Appendix A Detailed review checklist for Conditions of Approval

Lamberts North Compliance Tracking

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 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 2012			
	b)	Mt Piper Ash Placement (two volumes) – Environmental Assessments (EA), prepared by Sinclair Knight Merz, August 2010			Aug 2010			
	c)	Mt Piper Ash Placement – Submissions Report, prepared by Sinclair Knight Merz, March 2011			Mar 2011 & Jun 2012			
	d)	Delta's Letter to the Department – Submission Report Response to the Department and Agency Issues (dated 22 June 2011); and			Jun 2011			
	e)	The conditions of this approval.						
	A2	In the event of an inconsistency between:	Project Approval	Obligation	n/a		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 A1(a) 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 condition A1(a) to A1(d) inclusive, the most recent document shall prevail to the extent of the 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 2 December 2020, the Secretary of the DPIE requested one (1) action arising from their assessment of the 2019-2020 AEMR. These actions have been addressed in Section 5 of the 2020-21 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 (EA NSW, 2019a), 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 2020-21 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 in May 2013. The OEMP was reviewed and updated by EnergyAustralia NSW (2019a) which was approved by the DPIE on 1 October 2019. The abovementioned conditions are compliant for the Lamberts North stage. They have not been applied to the Lamberts South stage as no construction works have commenced for this stage to date.	**Compliant**
Environmental Representative	B1	Prior to the commencement of any construction activities or 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	Approval	1/12/2012	Secretary	In October 2012 Delta Electricity nominated the Senior Environment Officer Kelly Gillen as the Environmental Representative. The Senior Environmental Officer was approved as the Environmental Representative by the DPI on 1 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.	**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.						

Lamberts North Compliance Tracking

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
Groundwater Monitoring	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 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. EnergyAustralia NSW maintains an up-to-date groundwater model. The most recent update to the model is being undertaken as part of the independent groundwater investigation (ongoing and to be completed in 2022). The model is maintained by independent experts ERM.	**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.						
	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 Model 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. Additional groundwater monitoring bores were installed as part of the independent groundwater investigation in 2018 and 2020.	**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:	CEMP Section 8	Approved	10/12/2012	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 December 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 condition 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						

Lamberts North Compliance Tracking

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 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	10/12/2012	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 December 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 reasonable and feasible actions and measures to be implemented to minimise noise impacts;						
	vI)	details of reasonable and feasible actions and measures to be implemented to minimise noise impacts;						
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	10/12/2012	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 December 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)	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 identified 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.						
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	10/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing a Soil and Surface Water Management Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in December 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.						

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Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
Air Quality Management Plan	d)	an 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	10/12/2012	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 December 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 Fauna Sub Plan	Approved	10/12/2012	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 December 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	10/12/2012	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 December 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	10/12/2012	Secretary	A CEMP (CDM Smith, 2012a) for construction at Lamberts North containing an Ash Transportation Management Plan was developed in consultation with Delta Electricity Environment Section, NOW and SCA. The CEMP was approved by the DPI in December 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.						
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 (EA NSW, 2015) was approved 24 August 2015. A Biodiversity Offset Strategic Outline (BOSO) was prepared for Lamberts South and was considered appropriate by the Department. The BOMP was further revised in consultation with OEH and submitted to DPE 3 May 2019. The revised BOMP (EA NSW, 2019b) was approved 19 December 2019.	**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.						

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Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
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	Secretary	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). Autumn sampling for the September 2019 – August 2020 reporting period was performed in May 2020 (Cardno, 2020). Spring sampling for the September 2020 – August 2021 reporting period was performed in November 2020 (Cardno, 2021).	**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			
	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, Spring 2013	Complete	15/07/2015			
	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			
	d)	management measures to address any adverse ecological impacts.						
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. The Compliance and Tracking document is reviewed and updated each year during the development of the AEMR.	**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;		Complete	Ongoing			
	b)	provisions for periodic reporting of the compliance status to the Director- General;	AEMR, CoA and CEMP compliance					
	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					
	d)	procedures for rectifying any non-compliance identified during environmental auditing or review of compliance;	EMS Procedure #14					
	e)	mechanisms for recording environmental incidents and actions taken in response to those incidents;						
	f)	provisions for reporting environmental incidents to the Director-General during construction and operation; and						
	g)	provisions for ensuring all employees, contractors and sub-contractors are aware of, and comply with, the conditions of this approval relevant to their respective activities.	CEMP, CEMP compliance document and Training & Induction					
		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			
	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 including Ellipse, RCAS in addition to this document	On-going	n/a			
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/energygeneration/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/mtpiper-power-station/mt-piper-community	**Compliant**
	a)	the documents referred to under condition A1 of this approval;						
	b)	this project approval, Environment Protection Licence and any other relevant environmental approval, licence or permit required and obtained in relation to the project;						
	c)	all strategies, plans and programs required under this project approval, or details of where this information can be viewed;						
	d)	Information on construction and operational progress; and			5/04/2013			
	e)	the outcomes of compliance tracking in accordance with the requirements of this project approval.			5/12/2012			
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	5/12/2012 and April 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/mtpiper-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: community@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	8/12/2012	Secretary		

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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	On-going	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 2020-21 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	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 2020-21 reporting period (as per Appendix J of the AEMR).	**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	Complete for active ash placement area	10/12/2012 (CEMP)	Secretary	The ash placement areas were designed by JK Williams (CDM Smith), in consultation with Principal Contractors Lend Lease, to ensure structural stability of the ash placement areas. The active ash placement areas have been constructed in line with the design.	**Compliant**
PART C – DURING CONSTRUCTION-All Conditions in this section are covered in the 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	On-going	EPA	No environmental incidents requiring notification of the Director- General occurred within the September 2020-August 2021 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.						
Construction Hours	C3	Construction activities associated with the project shall only be undertaken during the following hours:	CEMP Section 4.3	Approved	10/12/2012	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.						

Lamberts North Compliance Tracking

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
Construction Noise	C6	The construction noise objective for the project is to manage noise from construction activities (as measured by $LA_{eq\ (15\ minute)}$ descriptor) so as not to exceed: **Location** — **Day ($LA_{eq\ (15\ minute)}$ 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).	CEMP Section 5.1 and Noise Sub Plan	Approved	10/12/2012	Secretary	No construction activities that trigger the requirements described under this condition have occurred during the reporting period.	**Not applicable**
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	10/12/2012	Secretary	No construction activities that trigger the requirements described under this condition have occurred during the reporting period.	**Not applicable**
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	10/12/2012	Secretary	The course of action for Aboriginal objects identified during construction is detailed in CEMP Aboriginal sub-plan. The CEMP was approved by the DPI 10 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)).					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 Surface Water Sub Plane	Approved	10/12/2012	Secretary	Compliance is achieved through the CEMP Soil and Surface Water sub-plan approved by DPI 10 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 Surface Water sub-plan approved by DPI 10 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 10/12/2012 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	30/07/2012 14/12/2020	Secretary	Lamberts North Consistency Report (SKM, 2012) and Ash Management Strategy (Delta Electricity, 2012) approved by DPI 30 July 2012 detailing the long-term ash management strategy for ash re-use. EnergyAustralia NSW have provided three updates on the status of the Ash Management Strategy in 2016, 2018 and 2020 (EA NSW, 2016; 2018; 2020). The goal of achieving a 40% reuse of ash by 31 December 2020 was achieved and approved by DPIE on 14 December 2020	**Compliant**

Lamberts North Compliance Tracking

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 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	Approved	19/05/2013 01/10/2019	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 in 2019 to ensure that it reflects the current activities and management. The OEMP (EA NSW, 2019a) 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 Noise Management & Monitoring Plan	Approved	19/05/2013 01/10/2019	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 in 2019 to ensure that it reflects the current activities and management. The OEMP (EA NSW, 2019a) was approved by the DPIE on the 1st October 2019. On-going operational noise monitoring was performed in April 2021 with noise resulting from Lamberts North operations deemed to comply with the OEMP at residential receivers (Global Acoustics, 2021).	**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						
	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 Groundwater Management & Monitoring Plan	Approved	19/05/2013 01/10/2019	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 in 2019 to ensure that it reflects the current activities and management. The OEMP (EA NSW, 2019a) 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						

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
	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 Soil & Surface Water Management Plan	Approved	19/05/2013 01/10/2019	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 in 2019 to ensure that it reflects the current activities and management. The OEMP (EA NSW, 2019a) 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;						
	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)	an Air Quality Management Plan to outline measures to minimise impacts from the project on local air quality. The Plan shall be prepared in consultation with NSW Health and the EPA and include, but not necessarily be limited to:	OEMP Air Quality Management Plan	Approved	19/05/2013 01/10/2019	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 in 2019 to ensure that it reflects the current activities and management. The OEMP (EA NSW, 2019a) was approved by the DPIE on the 1st October 2019. Air quality monitoring results were found to be in compliance for the 2020-21 reporting period, refer to Section 6.5.2 of the AEMR.	**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)	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;						
	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;						
	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 Landscape, Revegetation & Rehabilitation Plan	Approved	19/05/2013 01/10/2019	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 in 2019 to ensure that it reflects the current activities and management. The OEMP (EA NSW, 2019a) 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						

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
	iv)	procedures and methods to monitor and maintain revegetated areas during the establishment phase and long-term.						
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 Landscape, Revegetation & Rehabilitation Plan	Approved	19/05/2013 01/10/2019	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 in 2019 to ensure that it reflects the current activities and management. The OEMP (EA NSW, 2019a) 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	Geotechnical Report dated 11/10/2012 GW Report dated 11/12/2012	Secretary	A geotechnical report was prepared by CDM Smith (Delta Electricity – Lamberts North – Geotechnical Report dated 11/10/2012). 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 Section 2.2.1	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 Section 2.2.1	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;						
	b)	an assessment of all reasonable and feasible mitigation measures to avoid recurrence of the emergency situations;						
	c)	identification of a preferred mitigation measure(s); and						
	d)	timing and responsibility for implementation of the mitigation measure(s).						
		The report is to be submitted to the Director-General within 60 days of the second emergency situation occurring. The Proponent shall implement all reasonable and feasible mitigation measures in accordance with the requirements of the Director-General.						
	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.						
	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.						
	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.						

Lamberts North Compliance Tracking

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
Operational Noise	E7	The cumulative operational noise from the ash placement area and ash haulage activity shall not exceed the following $LA_{eq(15\ minute)}$ dB(A): **Location** / **Day (7am to 6pm)** / **Evening (6pm to 10pm)** / **Night (10pm to 7am)** All private sensitive receivers within the township of Blackmans Flat / 42 / 38 / 35 This noise criteria set out above applies under all meteorological conditions except for any of the following:	OEMP Noise Management & Monitoring Plan	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. Noise monitoring carried out during the reporting period confirmed compliance with the criteria. See Appendix C and D of the 2020-2021 AEMR.	**Compliant**
	a)	wind speed greater than 3 metres/second at 10 metres above ground level;						
	b)	stability category F temperature inversion conditions and wind speed greater than 2 metres/second at 10 metres above ground level; and						
	c)	stability category G temperature inversion conditions.						
		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.						
	E8	To determine compliance with the LAeq(15 minute) noise limits, the noise monitoring equipment must be located at the most affected point					Addressed in section 6.3.5.4 of the approved OEMP and section 6.2.2 of the 2020-21 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						
	b)	approximately on the boundary where any dwelling is situated 30 metres or less from the property boundary that is closest to the premises.						
	E9	For the purposes of monitoring noise from the premises to determine compliance with the noise limits:					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;						
		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;						
		the meteorological data to be used for determining meteorological conditions is the data recorded by the meteorological weather station at the premises; and						
		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.						
	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 Noise Management & Monitoring Plan	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. Due diligence assessment of heavy equipment SPLs were carried out over the reporting period. See Appendix D of the 2020-2021 AEMR.	**Compliant**
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 Noise Assessment Report	Complete	8/10/2013	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**
	a)	identify the appropriate operational noise objectives and levels for sensitive receivers;						
	b)	describe the methodologies for noise monitoring, including the frequency of measurements and location of monitoring sites;						
	c)	document the operational noise levels at sensitive receivers as ascertained by the noise monitoring program;						
	d)	assess the noise performance of the project against the noise 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						
	e)	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. 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:	CEMP and OEMP	On-going	Annual compliance monitoring reports	Secretary	The operational noise monitoring program is included in Table 6-5 of the approved OEMP. Annual monitoring was performed during 2020-2021 reporting period. The report states 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 (Global Acoustics, 2021).	**Compliant**
	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.						

