were generally comparable to those measured previously as part of the EMP by Cardno and others (GHD 2014b to e). Although the EC recorded in Wangcol Creek during the course of the EMP was often in excess of the upper DTV (350 µS/cm), this does not necessarily mean that this poses a threat to aquatic life. The relatively lower EC recorded in Wangcol Creek in December 2016 was likely a result of a diluting effect of recent rainfall and higher flows, whereas the elevated EC at WX22 in autumn 2018 and autumn 2020 appeared to be associated with low rainfall. A review of the sensitivity of Australian freshwater biota to salinity undertaken by Hart *et al*. (1991) indicates that adverse effects on freshwater macroinvertebrates are likely to become apparent when salinity rises to around 1,000 mg/L (approximately 1,562 µS/cm). Aquatic macrophytes and riparian plants are slightly more tolerant, being sensitive to salinities from 1,000 to 2,000 mg/L (1,562 to 3,134 µS/cm) and above 2,000 mg/L (>3,134 µS/cm), respectively. Adult fish are tolerant of salinities up to 10,000 mg/L (15,620 µS/cm). A subsequent review of the effects of increasing salinity on freshwater ecosystems in Australia undertaken by Nielsen *et al*. (2003) indicates the following:

> Majority of algae do not tolerate salinities > 10,000 mg/L (15,620 µS/cm);

> Diatoms decrease in abundance and richness as salinity increases;

> Freshwater plants tolerate salinities up to 4,000 mg/L (6,250 µS/cm), but adverse effects on growth and development of roots and leaves become apparent above 1,000 mg/L (1,562 µS/cm);

> Macroinvertebrate fauna of rivers appear to be tolerant and fairly resilient to increasing salinity;

> Structurally simple macroinvertebrates such as soft-bodied hydra, insect larvae and molluscs are more sensitive to increased salinity;

> Salinity tolerance testing of 59 macroinvertebrate taxa indicated tolerance ranged from 5,000 to 50,000 mg/L (7,810 to 78,100 µS/cm), with baetid mayflies and macrocrustaceans being the least and most tolerant, respectively; and

> A majority of native and introduced fish appear to be tolerant of salinities in excess of 3,000 mg/L (4,686 µS/cm).

These findings would suggest that for the majority of the time during the EMP the ECs measured in Wangcol Creek (i.e. approximately 100 to 2,000 µS/cm), while not ideal should not have substantial detrimental effects on most macroinvertebrates. Baetid mayflies, which were found to be particularly sensitive to EC, were found in the AUSRIVAs samples collected from Wangcol Creek (Cardno 2017) and at NCR2 in the current study. This followed the elevated EC of 3,040 µS/cm at WX22 in January 2020.

Elevated concentrations of some metals were detected at WX22 adjacent to the ash placement area in early 2018 and early 2020. Clear elevations in the concentrations of some metals were also detected around March 2015, though by the time of the 2015 survey, concentrations of these were no longer elevated. Elevations in the concentrations of barium, nickel, aluminium, and zinc in Wangcol Creek have also been previously detected, and prior to previous aquatic ecology investigations. No clear association with water quality and macroinvertebrate data was found during previous surveys (**Section 2.3**). Prior to the current survey, while concentrations of aluminium, copper and zinc appeared somewhat elevated at some sites on Wangcol Creek (**Section 5.2.2**), there was no evidence of any associated effect on macroinvertebrates (**Section 6.3.2**). The current finding of a reduction in the number of EPT taxa at NCR2 between autumn 2018 and autumn 2020 could, however, be related to observed changes in water quality in early 2020 (**Section 6.3.2**).

It is unlikely that any potential impact to water quality due to the Project could be completely isolated from background impacts associated with historic and current coal mining, power generation and historic land clearing activities. A complex interaction between the specific characteristics of each impact (in terms of type and magnitude of impact to water quality), local rainfall, flow and hydrology and water quality in Wangcol Creek would make it almost impossible to definitively attribute any change to water quality, and thus any effect on macroinvertebrates, to the Project. Nevertheless, the collection and interpretation of water quality data during monitoring of aquatic ecology will help identify the cause of any changes detected in macroinvertebrate data indicative of an impact. This information would help target any future impact minimisation and remediation efforts.

6.3 Macroinvertebrates

6.3.1 General Findings

The general findings of the current study support those of previous investigations. The macroinvertebrate assemblage supported by Wangcol Creek appears to experience some degree of environmental stress. This is evident in OE50 Taxa Scores and Bands generally indicative of macroinvertebrate assemblages that are less diverse than predicted by the AUSRIVAS model, and thus relatively poor aquatic habitat and / or water quality. Low individual taxon SIGNAL2 grades and SIGNAL2 indices are also indicative of severe to moderate pollution.