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
		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.						
	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.						
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 Groundwater Management & Monitoring Plan	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 was carried out on a continual monthly basis including the first 12 months of operations to establish baseline data until March 2020 when the frequency was changed to quarterly to align with other groundwater monitoring performed by EnergyAustralia NSW. Results of Groundwater monitoring during the reporting period have been addressed in Section 7.2.2 and can be found in Appendix G of the 2020-21 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.						
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 necessarily be limited to:	OEMP Soil & Surface Water Management Plan	On-going	19/05/2013	Secretary	The Surface water monitoring program is included in Table 6.21 of the approved OEMP. Monthly monitoring is performed at the Final Holding Pond monitoring station to Neubecks Creek (LMP01), 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 7.1.2 and can be found in Appendix G of the 2020-21 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, monitoring is 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 subsurface 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**

Heading	Number	Condition	Reference	Status	Date of Compliance	Approver	2020-2021 Observation	Compliance Finding
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. The monitoring program shall form part of the Air Quality Management Plan referred to in condition D3(d) of this approval.	CEMP and OEMP Air Quality Sub Plans	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. Air quality monitoring results were found to be in compliance for the 2020-21 reporting period, refer to Section 6.5.2 of the AEMR.	**Compliant**
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.						
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 2020-21 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 action required to be undertaken shall be completed within such period as the Director-General may require. The Proponent shall make copies of each AEMR available for public inspection on request. 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 Compliance	Approver	2020-2021 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 & 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 Annual Summary of Lend Lease Compliance

Summary of Contractor compliance at Lamberts North

	September 2020	October 2020	November 2020	December 2020	January 2021	February 2021	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021
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 C Lamberts North Operational Noise Assessment – April 2021

Lamberts North Ash Placement Project

Environmental Noise Monitoring

April 2021

Prepared for

EnergyAustralia NSW Pty Ltd

Global Acoustics

Noise and Vibration Analysis and Solutions

Global Acoustics Pty Ltd
PO Box 3115 | Thornton NSW 2322
Telephone +61 2 4966 4333
Email global@globalacoustics.com.au
ABN 94 094 985 734

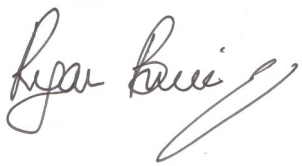
Lamberts North Ash Placement Project

Environmental Noise Monitoring
April 2021

Reference: 21045_R01
Report date: 6 August 2021

Prepared for
EnergyAustralia NSW Pty Ltd
350 Boulder Road
Portland NSW 2847

Prepared by
Global Acoustics Pty Ltd
PO Box 3115
Thornton NSW 2322



Prepared:	Ryan Bruniges Consultant	QA Review:	Jesse Tribby Consultant

Global Acoustics Pty Ltd ~ Environmental noise modelling and impact assessment ~ Sound power testing ~ Noise control advice ~ Noise and vibration monitoring ~ OHS noise monitoring and advice ~ Expert evidence in Land and Environment and Compensation Courts ~ Architectural acoustics ~ Blasting assessments and monitoring ~ Noise management plans (NMP) ~ Sound level meter and noise logger sales and hire

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Appendices

1 INTRODUCTION

1.1 Background

Global Acoustics were engaged by EnergyAustralia NSW Pty Ltd to conduct an annual noise survey of operations at the Lamberts North Ash Placement Project (LN) associated with Mount Piper Power Station near Wallerawang, NSW. The purpose of the survey was to quantify and describe the acoustic environment around the site and compare results with the specified limits, in accordance with the LN Operational Noise Management and Monitoring Plan (ONMMP).

Attended environmental noise monitoring described in this report were undertaken during the day, evening, and night periods of 27 April 2021 at two locations around LN.

1.2 Monitoring Locations

Monitoring locations are outlined Section 6.3 of the ONMMP, and have been detailed in Table 1.1 and shown in Figure 1 of this report.

Table 1.1: ATTENDED NOISE MONITORING LOCATIONS

Descriptor [1]	Name [1]	Monitoring Location
N1	Location 1	Noon Street, Blackmans Flat
N2	Location 2	End of Karawartha Drive, Wallerawang

Notes:

1. *Monitoring location descriptors and names sourced from LN Operational Environmental Management Plan.*

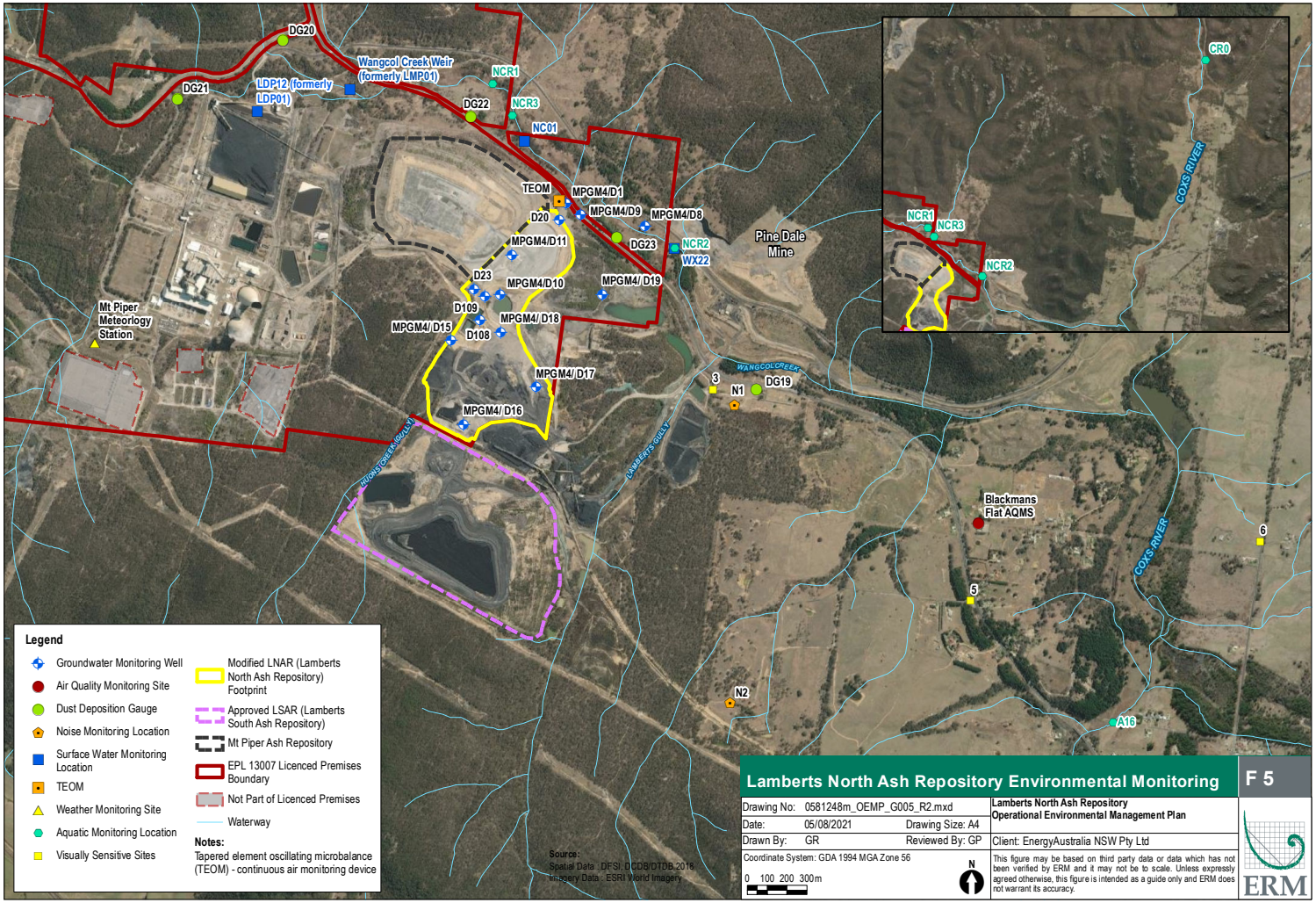

Figure 1: Lamberts North Noise Monitoring Locations

1.3 Terminology & Abbreviations

Some definitions of terms and abbreviations which may be used in this report are provided in Table 1.2.

Table 1.2: TERMINOLOGY & ABBREVIATIONS

Descriptor	Definition
dB(A)	Noise level measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise.
L_{Amax}	The maximum A-weighted noise level over a time period.
L_{A1}	The noise level which is exceeded for 1 per cent of the time.
$L_{A1,1minute}$	The noise level which is exceeded for 1 per cent of the specified time period of 1 minute.
L_{A10}	The noise level which is exceeded for 10 percent of the time.
L_{Aeq}	The average noise A-weighted energy during a measurement period.
L_{A50}	The noise level which is exceeded for 50 per cent of the time and the median noise level during a measurement period.
L_{A90}	The level exceeded for 90 percent of the time. The L_{A90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes.
L_{Amin}	The minimum A-weighted noise level over a time period.
L_{Ceq}	The average C-weighted noise energy during a measurement period. The "C" weighting scale is used to take into account low-frequency components of noise within the audibility range of humans.
SPL	Sound pressure level. Fluctuations in pressure measured as 10 times a logarithmic scale, with the reference pressure being 20 micropascals.
Hertz (Hz)	The frequency of fluctuations in pressure, measured in cycles per second. Most sounds are a combination of many frequencies together.
AWS	Automatic weather station used to collect meteorological data, typically at an altitude of 10 metres
VTG	Vertical temperature gradient in degrees Celsius per 100 metres altitude.
Sigma-theta	The standard deviation of the horizontal wind direction over a period of time.
SC	Stability class (or category) is determined from measured wind speed and either sigma-theta or VTG.
IA	Inaudible. When site noise is noted as IA then there was no site noise at the monitoring location.
NM	Not Measurable. If site noise is noted as NM, this means some noise was audible but could not be quantified.
Day	This is the period 7:00am to 6:00pm.
Evening	This is the period 6:00pm to 10:00pm.
Night	This is the period 10:00pm to 7:00am.

2 REGULATOR REQUIREMENTS AND NOISE CRITERIA

2.1 Project Approval

The most current approval associated with activities at LN is the 'Mount Piper Ash Placement Project', Project Approval 09_0186 (February 2012), which encompasses activities at LN and Lamberts South (LS) ash disposal areas. Part E of the project approval details specific conditions relating to noise generated by activities in operational areas. Relevant sections of the conditions of consent Appendix A.

2.2 Noise Monitoring Program

Noise monitoring requirements are detailed in the ONMMP, which is contained within the LN Operational Environmental Management Plan (OEMP). The most recent version of the OEMP was issued in 2019. Relevant sections are reproduced in Appendix A.

2.3 Noise Criteria

Operational noise criteria are set out in Condition E7 of the Project Approval. Noise criteria from the Project Approval are reproduced in Table 2.1.

Table 2.1: OPERATIONAL NOISE CRITERIA, dB(A)

Monitoring Location	Day $L_{Aeq,15minute}$	Evening $L_{Aeq,15minute}$	Night $L_{Aeq,15minute}$
N1	42	38	35
N2	42	38	35

2.4 Meteorological Conditions

Part E7 of the project approval outlines meteorological conditions required for criteria to be applicable. Noise criteria detailed in the project approval apply under all meteorological conditions except for the following:

(a) wind speed greater than 3 metres/second measured at 10 metres above ground level

(b) stability category F temperature inversion conditions and wind speed greater than 2 metres/second measured at 10 metres above ground level; or

(c) stability category G temperature inversion conditions.

Meteorological data for LN was obtained from the Mount Piper Power Station automatic weather station (AWS), in accordance with the NMMP.

2.5 Modifying Factors

The EPA 'Noise Policy for Industry' (NPfI, 2017) was approved for use in NSW in October 2017. For assessment of modifying factors, the NPfI immediately superseded the 'Industrial Noise Policy' (INP, 2000), as outlined in the EPA document 'Implementation and transitional arrangements for the Noise Policy for Industry' (2017). Assessment and reporting of modifying factors has been undertaken in accordance with Fact Sheet C of the NPfI.

3 METHODOLOGY

3.1 Overview

Attended environment noise monitoring was conducted in general accordance with Australian Standard AS1055 'Acoustics, Description and Measurement of Environmental Noise', relevant NSW EPA requirements, and the OEMP. Prior to conducting attended monitoring at the approved monitoring locations, LN operations were confirmed to be active as due diligence. Meteorological data was obtained from the Mount Piper AWS which allowed correlation of atmospheric parameters with measured noise levels.

3.2 Attended Noise Monitoring

During this survey, attended monitoring was undertaken during the day, evening, and night periods at each monitoring location. The duration of each measurement was 15 minutes. Atmospheric condition measurement was also undertaken at each monitoring location.

This survey presents noise levels gathered during attended monitoring that are the result of many sounds reaching the sound level meter microphone during monitoring. Received levels from various noise sources were noted during attended monitoring and particular attention was paid to the extent of LN's contribution, if any, to measured levels. At each receptor location, LN's $L_{Aeq,15minute}$ (in the absence of any other noise) was measured directly, where possible, or, determined by frequency analysis.

If the exact contribution of the source of interest (in this case LN) cannot be established, due to masking by other noise sources in a similar frequency range, but site noise levels are observed to be well below (more than 5 dB lower than) any relevant criterion, a maximum estimate of the potential contribution of the site might be made based on other measured site-only noise descriptors in accordance with Section 7.1 of the NPfI. This is generally expressed as a 'less than' quantity, such as <20 dB or <30 dB.

The terms 'Inaudible' (IA) or 'Not Measurable' (NM) may also be used in this report. When site noise is noted as IA, no noise from LN activities was audible at the monitoring location. When site noise is noted as NM, this means some noise was audible from LN activities but could not be quantified. If site noise was NM due to masking but estimated to be significant in relation to a relevant criterion, we would employ methods (e.g. measure closer and back calculate) to determine a value for reporting.

All LN noise levels noted as NM in this report are due to one or more of the following reasons:

- Site noise levels were extremely low and unlikely, in many cases, to be even noticed;
- Site noise levels were masked by another relatively loud noise source that is characteristic of the environment (e.g. breeze in foliage or continuous road traffic noise) that cannot be eliminated by moving closer; and/or
- It was not feasible, nor reasonable to employ methods such as move closer and back calculate. Cases

may include, but are not limited to, rough terrain preventing closer measurement, addition/removal of significant source to receiver shielding caused by moving closer, and meteorological conditions where back calculation may not be accurate.

Often extraneous noise events (for example, road traffic pass-bys and dogs) interfere with the measurement of site noise levels in the frequency range of interest. Where required, the sound level meter is paused during these occurrences to aid in quantification of the site only $L_{Aeq,15minute}$ level.

3.3 Modifying Factors

All measurements were evaluated for potential modifying factors in accordance with the NPfI. Specific methodology for assessment of each modifying factor is outlined in Fact Sheet C of the NPfI.

Assessment of modifying factors is undertaken at the time of measurement if the site was audible and directly quantifiable, such that the site-only L_{Aeq} was not "NM" or less than a maximum cut off value (e.g. "<20 dB" or "<30dB").

If applicable, modifying factors have been reported and added to measured site-only L_{Aeq} noise levels when meteorological conditions satisfied requirements for site noise criteria to be applicable. Low-frequency modifying factors have only been applied to site-only L_{Aeq} levels if LN was the only contributing low-frequency noise source.

3.4 Attended Monitoring Equipment

The equipment used to measure environmental noise levels is detailed in Table 3.1. Calibration certificates are provided in Appendix B.

Table 3.1: ATTENDED NOISE MONITORING EQUIPMENT

Model	Serial Number	Calibration Due Date
Rion NA-28 sound level meter	00701424	14/06/2021
Pulsar 105 acoustic calibrator	79631	13/05/2022

4 RESULTS

4.1 Total Measured Noise Levels

Overall noise levels measured at each location during attended measurement are provided in Table 4.1. These noise levels represent total environmental noise levels and are not necessarily the result of activities at LN.

Table 4.1: MEASURED NOISE LEVELS[1] – APRIL 2021

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N1 – Day	27/04/2021 10:15	60	56	52	48	47	39	33
N1 – Evening	27/04/2021 21:29	54	49	43	39	34	28	26
N1 – Night	27/04/2021 22:00	54	50	42	38	30	28	26
N2 – Day	27/04/2021 09:46	47	40	34	32	31	29	27
N2 – Evening	27/04/2021 21:05	50	46	41	38	36	28	20
N2 – Night	27/04/2021 22:29	50	43	39	35	32	25	20

Notes:

1. *Levels in this table are not necessarily the result of activity at LN.*

4.2 Modifying Factors

Measured LN-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.3.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.3 Attended Noise Monitoring

Table 4.2 details noise levels from LN in the absence of other noise sources. Criteria are then applied if weather conditions are in accordance with the project approval. Discussion as to the noise sources responsible for these measured levels is provided in Section 5 of this report.

Table 4.2: $L_{Aeq,15minute}$ GENERATED BY LN AGAINST OPERATIONAL NOISE CRITERIA – APRIL 2021

Location	Start Date and Time	Wind Speed m/s	Stability Class	Criterion dB	Criterion Applies?[1]	LN $L_{Aeq,15min}$ dB [2,3]	Exceedance [3,4]
N1	27/04/2021 10:15	0.5	A	42	Yes	31	Nil
N1	27/04/2021 21:29	0.7	D	38	Yes	IA	Nil
N1	27/04/2021 22:00	0.3	F	35	Yes	IA	Nil
N2	27/04/2021 09:46	1.3	A	42	Yes	IA	Nil
N2	27/04/2021 21:05	0.7	F	38	Yes	IA	Nil
N2	27/04/2021 22:29	0.6	F	35	Yes	IA	Nil

Notes:

1. *Noise emission limits apply for all meteorological conditions except those detailed in Section 2.4;*
2. *Site-only $L_{Aeq,15minute}$ attributed to LN, including modifying factors if applicable;*
3. *Bold results in red indicate exceedance of the relevant criterion (if applicable); and*
4. *NA in exceedance column means atmospheric conditions outside conditions specified in Section 2.4, therefore criterion was not applicable.*

4.4 Atmospheric Conditions

Atmospheric condition data measured by the operator during each measurement using a Kestrel hand-held weather meter is shown in Table 4.3. The wind speed, direction and temperature were measured at approximately 1.8 metres. Attended noise monitoring is not undertaken during rain, hail, or wind speeds above 5 m/s at microphone height.

Table 4.3: MEASURED ATMOSPHERIC CONDITIONS – APRIL 2021

Location	Start Date and Time	Temperature ° C	Wind Speed m/s	Wind Direction ° Magnetic North[1]	Cloud Cover 1/8s
N1	27/04/2021 10:15	13	0.8	140	1
N1	27/04/2021 21:29	8	0.0	-	0
N1	27/04/2021 22:00	11	0.0	-	6
N2	27/04/2021 09:46	13	1.0	235	2
N2	27/04/2021 21:05	9	0.0	-	0
N2	27/04/2021 22:29	10	0.0	-	7

Notes:

1. *"-" indicates calm conditions at monitoring location.*

Meteorological data used for compliance assessment is sourced from the LN AWS.

5 DISCUSSION

5.1 Noted Noise Sources

During attended monitoring, the time variations (temporal characteristics) of noise sources are taken into account in each measurement via statistical descriptors. From these observations, summaries have been derived for each location and provided in this chapter. Statistical 1/3 octave-band analysis of environmental noise was undertaken and the following figures display frequency ranges of various noise sources at each location for L_{A1}, L_{A10}, L_{Aeq}, L_{A50} and L_{A90} descriptors. These figures also provide, graphically, statistical information for these noise levels.

An example is provided as Figure 2 where it can be seen that frogs and insects are generating noise at frequencies above 1000 Hz while mining noise is at frequencies less than 1000 Hz, which is typical. Adding levels at frequencies that relate to the source of interest only allows separate statistical results to be calculated. This analysis cannot always be performed if there are significant levels of other noise at the same frequencies as the source of interest, such as dogs, cows, or (most commonly) road traffic.

It should be noted that the method of summing statistical values up to a cut-off frequency can overstate the L_{A1} result by a small margin but is entirely accurate for L_{Aeq}.

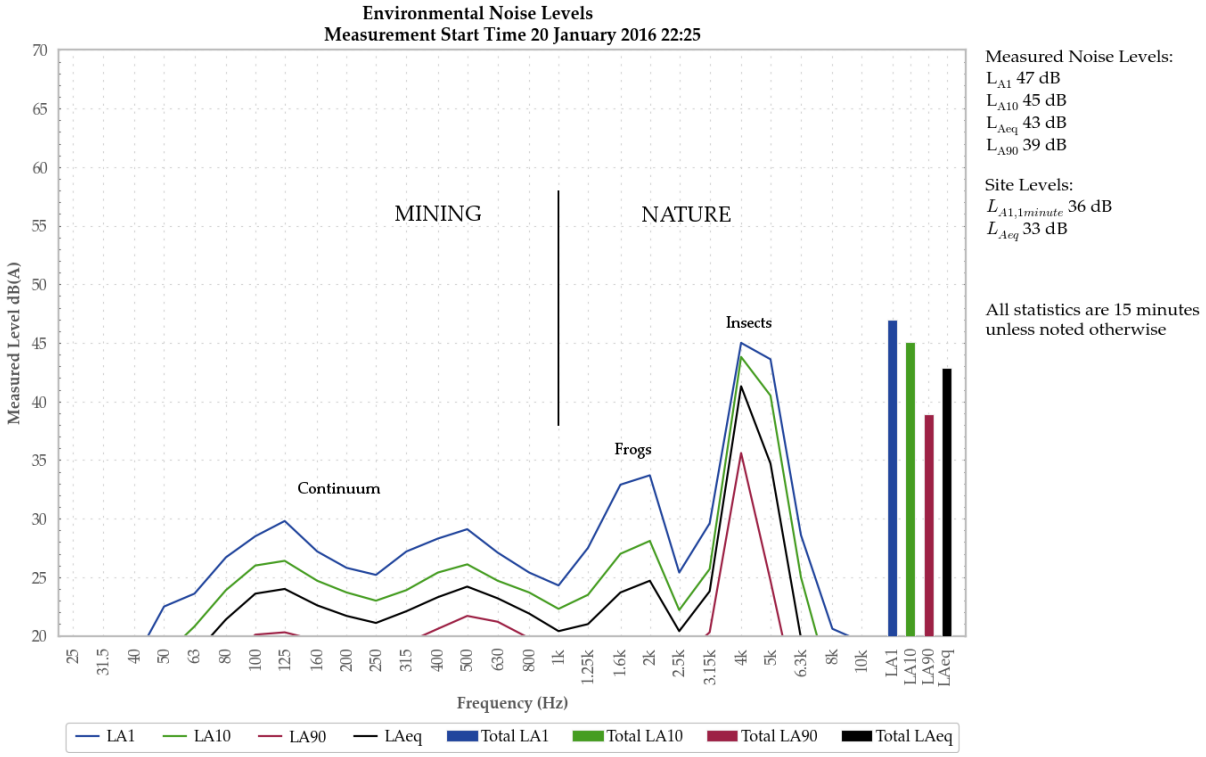

Figure 2: Example Graph (refer to section 5.1 for explanatory note)

5.1.1 N1 – Day

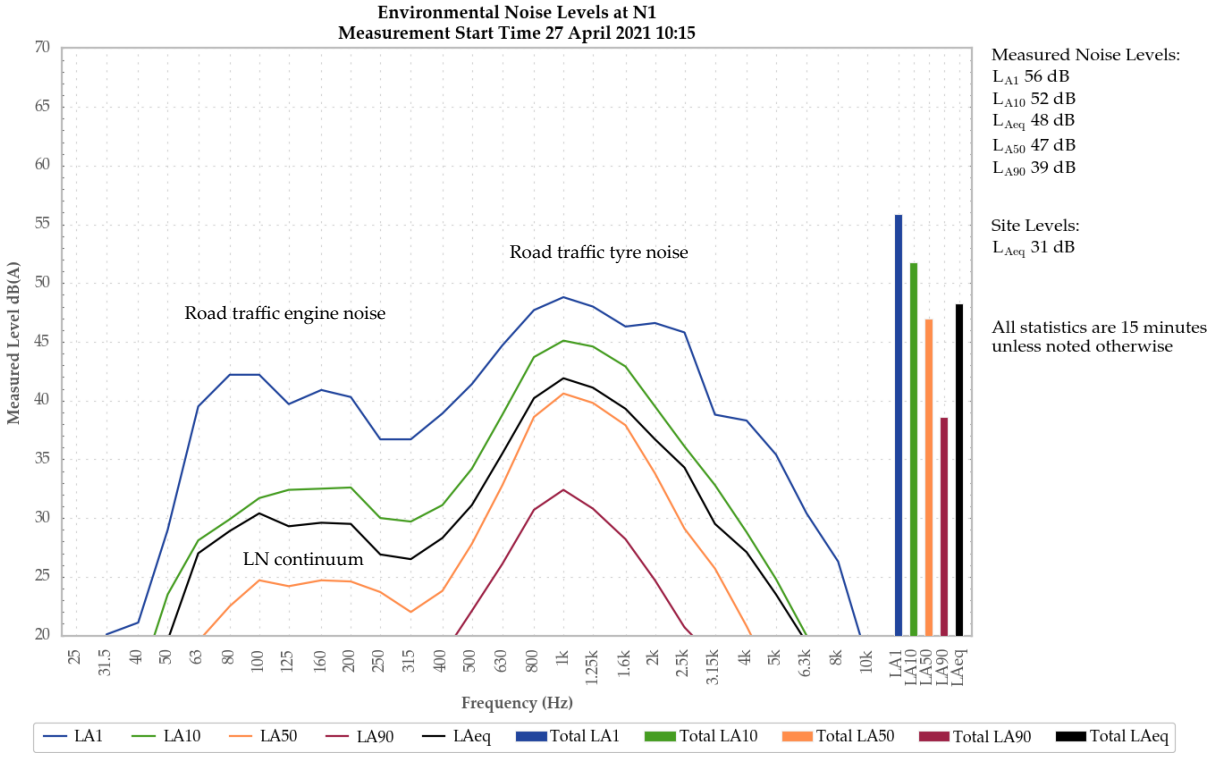

Figure 3: Environmental Noise Levels – N1

A continuum from LN was audible throughout the day period measurement at N1, and generated the measured site-only L_{Aeq} of 31dB.