Despite this, some pollution sensitive taxa were also identified. This suggests that while the macroinvertebrate assemblage does experience some degree of environmental stress due to poor habitat and water quality, conditions are not as severe as what may be expected considering the sometimes very poor water quality of Wangcol Creek (with several indicators often measured outside of guidelines for the protection of aquatic life) and the degree of historic habitat modification it has experienced. The aquatic ecology of Wangcol Creek also does not appear to be particularly poor in a regional context. AUSRIVAS data collected from Wangcol Creek were comparable to those collected from A16 on the Coxs River, which has, and continues to, experience similar disturbances (i.e. impacts to water quality and the condition of riparian vegetation) to Wangcol Creek. These results were also comparable to those of the ongoing Coxs River Biological Monitoring Program, where the AUSRIVAS Bands at sites on the Coxs River downstream of Wangcol Creek during 2011 to 2015 ranged from Band C to Band B, with most sites on most occasions assigned Band B (Cardno Ecology Lab 2020).

The presence of Leptophlebiidae in edge samples collected from Wangcol Creek (including each sample collected from NCR2 in autumn 2020) also suggests that the effect of poor water quality on macroinvertebrate fauna in the creek is somewhat limited. Previously, fewer leptophlebiids have been associated with elevated ECs due to mine water discharge in the Georges River (Cardno Ecology Lab 2010a and references therein). This study, and the findings of an Australian Coal Industry Research Program (ACARP) funded study into the effects of saline water discharge on aquatic biota in the Southern and Hunter Coalfields of NSW (Cardno Ecology Lab 2010b), also suggested that elevated EC can influence the abundance of aquatic macroinvertebrates.

While low pH was suggested as a possible cause of depauperate macroinvertebrate assemblages in Wangcol Creek in an earlier study by Battaglia *et al*. (2005), this was not apparent in EMP. pH measured during the EMP was above that measured in Wangcol Creek (pH 5.1) by Battaglia *et al*. (2005) and largely within DTVs. The findings here are similar to those of Soucek *et al*. (2000), where the abundance and diversity of macroinvertebrates was found to be reduced in streams affected by acid mine discharge, irrespective of pH, suggesting other factors such as metal toxicity were responsible.

Any inferences regarding the role of water quality in influencing macroinvertebrates in Wangcol Creek must be made with caution as several other measures of water quality not considered here, such as concentrations of nutrients, or a combination of these, may be influencing macroinvertebrates in Wangcol Creek. It is also likely that assemblages sampled through time on Wangcol Creek (and any other watercourse) are not independent, potentially confounding any associated inferences. It is also possible that the macroinvertebrate fauna present in Wangcol Creek has, over time, become tolerant to impaired water quality and that any short-term elevations in otherwise already elevated measures may have a limited observable effect.

6.3.2 Changes in Macroinvertebrates

The apparent reduction in the number of EPT taxa detected between autumn 2018 and autumn 2020 at NCR2 provides some evidence of an impact that could be related to elevated EC and concentrations of metals that occurred in January 2020. However, evidence is limited. Unlike the reduction in numbers observed at NCR2 between autumn 2014 and autumn 2020, the change that occurred at NCR2 between the last two surveys was not accompanied by a similar change at NCR1 or NCR3 (i.e. upstream control sites). However, a similar change at NCR1, at least, would not have been possible given no EPT taxa were found at NCR1 in autumn 2018. This complicates the confident identification of an impact. Further, irrespective of the presence of any impact at NCR2 in autumn 2020, numbers were still greater than those at NCR1, and comparable to those at NCR3 in autumn 2020 suggesting any impact, if it occurred, resulted in limited consequences for aquatic ecology (e.g. any substantial loss of biodiversity). Although not statistically significant, fewer EPT taxa were also observed at NCR3 in autumn 2020 than in autumn 2018. Lastly, the reduction in numbers of EPT taxa at NCR2 between the last two surveys was related to the absence of three caddisfly taxa (Philopotamidae, Ecnomidae and Leptoceridae), two of which were rare and occurred in a total of 3 of the 27 samples collected in autumn. Identifying impacts on the occurrence of rare taxa is problematic due to uncertainty in the processes that generate a zero count (i.e. it is unclear whether it is a result background rarity or a potential impact resulting in unsuitable habitat quality). It is noted also that no such changes were detected in any other of the biotic indices considered (i.e. number of taxa, SIGNAL2 Scores, OE50 Taxa Score and multivariate assemblage structure). It is possible, therefore, that while coinciding with reductions in water quality, the observed change in number of EPT taxa is due to the natural variability of a small number of uncommon taxa.

Previously, the only other evidence of an impact occurring in data collected in spring and autumn was the apparent reduction in the total number of taxa and the number of EPT taxa, a lower OE50 Taxa Score and a change in the structure of the macroinvertebrate assemblage observed at NCR2 in autumn 2013 (**Section 2.3**). However, these observations could not be supported by statistical tests and, in any case, there was evidence of a recovery following this survey.

7 Conclusion and Recommendations

There was limited evidence to suggest a change in one indicator, which occurred at NCR2 in autumn 2020, could be associated with the Project. Detailed examination of trends in this indicator at other sites and of the individual taxa did not provide convincing evidence of an impact. The presence of an impact associated with observed changes in water quality, however, cannot be discounted. In any case, the observed small magnitude of the reduction in this indicator relative to other sites does not raise concern for aquatic ecology in Wangcol Creek at present. Further monitoring will be undertaken in spring 2020 that will help ascertain the magnitude and extent of any impact to aquatic ecology.

The complex interaction that exists between the various types of disturbances (e.g. those to habitat, water quality and flow) experienced in Wangcol Creek make any changes in water quality, and thus associated changes in macroinvertebrates, difficult to distinguish from those that could be due to the Project. Nevertheless, the Environmental Monitoring Program adds value to the wider monitoring program, and it is expected that any large magnitude and / or cumulative impacts to aquatic biota would be detected, allowing appropriate management actions to be implemented. Recent changes to the monitoring of aquatic ecology, including the addition of two further macroinvertebrate control sites, will assist in identifying any future impacts, were they to occur, and help inform future impact minimisation and remediation efforts as necessary.

The following recommendations will help to ensure the robustness of the EMP and the detection of potential impacts on aquatic ecology due to the Project:

1. Further monitoring should be undertaken as planned in spring of 2020. This will maximise the validity of comparisons among data collected following Project commencement and between these data and baseline data collected in spring 2012. Data from this survey will allow more confident conclusions to be made on the presence and duration of any potential impact in Wangcol Creek following the changes in water quality observed here in January 2020.
2. Three replicate AUSRIVAS samples should continue to be collected from each site during all future surveys. This will provide a measure of the variation present in each indicator at each site, thereby, improving the ability to detect any future impact by enabling the use of appropriate statistical analysis.

At this stage no Project specific mitigation, impact minimisation or ameliorate actions are recommended. Such actions may be appropriate and may be recommended following more definitive assessments of the presence or absence of an impact that will be undertaken in subsequent monitoring reports and following the recommendations described above.

8 References

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APPENDIX

A

GPS COORDINATES OF AQUATIC ECOLOGY MONITORING SITES FOR THE WANGCOL CREEK EMP

Site	Latitude	Longitude
NCR1	-33.35061	150.04753
NCR2	-33.35822	150.05704
NCR3	-33.35205	150.04852
A16	-33.38001	150.07990
CR0	-33.32678	150.09817

Datum: WGS 84, Zone 56H

APPENDIX B

REFERENCE CONDITION SELECTION CRITERIA

No.	Reference Condition Selection Criteria Category	Comment
1	Influence of intensive agriculture upstream	Intensive agriculture is that which involves irrigation, widespread soil disturbance, use of agrochemicals and pine plantations. Dry-land grazing does not fall into this category.
2	Influence of major extractive industry (current or historical) upstream	This includes mines, quarries and sand/gravel extraction.
3	Influence of major urban area upstream	This will be relative to population size, river size and distance between the site and the impact.
4	Influence of significant point-source wastewater discharge upstream	Exceptions can be made for small discharges into large rivers.
5	Influence of dam or major weir	Sites within the ponded area of impoundments also fail.
6	Influence of alteration to seasonal flow regime	This may be due to abstraction or regulation further upstream than the coverage by Criterion 5. Includes either an increase or decrease in seasonal flow.
7	Influence of alteration to riparian zone	Riparian vegetation should be intact and dominated by native species.
8	Influence of erosion and damage by stock on riparian zone and banks	Stock damage to the stream bed may be included in this category.
9	Influence of major geomorphological change on stream channel	Geomorphological change includes bank slumping, shallowing, braiding and unnatural aggradation or degradation.
10	Influence of alteration to in-stream conditions and habitats	This may be due to excessive algal and macrophyte growth, by sedimentation and siltation, by reduction in habitat diversity by drowning or drying out of habitats (e.g. riffles) or by direct access of stock into the river