Road traffic tyre and engine noise was responsible for the measured noise levels.

Insects and birds were also noted.

5.1.2 N1 – Evening

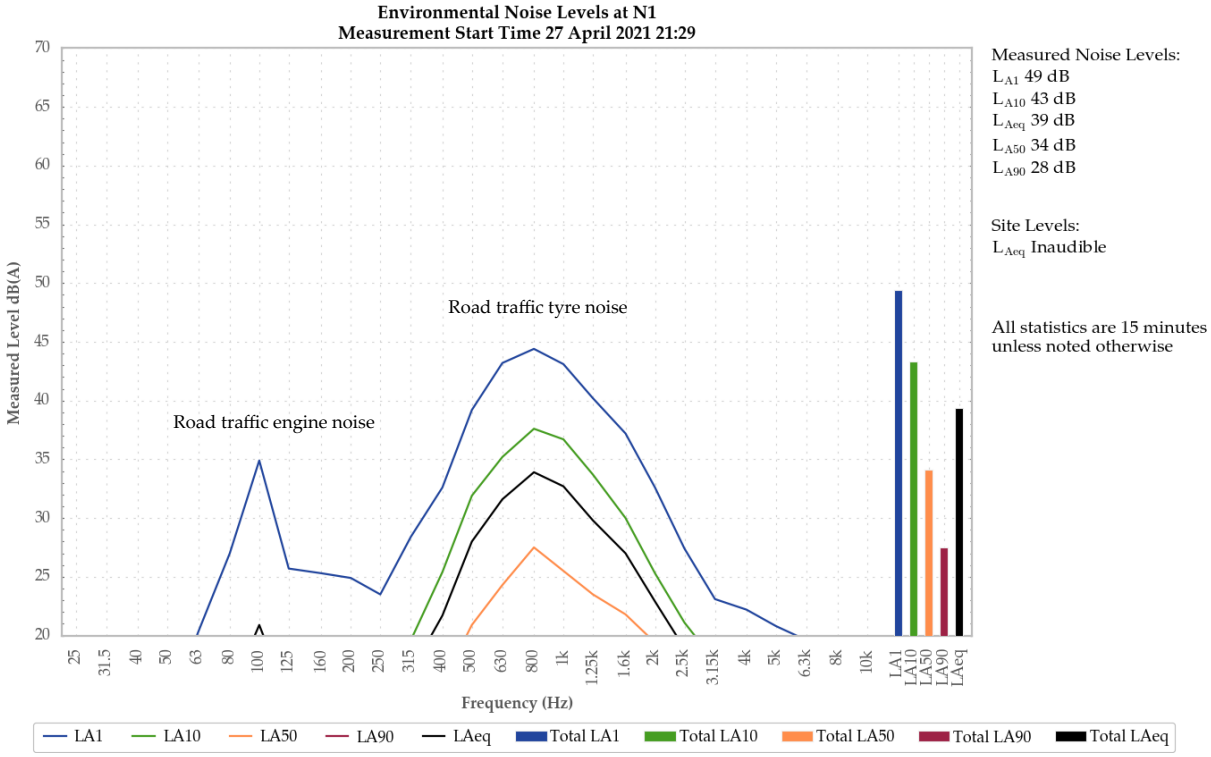

Figure 4: Environmental Noise Levels – N1

LN was inaudible during the evening period measurement at N1.

Road traffic noise was responsible for the measured noise levels.

A nearby creek was also noted.

5.1.3 N1 – Night

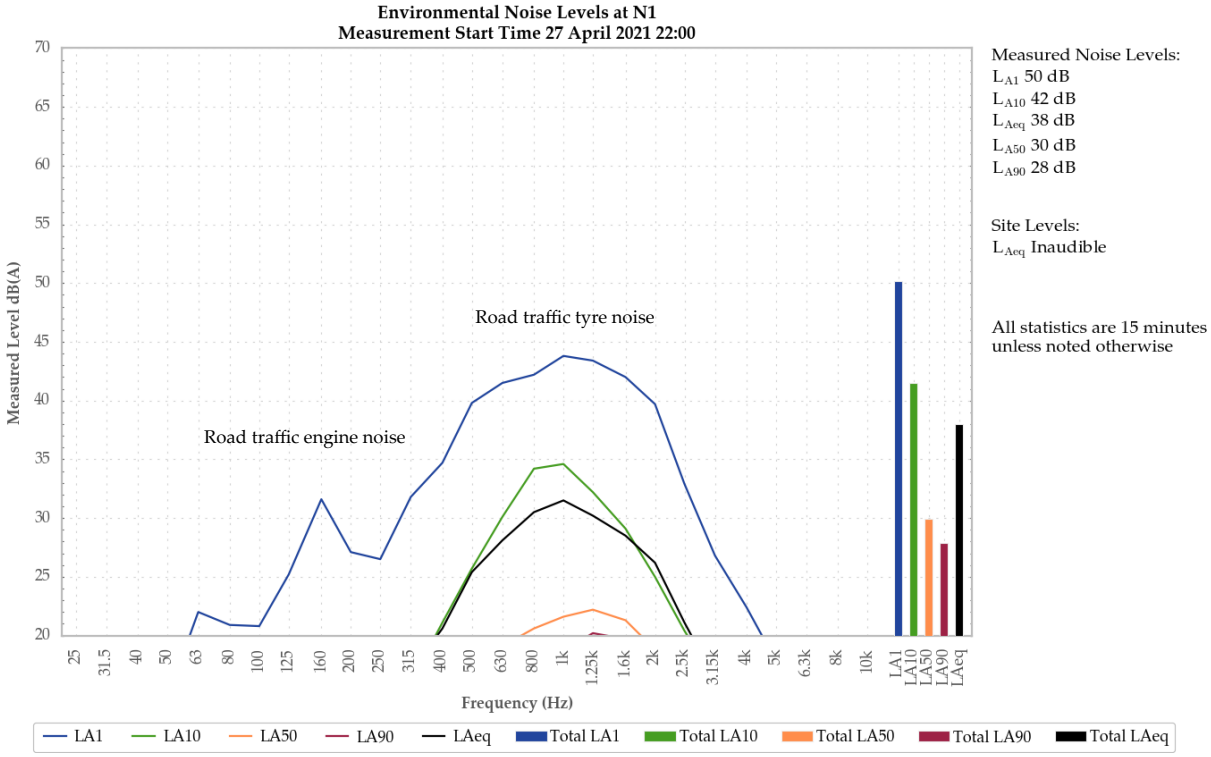

Figure 5: Environmental Noise Levels – N1

LN was inaudible during the night period measurement at N1.

Road traffic noise was responsible for the measured noise levels.

A nearby creek was also noted.

5.1.4 N2 – Day

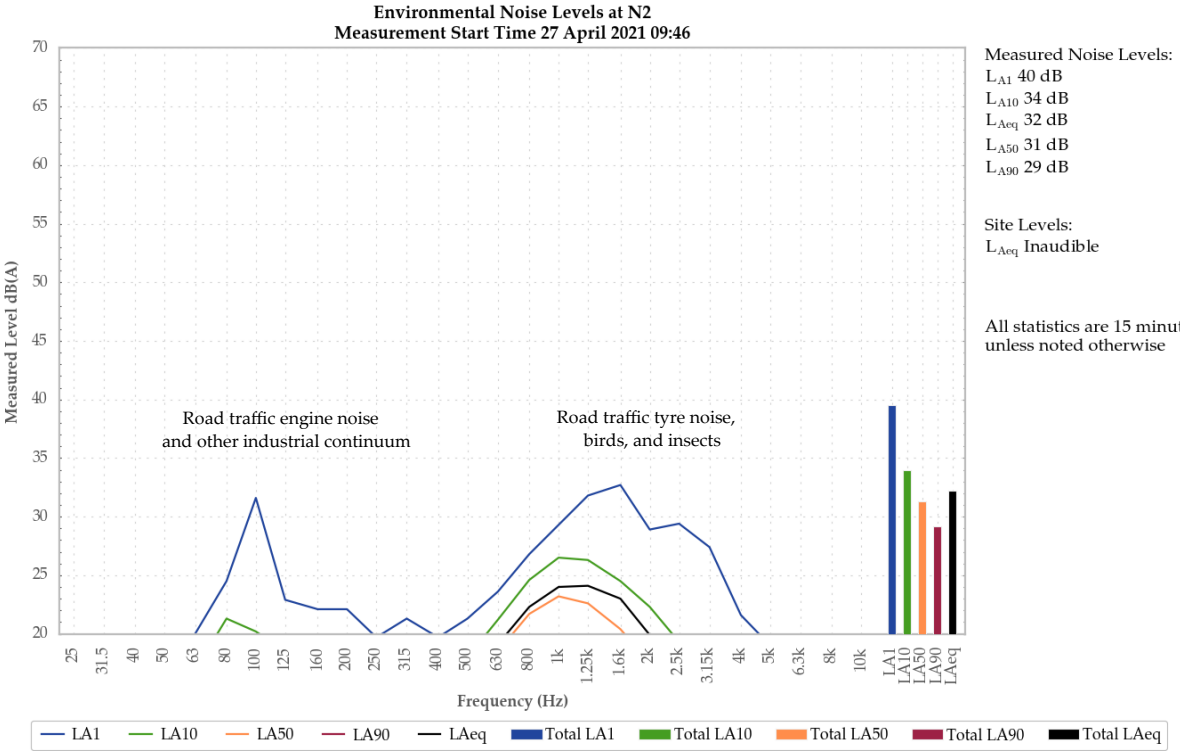

Figure 6: Environmental Noise Levels – N2

LN was inaudible during the day period measurement at N2.

Road traffic engine and tyre noise was primarily responsible for the measured noise levels. Continuum from another industrial operation, including track noise, reverse alarms, and engine surges, also contributed to the measured noise levels.

Birds and insects were also noted.

5.1.5 N2 – Evening

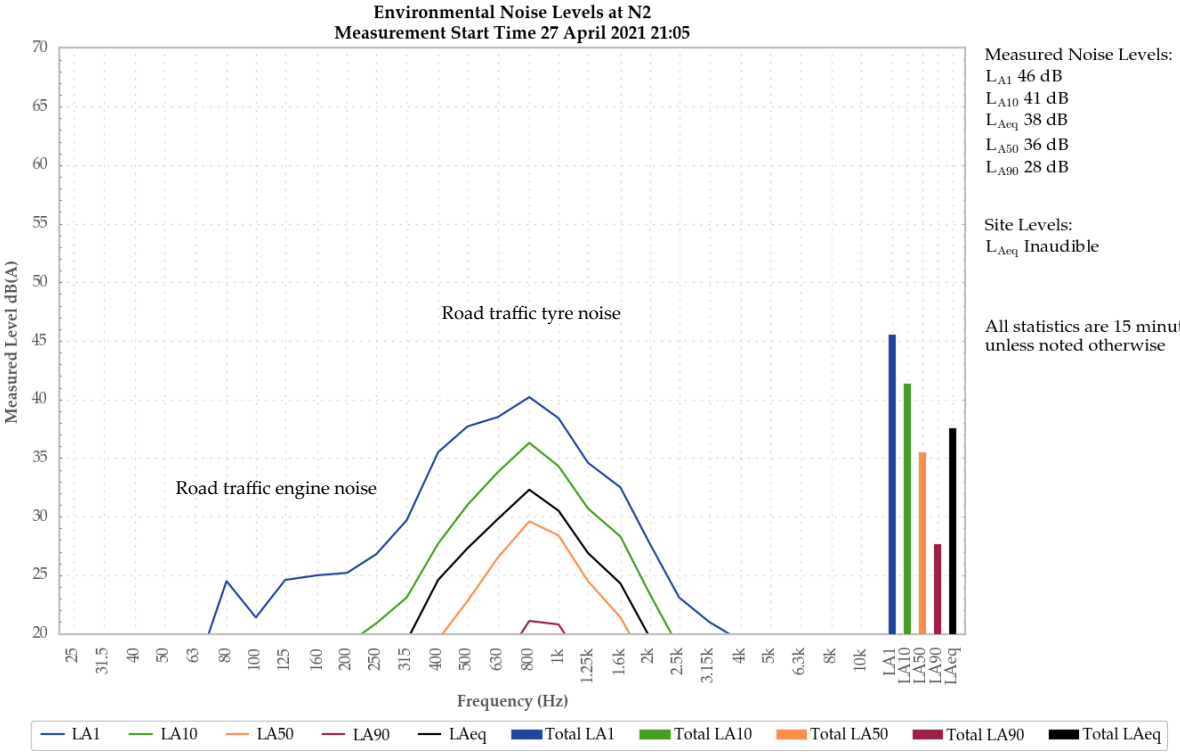

Figure 7: Environmental Noise Levels – N2

LN was inaudible during the evening period measurement at N2.