APPENDIX C

RIVER, CHANNEL AND ENVIRONMENTAL (RCE) CATAGORIES

Cardno
Shaping the Future

Descriptor and category	Score
1. Land use pattern beyond the immediate riparian zone	
Undisturbed native vegetation	4
Mixed native vegetation and pasture/exotics	3
Mainly pasture, crops or pine plantation	2
Urban	1
2. Width of riparian strip of woody vegetation	
More than 30 m	4
Between 5 and 30 m	3
Less than 5 m	2
No woody vegetation	1
3. Completeness of riparian strip of woody vegetation	
Riparian strip without breaks in vegetation	4
Breaks at intervals of more than 50 m	3
Breaks at intervals of 10 - 50 m	2
Breaks at intervals of less than 10 m	1
4. Vegetation of riparian zone within 10 m of channel	
Native tree and shrub species	4
Mixed native and exotic trees and shrubs	3
Exotic trees and shrubs	2
Exotic grasses / weeds only	1
5. Stream bank structure	
Banks fully stabilised by trees, shrubs etc.	4
Banks firm but held mainly by grass and herbs	3
Banks loose, partly held by sparse grass etc.	2
Banks unstable, mainly loose sand or soil	1
6. Bank undercutting	
None, or restricted by tree roots	4
Only on curves and at constrictions	3
Frequent along all parts of stream	2
Severe, bank collapses common	1
7. Channel form	
Deep: width / depth ratio < 7:1	4
Medium: width / depth ratio 8:1 to 15:1	3
Shallow: width / depth ratio > 15:1	2
Artificial: concrete or excavated channel	1

Descriptor and category	Score
8. Riffle / pool sequence	
Frequent alternation of riffles and pools	4
Long pools with infrequent short riffles	3
Natural channel without riffle / pool sequence	2
Artificial channel; no riffle / pool sequence	1
9. Retention devices in stream	
Many large boulders and/or debris dams	4
Rocks / logs present; limited damming effect	3
Rocks / logs present, but unstable, no	2
Stream with few or no rocks / logs	1
10. Channel sediment accumulations	
Little or no accumulation of loose sediments	4
Some gravel bars but little sand or silt	3
Bars of sand and silt common	2
Braiding by loose sediment	1
11. Stream bottom	
Mainly clean stones with obvious interstices	4
Mainly stones with some cover of algae / silt	3
Bottom heavily silted but stable	2
Bottom mainly loose and mobile sediment	1
12. Stream detritus	
Mainly un-silted wood, bark, leaves	4
Some wood, leaves etc. with much fine	3
Mainly fine detritus mixed with sediment	2
Little or no organic detritus	1
13. Aquatic vegetation	
Little or no macrophyte or algal growth	4
Substantial algal growth; few macrophytes	3
Substantial macrophyte growth; little algae	2
Substantial macrophyte and algal growth	1

APPENDIX D

RESULTS OF RCSC AND RCE ASSESSMENTS

River, Channel and Environmental (RCE) Category				Site
	NCR1	NCR2	NCR3	A16
Land use pattern beyond the immediate riparian zone	3	2	3	2
Width of riparian strip of woody vegetation	3	2	3	1
Completeness of riparian strip of woody vegetation	2	1	2	1
Vegetation of riparian zone within 10 m of channel	3	2	3	1
Stream bank structure	3	1	3	2
Bank undercutting	4	1	4	3
Channel form	3	3	3	4
Riffle / pool sequence	2	2	2	4
Retention devices in stream	3	1	3	2
Channel sediment accumulations	2	2	2	4
Stream bottom	3	3	3	4
Stream detritus	3	2	3	2
Aquatic vegetation	2	3	2	3
Total	36	25	36	33

Reference Condition Selection Criteria Category				Site
	NCR1	NCR2	NCR3	A16
Influence of intensive agriculture upstream	5	5	5	5
Influence of major extractive industry (current or historical) upstream	1	1	1	1
Influence of major urban area upstream	3	3	3	5
Influence of significant point-source wastewater discharge upstream	2	2	2	2
Influence of dam or major weir	5	5	5	5
Influence of alteration to seasonal flow regime	3	3	3	3
Influence of alteration to riparian zone	1	1	1	1
Influence of erosion and damage by stock on riparian zone and banks	5	5	5	3
Influence of major geomorphological change on stream channel	3	1	3	2
Influence of alteration to in-stream conditions and habitats	3	3	3	3

1 = Very major impact

2 = Major impact

3 = Moderate impact

4 = Minor impact

5 = Indiscernible impact

APPENDIX E

MEAN WATER QUALITY DATA FROM SITES NCR1, NCR2, NCR3 AND A16 SAMPLED MAY 2020

Measure	DTVs	Site							
		NCR1		NCR2		NCR3		A16	
		Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Temperature (°C)	n/a	8.8	0.0	9.7	0.0	8.83	0.0	11.7	0.0
Conductivity (µS/cm)	30-350	591	0	600	0	567	0	1130	0
pH	6.5-8.0	7.5	0.0	7.5	0.0	7.4	0.0	7.5	0.0
ORP (mV)	n/a	31.4	0.0	30.1	0.0	20.8	0.0	32.5	0.0
DO (% Sat)	90-110	74.9	0.0	85.5	0.0	75.1	0.0	95.2	0.0
Turbidity (NTU)	2-25	17.5	0.0	0.6	0.0	4.6	0.0	0.7	0.0

DTV: Default Trigger Values for slightly disturbed upland rivers in southeast Australia (ANZECC/ARMCANZ 2000). Grey shading indicates measure outside of DTVs

Wangcol Creek EMP Autumn 2013 to Autumn 2020

APPENDIX F

RAW AUSRIVAS DATA MAY 2020

Site	NCR1	NCR1	NCR1	NCR2	NCR2	NCR2	NCR3	NCR3	NCR3	A16	A16	A16
Rep	1	2	3	1	2	3	1	2	3	1	2	3
Nematoda											1	1
Corbiculidae/Sphaeriidae									1		2	4
Lymnaeidae		1		1						1		
Physidae				1								
Oligochaeta						1	1					1
Cladocera	10		4									
Copepoda	10	10	10	2		1	2	4			2	
Ostracoda	6	10	10	6	1		3		5			2
Atyidae	2											
Parastacidae		1					1	1	1	1	1	
Hydracarina				1				1				
Hypogastruridae	1			2								
Entomobryidae	2	1	1				2	2			2	
Caenidae						1				1	2	1
Baetidae				1								
Leptophlebiidae			1	10	8	10				1	3	
Coenagrionidae		1									2	
Gomphidae											3	1
Hemicorduliidae							2	1	1	3		2
Libellulidae	1	2									2	2
Gripopterygiidae											1	
Aphididae		1	3									
Mesoveliidae							1		2			
Veliidae		1	4			4	1	6	10			1
Belostomatidae		1									1	
Gelastocoridae												2
Corixidae		10	7	3	3	1						9
Notonectidae	3	10										
Dytiscidae	1	10	4	3			3	2			1	
Hydrophilidae			1	1			1		2	1	2	
Scirtidae							2					
Dixidae	1											
Culicidae			1				1					
Chironomidae/Chironominae	4	8	10	5	1	4	2		6	1		
Chironomidae/Tanypodinae	6	8	10	7		5	4	2	1	1	3	3
Ceratopogonidae				3		2						
Simuliidae	3		1	1	2			10	1			
Tipulidae										1		
Hydroptilidae				1								
Hydropsychidae					1					5		
Calamoceratidae											1	
Leptoceridae										5		4