Road traffic noise was responsible for the measured noise levels.

Dogs and bats were also noted.

5.1.6 N2 – Night

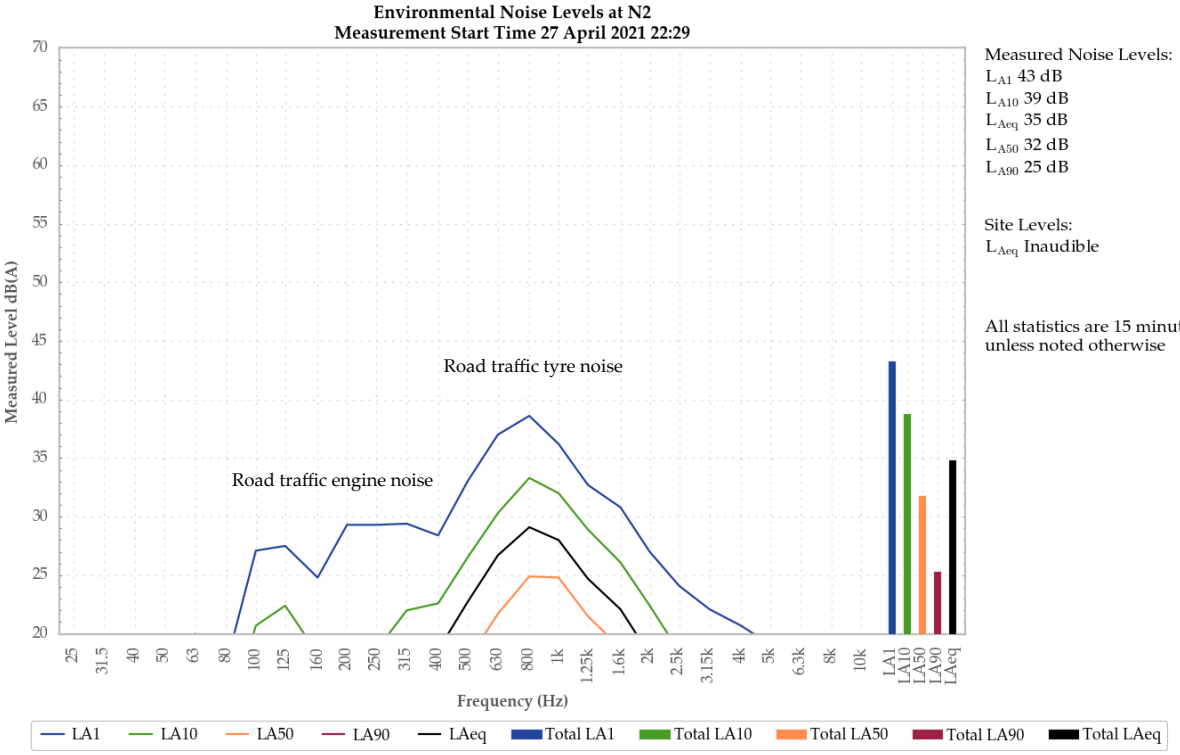

Figure 8: Environmental Noise Levels – N2

LN was inaudible during the night period measurement at N2.

Road traffic noise was primarily responsible for the measured noise levels.

Local impact noise and birds were also noted.

6 SUMMARY

Global Acoustics were engaged by EnergyAustralia NSW Pty Ltd to conduct an annual noise survey of operations at LN. The purpose of the survey was to quantify and describe the acoustic environment around the site and compare results with the specified limits, in accordance with the ONMMP.

Attended environmental noise monitoring described in this report was undertaken during the day, evening, and night periods of 27 April 2021 at two monitoring locations around LN.

Noise levels from LN complied with relevant criteria at all monitoring locations during the April 2021 survey.

Global Acoustics Pty Ltd

APPENDIX

A REGULATOR DOCUMENTS

A.1 Project Approval

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:

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:

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

vi) provisions for periodic reporting of results to the EPA as per condition B8.

Operational Noise

E7. The cumulative operational noise from the ash placement area and ash haulage activity shall not exceed the following $L_{Aeq(15\ minute)}$ dB(A):

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

This noise criteria set out above applies under all meteorological conditions except for any of the following:

(a) wind speed greater than 3 metres/second at 10 metres above ground level;
(b) stability category F temperature inversion conditions and wind speed greater than 2 metres/second at 10 metres above ground level; and
(c) stability category G temperature inversion conditions.

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.

E8. To determine compliance with the $L_{Aeq(15\ minute)}$ noise limits, the noise monitoring equipment must be located at the most affected point:

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
b) approximately on the boundary where any dwelling is situated 30 metres or less from the property boundary that is closest to the premises.

E9. For the purposes of monitoring noise from the premises to determine compliance with the noise limits:

a) 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;
b) 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;
c) the meteorological data to be used for determining meteorological conditions is the data recorded by the meteorological weather station at the premises; and
d) 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.

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.

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.

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.

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:

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).

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.

A.2 Noise Management and Monitoring Plan

6.3.2 Sensitive Receptors

The term 'sensitive receiver' used in this plan refers to nearby receivers, such as residents and businesses that may potentially be affected by noise emissions identified for the project. In the Environmental Assessment (EA), two sensitive receivers were identified as locations 1 and 2. Location 1 is located in Blackmans Flat approximately 1.1km east of the project. Location 2 is located on a rural property 1.1km west of Castlereagh Highway (SKM, 2010). Refer to Figure 3 for more detail.

6.3.3 Noise generating activities

6.3.3.1 Approved operational conditions

Operational hours associated with the project shall be undertake during the following hours (CoA E1):

- Monday to Friday: 6am – 8pm
- Saturday to Sunday: 6am – 5pm.

6.3.3.2 Key potential noise impacts

Key potential noise impacts during operational activities are anticipated to include those 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 sprinklers systems;
- Developing and maintaining water management structures (containments, drains and sumps) using an excavator;
- Using variously 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;

  The machinery & plant generate noise from the engine & drive line, hydraulics and reverse warning devices

6.3.5 Operational Noise Monitoring Program

This section provides the requirements for the ongoing noise monitoring program and operational noise review in accordance with CoA E8, E9, E11 E12, E13, and E14.

Table 6-5 provides the details of the noise monitoring program.

Table 6-6 provides the standards and requirements that shall be considered during monitoring. The meteorological data recorded at the Mount Piper Power Station weather station will be used in the investigation of any recorded exceedance exceedances of approved noise criteria or noise complaints (Figure 3).

The reporting requirements and corrective actions required in the event of non-compliance are listed in Table 6-7 and Table 6-8 , respectively. The source or reference for measures is the OEMP and the CoA.

6.3.5.1 Guidelines

All operator-attended and unattended noise monitoring will be conducted in accordance with the following guidelines:

- Environmental Noise Control Manual (EPA, 1994);
- Noise Policy for Industry (EPA, 2017), and
- AS 1055: 1997 *Acoustics – Description and Measurement of Environmental Noise.*

6.3.5.2 Noise Criteria

As specified in CoA E7, the cumulative operational noise from the ash placement area and ash haulage activity shall not exceed the LAeq (15 minute) dB(A) identified in Table 6-4 .

Table 6-4 Operational Noise criterion (LAeq(15 minute) dB(A))

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

These criteria do not apply where the Proponent and an affected landowner have reached a negotiated agreement in regard to noise, and a copy of that agreement has been forwarded to the Secretary and the NSW EPA.

6.3.5.3 Meteorological Conditions

The noise criteria identified in Table 6-4 above applies under meteorological conditions except for any of the following:

- Wind speed greater than 3 m/second at 10 m above ground level;
- Stability category F temperature inversion conditions and wind speed greater than 2 m/second at 10 m above ground level; and
- Stability category G temperature inversion conditions.

6.3.5.5 Monitoring

The Noise Monitoring Program, including the Noise Monitoring Review, is provided below in Table 6-5. Table 6-6 provides the standards and requirements that shall be considered during monitoring.

Table 6-5 Noise monitoring program

Potential impact	Location	Parameters	Frequency	Technique	Reporting	Responsibility	CoA and OEMP reference
Operational Noise Review	Two most affected sensitive receivers: • Blackmans Flat • Wallerawang (Refer to Figure 3)	LAeq, LA10, LA90 and LAMax. Noise levels shall not exceed criterion stipulated in Table 6-4	One-off survey that includes: Four separate days – 3-week days and a Sunday, within the first 60 days of operation.	Attended and unattended noise monitoring technique shall be undertaken adopting the following guidelines; ▪ NSW industrial Noise policy; ▪ AS 1055: 1997 *Acoustics – Description and Measurement of Environmental Noise;* ▪ *Environmental noise control manual (EPA 2004)* Ongoing attended monitoring using Class 1 or 2 noise monitoring equipment as defined by AS IEC61672.1-2004 and ASEIC61672.2-2004, or other noise monitoring equipment accepted by the NSW EPA in writing.	An Operational Noise Review within the 60 days of commencement of operation.	Specialist consultant on behalf of EnergyAustralia NSW.	D3(a) (ii) D3(a) (iii), E7, E8, E9, E11
Ongoing Noise monitoring	Two most affected sensitive receivers: Blackmans Flat Wallerawang	LAeq, LA10, LA90 and LAMax. Noise levels shall	Annual or following a complaint as required	Attended and unattended noise monitoring technique shall be undertaken adopting the following guidelines;	Annual monitoring report. Non-compliances:	Noise Specialist	D3(a) (ii) D3(a) (iii), E7, E8, E9, E12

Potential impact	Location	Parameters	Frequency	Technique	Reporting	Responsibility	CoA and OEMP reference
	(refer to Figure 3) Other locations as required, in response to a substantiated complaint.	not exceed the noise criteria (Table 6-4) at the nearest most affected receiver.	Annual	▪ NSW industrial Noise policy; ▪ AS 1055: 1997 *Acoustics – Description and Measurement of Environmental Noise;* ▪ *Environmental noise control manual (EPA 2004)* Ongoing attended monitoring using Class 1 or 2 noise monitoring equipment as defined by AS IEC61672.1-2004 and ASEIC61672.2-2004, or other noise monitoring equipment accepted by the NSW EPA in writing.	1. If noise monitoring survey indicates non-compliance against compliance criteria, then EnergyAustralia NSW is required to forward a report containing the results to the NSW EPA and the Secretary within 14 days of conducting a noise assessment. 2. An additional investigation report shall be submitted to the Secretary within 60 days of undertaking noise monitoring and must include the criteria specified in CoA E13 within 60 days of undertaking the noise monitoring.	EnergyAustralia NSW EnergyAustralia NSW	Environmental Noise Control Manual Industrial Noise Policy (EPA 2000) AS1055 CoA E12 CoA E13

Table 6-6 Monitoring requirements

No.	Monitoring measures	Responsibility	Timing	Source/ Reference
1.	All operator-attended and unattended noise monitoring will be conducted in accordance with the Environmental Noise Control Manual (EPA, 1994), Noise Policy for industry (EPA, 2017), and AS 1055: 1997 *Acoustics – Description and Measurement of Environmental Noise.*	Specialist Consultant/ EnergyAustralia NSW	As identified in this plan	D3(a) (iii) D3(a) (v)
2.	To determine compliance with the LAeq(15 minute) noise limits at identified sensitive receivers, the noise monitoring equipment must be located at the most affected point: ▪ Within 30 m of a dwelling façade where any dwelling on the property is situated more than 30 m from the property boundary that is closest to the premises; or ▪ Within close proximity to the boundary where any dwelling is situated 30 m or less from the property boundary that is closest to the premises.	Specialist Consultant/EnergyAustralia NSW	During monitoring	E8
3.	The Operation Noise Management and Monitoring Plan shall be reviewed every 3 years as part of the OEMP review to determine effectiveness of mitigation measurement and the monitoring commitments.	EnergyAustralia NSW	Every 3 years	D3(a)(v) E12