Note: a maximum of 10 individuals were counted per sample

APPENDIX

G

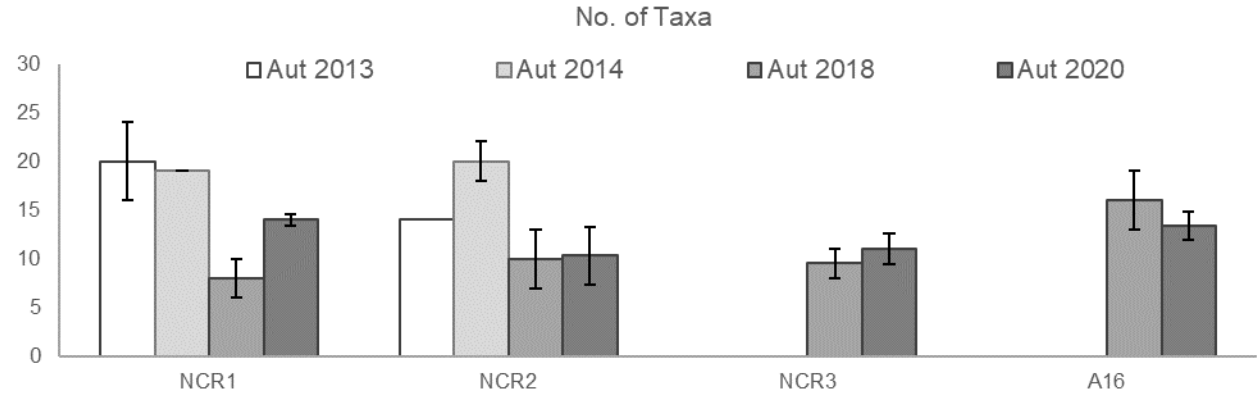
BIOTIC INDICES RAW DATA

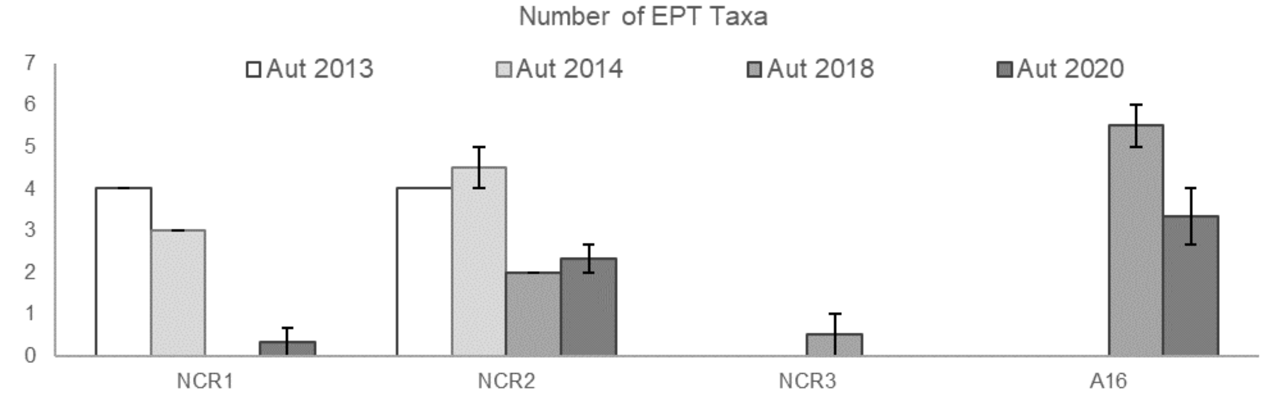
Site		No. of Taxa	No. of EPT Taxa	OE50 Taxa Score	AUSRIVAS Band	SIGNAL2 Index
NCR1						
NCR1	6 May 2013	16	4	0.52	B	3.6
NCR1	6 May 2013	24	4	0.70	B	3.5
NCR1	22 May 2014	19	3	0.74	B	3.6
NCR1	22 May 2014	19	3	0.70	B	3.8
NCR1	9 and 11 May 2018	6	0	0.26	C	2.6
NCR1	9 and 11 May 2018	10	0	0.37	C	3.3
NCR1	20 May 2020	13	0	0.40	C	3.4
NCR1	20 May 2020	15	0	0.62	B	2.5
NCR1	20 May 2020	14	1	0.72	B	3.5
NCR2						
NCR2	6 May 2013	14	4	0.57	B	4.3
NCR2	22 May 2014	18	4	0.90	A	3.7
NCR2	22 May 2014	22	5	0.57	B	3.9
NCR2	9 and 11 May 2018	10	4	0.35	C	4.1
NCR2	9 and 11 May 2018	16	4	0.52	B	4.0
NCR2	20 May 2020	16	3	0.70	B	3.8
NCR2	20 May 2020	6	2	0.30	C	5.5
NCR2	20 May 2020	9	2	0.60	B	4.0
NCR3						
NCR3	9 and 11 May 2018	8	0	0.34	C	2.7
NCR3	9 and 11 May 2018	11	1	0.51	B	3.8
NCR3	20 May 2020	14	0	0.51	B	3.1
NCR3	20 May 2020	9	0	0.31	C	4.1
NCR3	20 May 2020	10	0	0.41	C	3.7
A16						
A16	9 and 11 May 2018	13	5	0.43	C	4.9
A16	9 and 11 May 2018	19	6	0.52	B	4.5
A16	20 May 2020	11	4	0.60	B	4.4
A16	20 May 2020	16	4	0.50	B	4.2
A16	20 May 2020	13	2	0.50	B	4.2