Table 6-7 Reporting requirements

No.	Reporting requirements	Responsibility	Timing	Source/ Reference
1.	Any noise related complaints will be registered in EnergyAustralia NSW complaints register for Lamberts North. Complaints will be thoroughly investigated to determine and mitigate the cause.	EnergyAustralia/ Contractor	Ongoing	D3 (a)(v) OEMP Section 3.5
2.	EnergyAustralia NSW shall review the periodic noise monitoring reports and implement recommendations where feasible and practicable. In addition, EnergyAustralia NSW shall report any results and recommendations to the Ash repository contractor as part of their monthly meeting.	EnergyAustralia/Contractor	Whenever a noise report has been received	D3 (a)(v) E14
3.	All complaints/incidents regarding noise will be reported to the Contract Administrator.	Contractor	As required	D3(a) (iv) D3(a) (v) OEMP Sections 3.5 & 3.9
4.	Operational Noise Review will be completed within 60 days of the commencement of Lambert North Ash Placement operations. The review shall be prepared in consultation with the NSW EPA and shall meet the requirement of CoA E11	EnergyAustralia NSW	Within 60 days of commencement of operations	D3 (a)(v) E11

No.	Reporting requirements	Responsibility	Timing	Source/ Reference
5.	EnergyAustralia NSW shall submit a noise report to the NSW EPA, upon their request at any time during the project.	EnergyAustralia NSW	As required	D3(a) (v) D3(a) (vi) E21
6.	The Proponent shall forward to the NSW EPA and the Secretary a report containing the results of any non-compliance within 14 days of conducting a noise assessment.	EnergyAustralia NSW	As required	D3 (a)(v) E12
7.	In addition, a separate investigation report (to report specified in #6) shall be submitted to the Secretary and must include the criteria specified in CoA E13 within 60 days of undertaking the noise monitoring which has identified the exceedance of the operational noise criteria.	EnergyAustralia NSW and Contractor	Within 60 days of conducting a noise assessment	D3 (a)(v) E12, E13
8.	The Annual Environmental Management Report (AEMR) shall be submitted to the Secretary complete with a summary of monitoring results of noise assessment reports carried out during that reporting year.	EnergyAustralia NSW	At least annually	D3(a) (v) D3(a) (vi) E21

Table 6-8 Response Plan and Corrective Actions

No.	Corrective Actions	Responsibility	Timing	Source/ Reference
1.	Where non-compliance with the noise goals are identified through noise monitoring, a further assessment of feasible noise management and mitigation measure shall be undertaken and implemented.	Contractor/ EnergyAustralia NSW	As required	D3 (a)(v)
2.	If after the implementation of reasonable and feasible source controls, as identified in the report required by condition E13, the noise generated by the project continues to exceed the project noise criteria (see Table 6-4) EnergyAustralia NSW 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.	EnergyAustralia NSW	As required	E14
3.	Any unusually noisy equipment will be investigated and rectified as soon as possible.	Contractor	As required and practicable	D3 (a)(v)
4.	In the unlikely event of a noise complaint being received, investigations shall take place to find the source and mitigate noise emissions as soon as possible.	Contractor	As required	D3(a)(v)
5.	Any noise issue identified as a concern shall be discussed as part of routine tool box talks to keep staff aware of operational activities and potential issues.	Contractor	As required	D3(a)(v)

APPENDIX

B CALIBRATION CERTIFICATES

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C19342

Client Details	Global Acoustics Pty Ltd 12/16 Huntingdale Drive Thorton NSW 2322
Equipment Tested/ Model Number :	Rion NA-28
Instrument Serial Number :	00701424
Microphone Serial Number :	01916
Pre-amplifier Serial Number :	01463

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	26°C	**Ambient Temperature :**	26°C
Relative Humidity :	40.2%	**Relative Humidity :**	40.7%
Barometric Pressure :	100.96kPa	**Barometric Pressure :**	100.32kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 14 Jun 2019
Secondary Check: Eloise Burrows
Report Issue Date : 18 Jun 2019

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.11dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Calibrator
IEC 60942-2017

Calibration Certificate

Calibration Number C20270

Client Details	Global Acoustics Pty Ltd 12/16 Huntingdale Drive Thornton NSW 2322
Equipment Tested/ Model Number :	Pulsar Model 105
Instrument Serial Number :	79631

Atmospheric Conditions

Ambient Temperature :	21.9°C
Relative Humidity :	43.9%
Barometric Pressure :	101.2kPa

Calibration Technician :	Lucky Jaiswal	**Secondary Check:**	Max Moore
Calibration Date :	13 May 2020	**Report Issue Date :**	19 May 2020

Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.07	1000.40

The sound calibrator has been shown to conform to the class 2 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.14dB*	*Temperature*	*±0.2°C*
Frequency	*±0.09%*	*Relative Humidity*	*±2.4%*
Distortion	*±0.09%*	*Barometric Pressure*	*±0.015kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

* The tests <1000 kHz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

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Appendix D Lamberts North Mobile Plant Power Assessment – April 2021

Lamberts North Ash Placement Project

Mobile plant sound power assessment

Prepared for

EnergyAustralia Pty Ltd

Global Acoustics

Noise and Vibration Analysis and Solutions

Global Acoustics Pty Ltd
PO Box 3115 | Thornton NSW 2322
Telephone +61 2 4966 4333
Email global@globalacoustics.com.au
ABN 94 094 985 734

Lamberts North Ash Placement Project

Mobile plant sound power assessment

Reference: 21045_R02
Report date: 8 July 2021

Prepared for

EnergyAustralia NSW Pty Ltd
350 Boulder Road
Portland NSW 2847

Prepared by

Global Acoustics Pty Ltd
PO Box 3115
Thornton NSW 2322

Prepared:	Ryan Bruniges Consultant	QA Review:	Jesse Tribby Consultant

Global Acoustics Pty Ltd ~ Environmental noise modelling and impact assessment ~ Sound power testing ~ Noise control advice ~ Noise and vibration monitoring ~ OHS noise monitoring and advice ~ Expert evidence in Land and Environment and Compensation Courts ~ Architectural acoustics ~ Blasting assessments and monitoring ~ Noise management plans (NMP) ~ Sound level meter and noise logger sales and hire

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Appendices

1 INTRODUCTION

Global Acoustics was engaged by EnergyAustralia Pty Ltd to determine sound power data for a selection of mobile plant in operation at Lamberts North Ash Placement.

Plant and equipment used at Lamberts North Ash Placement are required to meet typical sound power levels as per manufacturing standards. The Lamberts North Ash Placement Project Operational Environmental Management Plan requires that sound power levels be tested following any ongoing noise complaints (Table 6-3.3).

No noise complaints have been made in the previous 12 months. However, annual sound power testing has been undertaken as due diligence and a form of noise control to identify mobile plant that may require maintenance to meet modelled sound power levels. Test measurements were made on 26 April 2021.

1.1 Measurement Equipment

Equipment used to measure and record noise levels are listed in Table 1.1. Calibration certificates are provided in Appendix B.

Table 1.1: SOUND LEVEL MEASUREMENT EQUIPMENT

Model	Serial Number	Calibration Due Date
SVAN 958A noise and vibration analyser	69814	23/05/2021
Rion NC-74 sound level calibrator	34483783	11/03/2022

1.2 Terminology

Definitions of terminology which may be used in this report are provided in Table 1.2.

Table 1.2: TERMINOLOGY & ABBREVIATIONS

Descriptor	Definition
dB	Decibels. Relative unit of measurement on a logarithmic scale used extensively in the field of acoustics.
dB(A)	Decibels adjusted using the "A"-weighting scale to consider human response to sound.
Hertz (Hz)	SI unit of frequency, used to measure fluctuations in pressure. Most sounds are a combination of many frequencies together.
$L_{Aeq,t}$	The average A-weighted sound energy during a measurement period of time (t).
SPL	Sound pressure level. Measured as 10 times the logarithmic ratio of pressure fluctuations relative to a reference level of 20 micropascals.
L_W	Sound power level. Measured as 10 times the logarithmic ratio of power of a source relative to a reference level of one picowatt.
L_{WA}	A-weighted sound power level.

1.3 Weather Conditions

Weather conditions at the time of testing are presented in Table 1.3.

Table 1.3: ATMOSPHERIC CONDITIONS

Date	Temperature (°C)	Wind Speed (m/s)	Relative Humidity (%)
26/04/2021	17	0 - 1	47

2 SOUND POWER BY SOUND PRESSURE LEVEL

Sound power levels were determined from measured sound pressure level (SPL), including octaves, third-octaves, and overall results.

2.1 Methodology

2.1.1 Test Standards

Measurement and calculation was conducted using a reduced scope version of the following:

- ISO 3744:2010 'Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane';
- AS ISO 6393:2019(E) 'Earth-moving machinery – Determination of sound power level – Stationary test conditions'; and
- ISO 6395:2008(E) 'Earth-moving machinery – Determination of sound power level noise emissions – Dynamic test conditions'.

The reduced scope uses fewer microphone positions than specified in the standards, with only ground positions used. The rationale being to increase mobility of the testing team, provide flexibility in choice of testing location, and to minimise disruption to LN operational activities.

The test is mainly used as a screening tool. A more accurate equipment sound power result obtained from full adherence to the above standards was not required. A minimum of two test runs were recorded for each plant item with the aim to have less than 1.5 dB difference between results. It is considered that the results are of sufficient accuracy and repeatability for the purpose of this survey.

Typical test areas are present in Figure 1 and Figure 2. Stationary and dynamic testing was undertaken for dozers using the ISO positions in Figure 1. The measurement is commenced and completed when the plant item (centre of) passes between microphone positions 2 & 3 and 1 & 4 respectively.

Typically for mobile plant items the test area radius ("R" in Figure 1 and 2) was 16-20m depending on equipment size and test area limitations. For stationary tests excavator, the alternate stationary microphone positions were used as presented in Figure 2. Excavator measurements were completed with a simulated dig and load cycle.