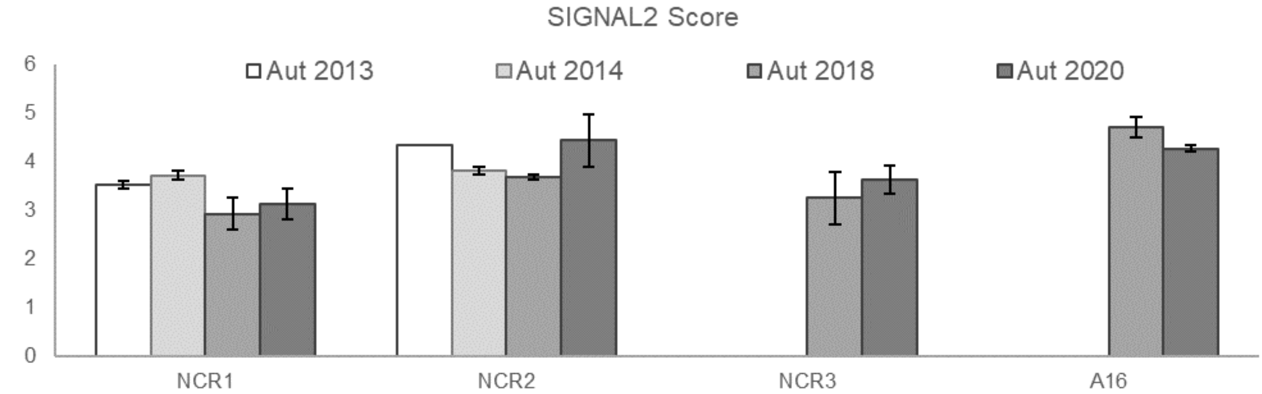
EPT = Ephemeroptera, Plecoptera and Trichoptera

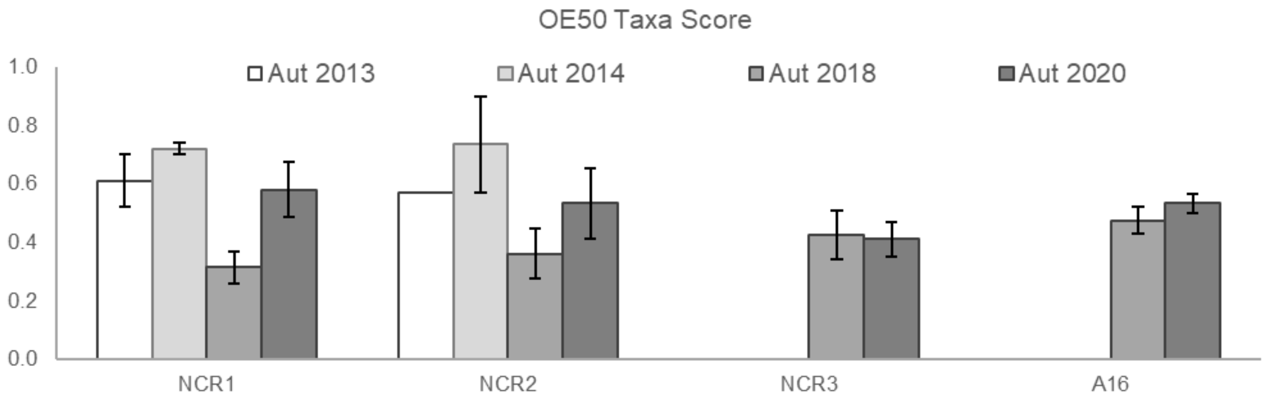
APPENDIX H

BIOTIC INDICES









Standard error bars are displayed where n ≥ 2 (see **Table 4-1** for more information)

APPENDIX

I

RESULTS OF PERMANOVAS

A) Comparison between NCR1 and NCR2 sampled in autumn of 2014, 2018 and 2020.

i) No. of Taxa

Source of Variation	df	SS	MS	*F*	*P*
Site	1	2.042	2.042	0.184	0.676
Survey	**2**	**189.520**	**94.762**	**8.550**	**0.012**
Survey x Site	2	46.095	23.048	2.080	0.187
Residual	8	88.667	11.083		
Total	13	324.360			

ii) No. of EPT Taxa

Source of Variation	df	SS	MS	*F*	*P*
Site	1	21.094	21.094	92.045	RED
Survey	2	14.274	7.137	31.143	RED
Survey x Site	**2**	**3.607**	**1.804**	**7.870**	**0.017**
Residual	8	1.833	0.229		
Total	13	40.357			

No. of EPT Taxa: Pairwise tests of levels of factor: Site

Groups	t	P
Within level 'Aut14' of factor 'Year'		
NCR1, NCR2	3	0.099
Within level 'Aut18' of factor 'Year'		
NCR1, NCR2	No test	
Within level 'Aut20' of factor 'Year'		
NCR1, NCR2	**4.2426**	**0.013**

No. of EPT Taxa: Pairwise tests of levels of factor: Year

Groups	t	P
Within level 'NCR1' of factor 'Site'		
Aut14, Aut18	No test	
Aut14, Aut20	**6.1968**	**0.008**
Aut18, Aut20	0.7746	0.497
Within level 'NCR2' of factor 'Site'		
Aut14, Aut18	1	0.416
Aut14, Aut20	**3.806**	**0.030**
Aut18, Aut20	**3.873**	**0.031**

iii) OE50 Taxa Score

Source of Variation	**df**	**SS**	**MS**	***F***	***P***
Site	1	0.003	0.003	0.108	0.742
Survey	**2**	**0.249**	**0.124**	**4.604**	**0.046**
Survey x Site	2	0.017	0.008	0.309	0.729
Residual	8	0.216	0.027		
Total	13	0.483			

iv) SIGNAL2 Score

Source of Variation	df	SS	MS	*F*	*P*
Site	**1**	**2.341**	**2.341**	**6.853**	**0.018**
Survey	2	0.229	0.114	0.335	0.735
Survey x Site	2	0.928	0.464	1.358	0.338
Residual	8	2.732	0.342		
Total	13	6.707			

v) Assemblage

Source of Variation	df	SS	MS	*F*	*P*
Site	**1**	**4280**	**4280**	**4.423**	**0.004**
Survey	**2**	**7063**	**3532**	**3.650**	**<0.001**
Survey x Site	2	1982	991	1.024	0.459
Residual	8	7741	968		
Total	13	21220			

B) Comparison among all sites sampled in autumn of 2018 and 2020

i) No. of Taxa

Source of Variation	df	SS	MS	*F*	*P*
Site	3	53.958	17.986	1.662	0.222
Survey	1	1.408	1.408	0.130	0.720
Survey x Site	3	61.558	20.519	1.897	0.180
Residual	12	129.830	10.819		
Total	19	236.950			

ii) No. of EPT Taxa

Source of Variation	df	SS	MS	*F*	*P*
Site	3	65.400	21.800	52.320	RED
Survey	1	4.800	4.800	11.520	RED
Survey x Site	**3**	**4.600**	**1.533**	**3.680**	**0.048**
Residual	12	5.000	0.417		
Total	19	75.800			

No. of EPT Taxa: Pairwise tests of levels of factor: Site

Groups	t	P
Within level 'Aut18' of factor 'Year'		
A16, NCR1	**11.000**	**0.008**
A16, NCR2	3.000	0.095
A16, NCR3	**7.071**	**0.020**
NCR1, NCR2	No test	
NCR1, NCR3	1.000	0.420
NCR2, NCR3	**7.000**	**0.018**
Within level 'Aut20' of factor 'Year'		
A16, NCR1	**4.025**	**0.015**
A16, NCR2	1.342	0.257

Groups	t	P
A16, NCR3	**5.000**	**0.007**
NCR1, NCR2	**4.243**	**0.013**
NCR1, NCR3	1.000	0.379
NCR2, NCR3	**7.000**	**0.003**

No. of EPT Taxa: Pairwise tests of levels of factor: Year

Groups	t	P
Within level 'A16' of factor 'Site'		
Aut18, Aut20	2.3102	0.106
Within level 'NCR1' of factor 'Site'		
Aut18, Aut20	0.7746	0.492
Within level 'NCR2' of factor 'Site'		
Aut18, Aut20	**3.873**	**0.029**
Within level 'NCR3' of factor 'Site'		
Aut18, Aut20	1.3416	0.276

iii) OE50 Taxa Score

Source of Variation	df	SS	MS	*F*	*P*
Site	3	0.021	0.007	0.415	0.737
Survey	1	0.050	0.050	2.891	0.114
Survey x Site	3	0.051	0.017	0.983	0.429
Residual	12	0.206	0.017		
Total	19	0.331			

iv) SIGNAL2 Score

Source of Variation	df	SS	MS	*F*	*P*
Site	**3**	**6.583**	**2.194**	**6.667**	**0.007**
Survey	1	0.074	0.074	0.224	0.643
Survey x Site	3	0.558	0.186	0.565	0.648
Residual	12	3.950	0.329		
Total	19	11.019			

v) Assemblage

Source of Variation	df	SS	MS	*F*	*P*
Site	**3**	**16365**	**5455**	**4.318**	**<0.001**
Survey	**1**	**6198**	**6198**	**4.906**	**0.001**
Survey x Site	3	4038	1346	1.066	0.408
Residual	12	15158	1263		
Total	19	41844			

RED = redundant term due to significant interactive effect.

Appendix J Complaints Register

Complaint No.	Date Received	Nature (Enquiry / Notification / Complaint)	Issue(s)	EA response	Corrective Actions Required	Actions Completed	
						(Y/N)	Date
No complaints received							