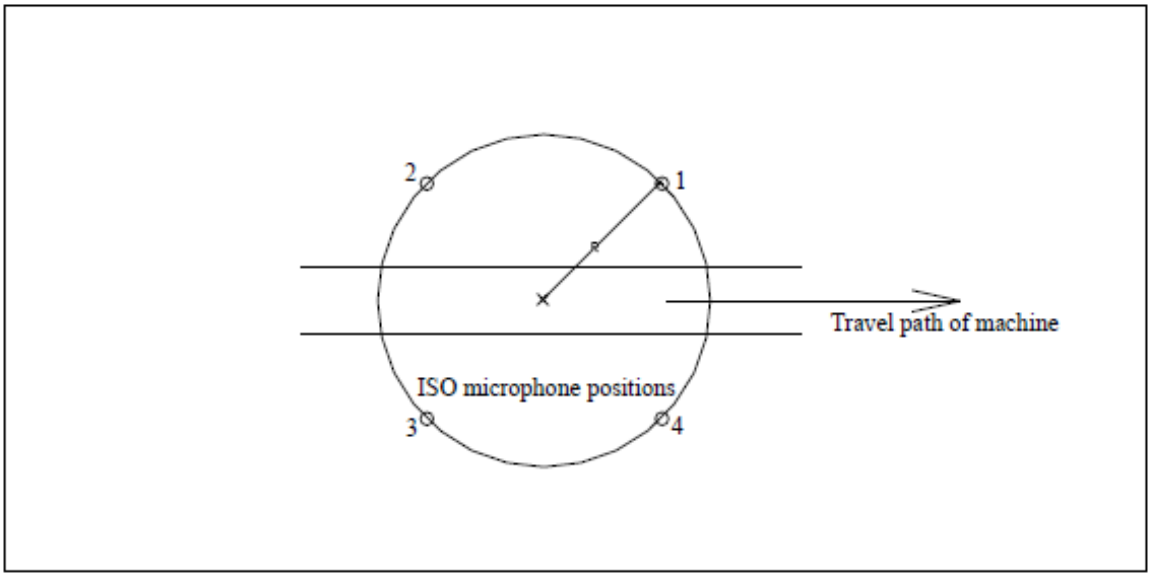


Figure 1 Sound Power Microphone Positions

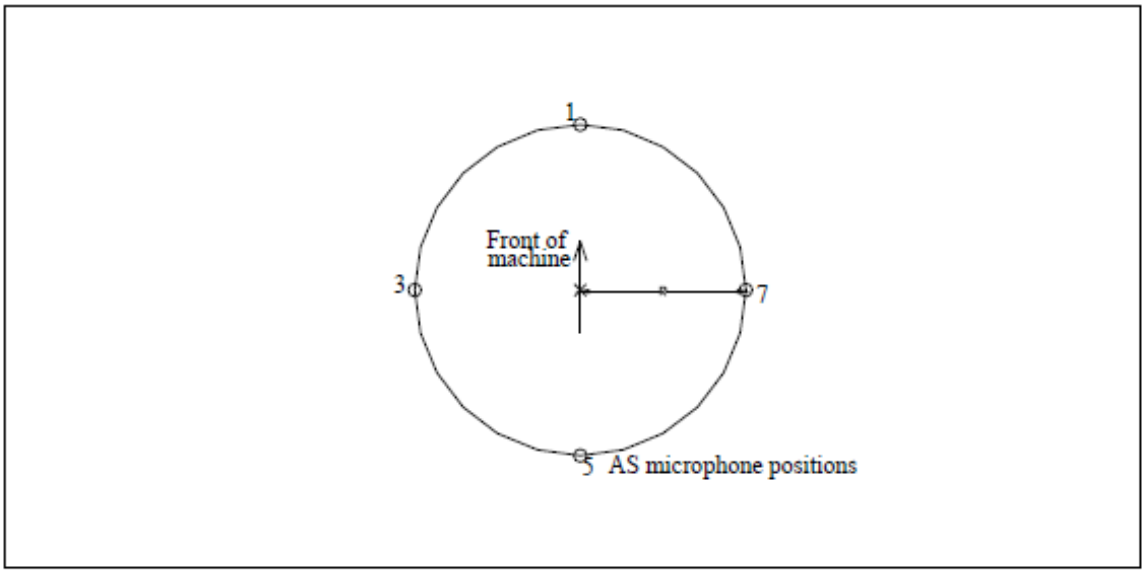


Figure 2 Alternate Stationary Sound Power Microphone Positions

2.1.2 Test Configuration

Information regarding unit configuration and conditions is provided below:

Komatsu PC300-8 Excavator

- Dynamic simulated loading test, operating at high-idle with uncontrolled engine cooling fan.

Komatsu D65EX Bulldozer

- Stationary test, operating at high-idle with uncontrolled engine cooling fan;
- Dynamic 1st gear forward test, operating at high-idle with uncontrolled engine cooling fan; and
- Dynamic 1st gear reverse test, operating at high-idle with uncontrolled engine cooling fan, reverse alarms disconnected.

Engine compartment doors and hatches were closed during all testing.

2.2 Results

Sound power determined from measured SPL are provided in Table 2.1.

Table 2.1: OVERALL SOUND POWER RESULTS (L_{eq} dB)

Unit Type	Test Condition	L_W	L_{WA}
Komatsu PC300-8	Dynamic	116	108
Komatsu D65EX	Stationary	115	103
Komatsu D65EX	Dynamic, 1st Gear Forward	116	108
Komatsu D65EX	Dynamic, 1st Gear Reverse	117	110

Notes:

1. *Sound power targets are not outlined in the Operational Environmental Management Plan 2019.*

Figures showing octave and third-octave spectrum data are provided in Appendix A.

3 SUMMARY

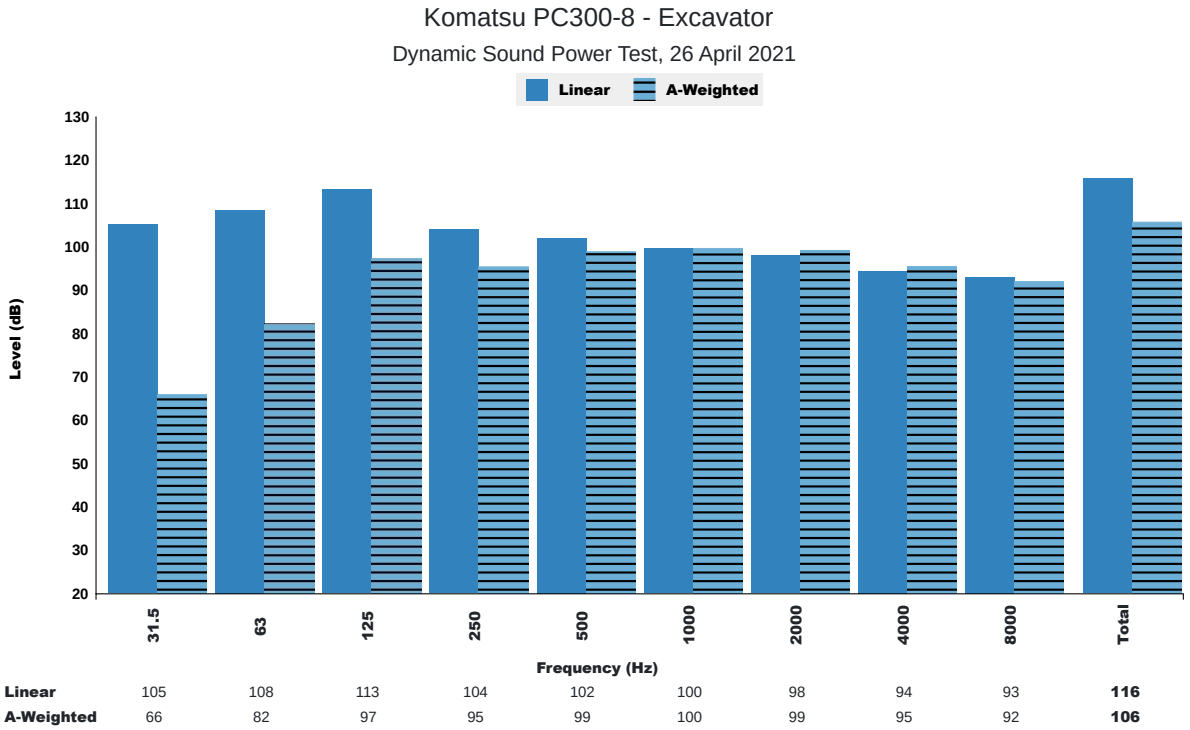
Mobile plant sound power results presented in this report are for a selection of equipment in operation at Lamberts North Ash Placement. Testing was undertaken on 26 April 2021.

We trust this information is per your requirements. Please contact us if you require further details or advice.

Global Acoustics Pty Ltd

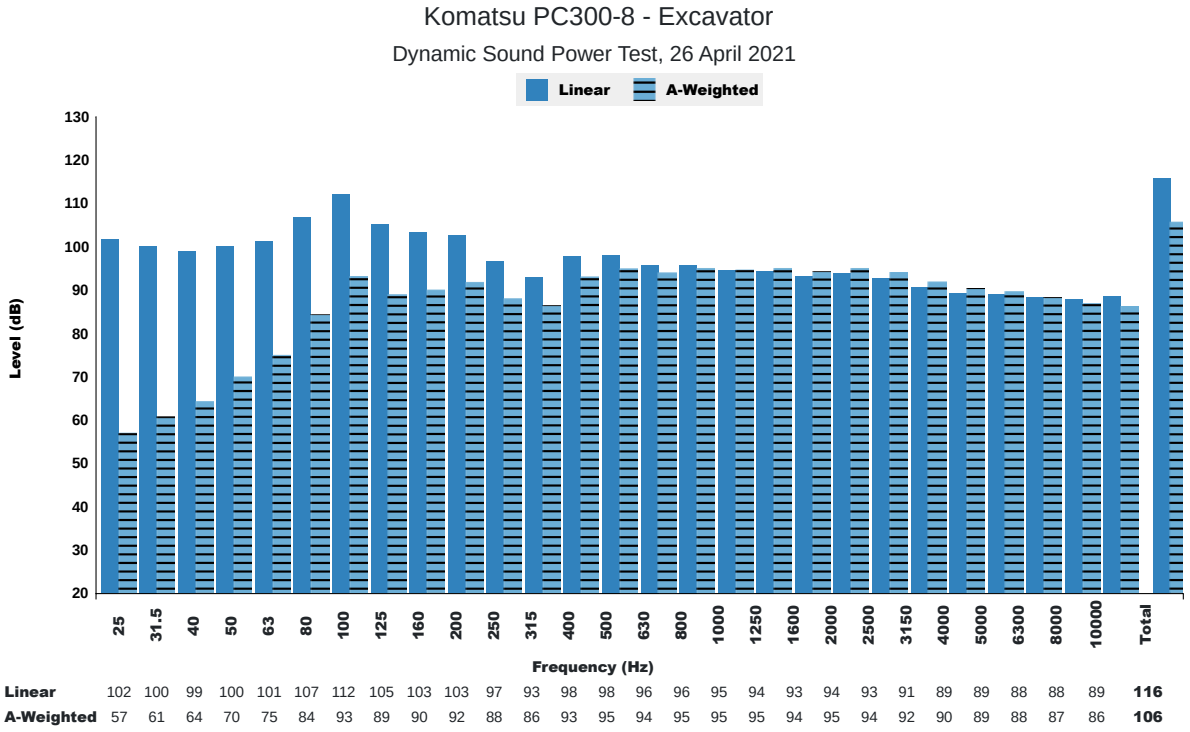
APPENDIX

A SOUND POWER BY SPL GRAPHS



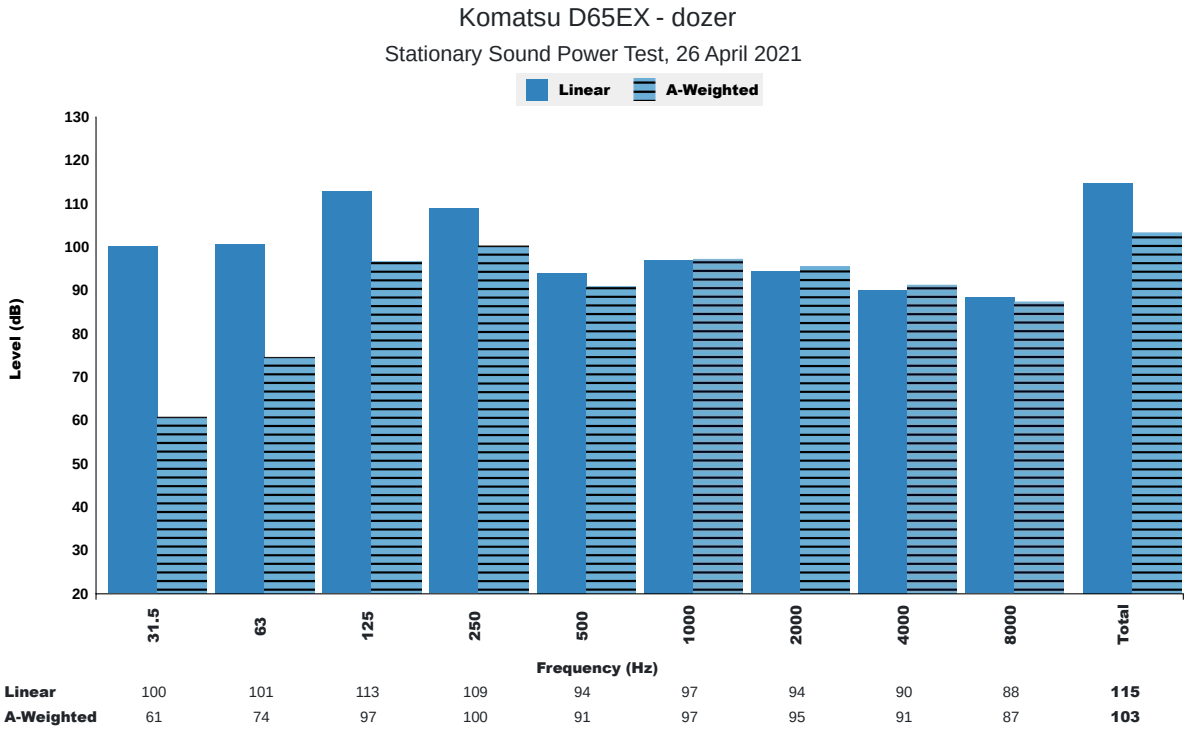
	31.5	63	125	250	500	1000	2000	4000	8000	Total
Linear	105	108	113	104	102	100	98	94	93	**116**
A-Weighted	66	82	97	95	99	100	99	95	92	**106**

Figure 1: Dynamic L_W (single octaves)



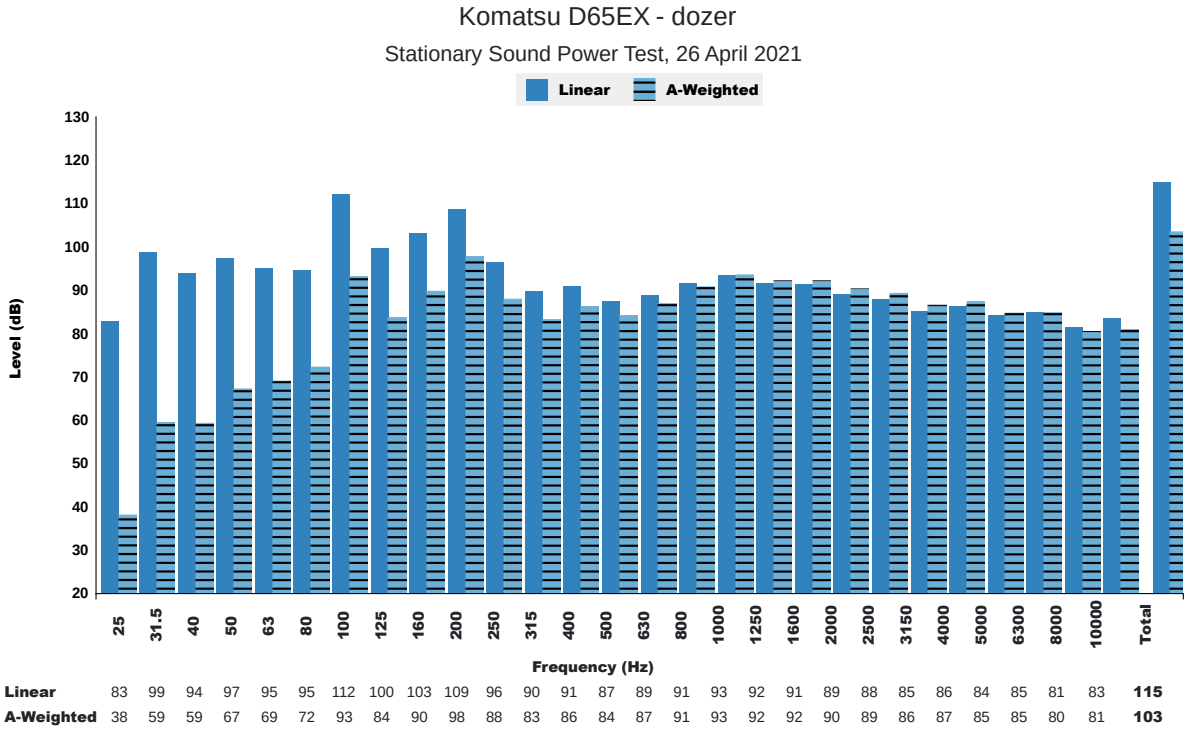
	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	Total
Linear	102	100	99	100	101	107	112	105	103	103	97	93	98	98	96	96	95	94	93	94	93	91	89	89	88	88	89	**116**
A-Weighted	57	61	64	70	75	84	93	89	90	92	88	86	93	95	94	95	95	95	94	95	94	92	90	89	88	87	86	**106**

Figure 2: Dynamic L_W (third octaves)



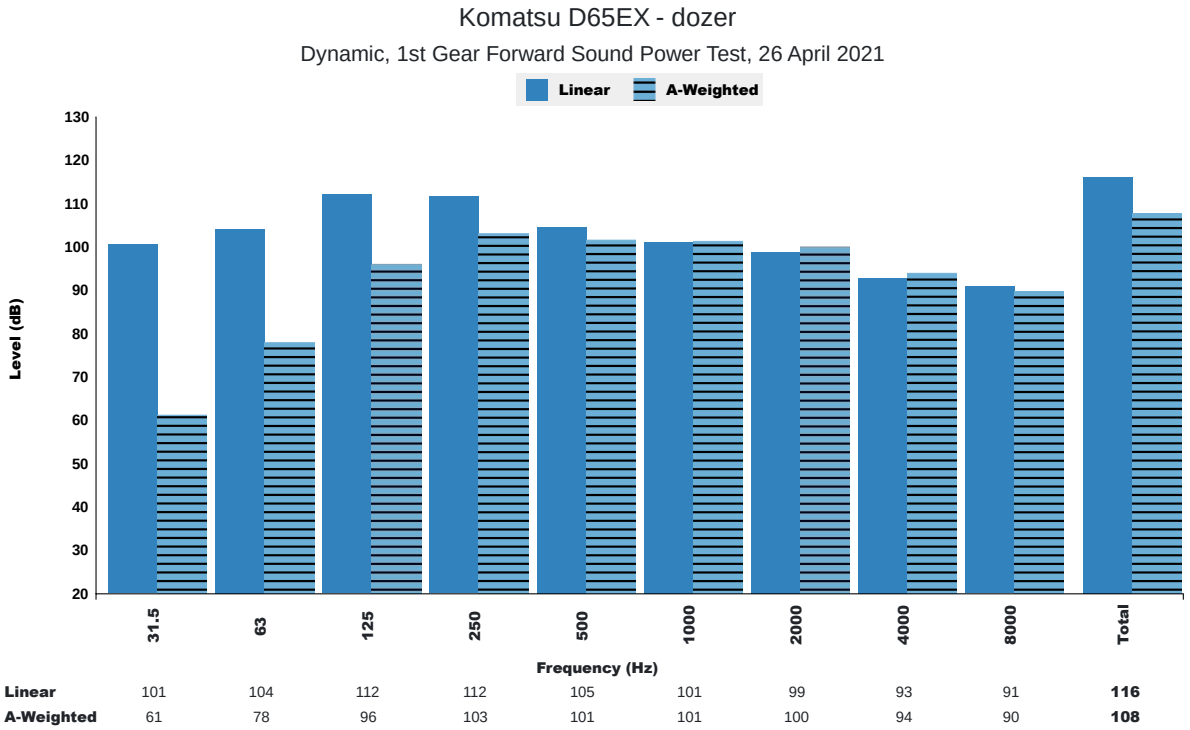
	31.5	63	125	250	500	1000	2000	4000	8000	Total
Linear	100	101	113	109	94	97	94	90	88	**115**
A-Weighted	61	74	97	100	91	97	95	91	87	**103**

Figure 3: Stationary L_W (single octaves)



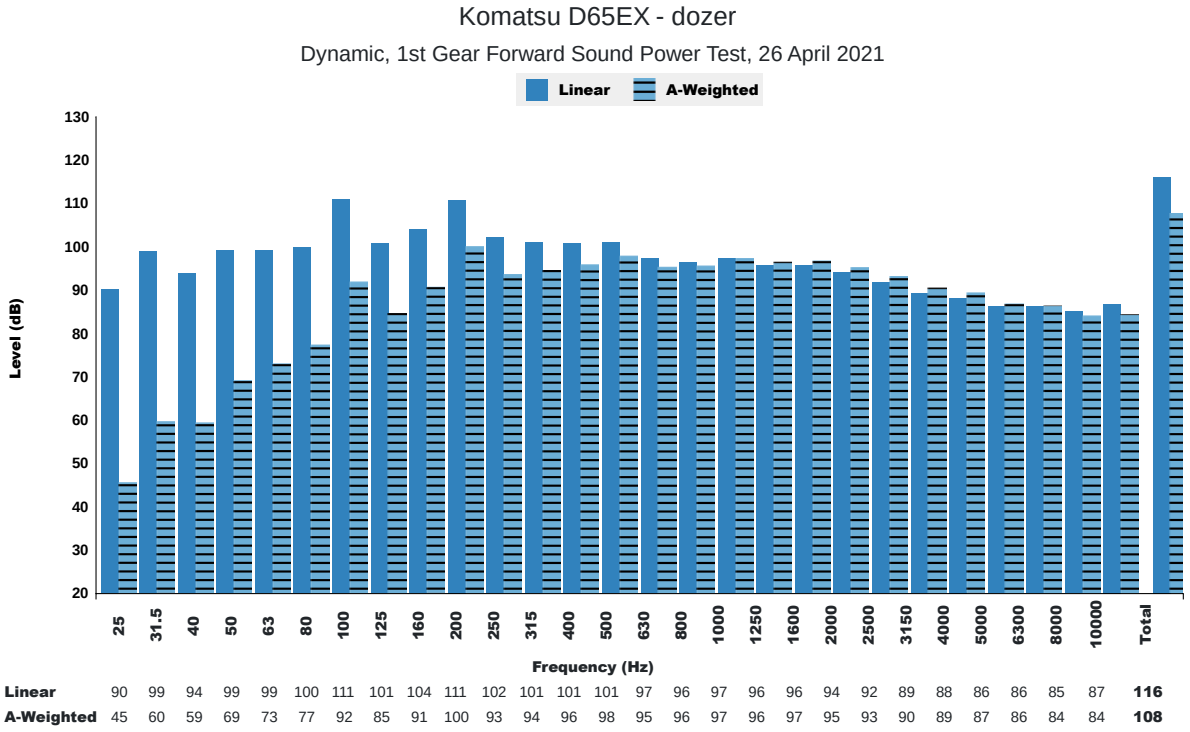
	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	Total
Linear	83	99	94	97	95	95	112	100	103	109	96	90	91	87	89	91	93	92	91	89	88	85	86	84	85	81	83	**115**
A-Weighted	38	59	59	67	69	72	93	84	90	98	88	83	86	84	87	91	93	92	92	90	89	86	87	85	85	80	81	**103**

Figure 4: Stationary L_W (third octaves)



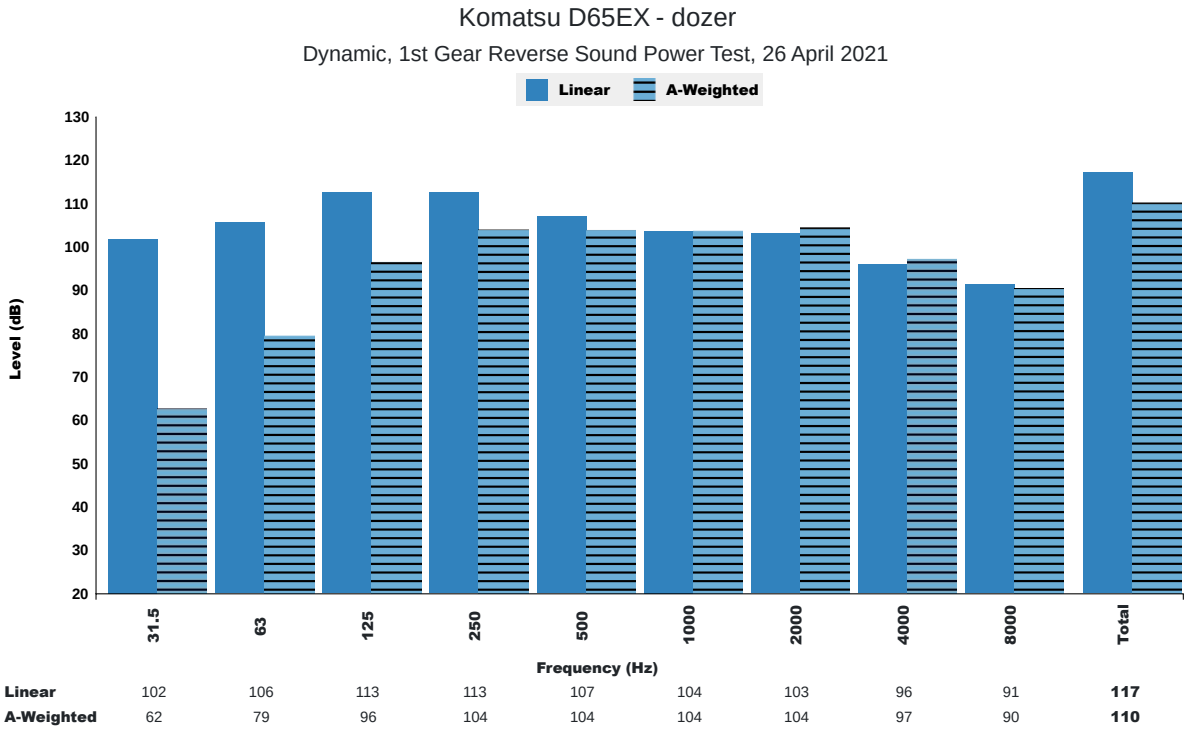
	31.5	63	125	250	500	1000	2000	4000	8000	Total
Linear	101	104	112	112	105	101	99	93	91	**116**
A-Weighted	61	78	96	103	101	101	100	94	90	**108**

Figure 5: Dynamic, 1st gear forward L_W (single octaves)



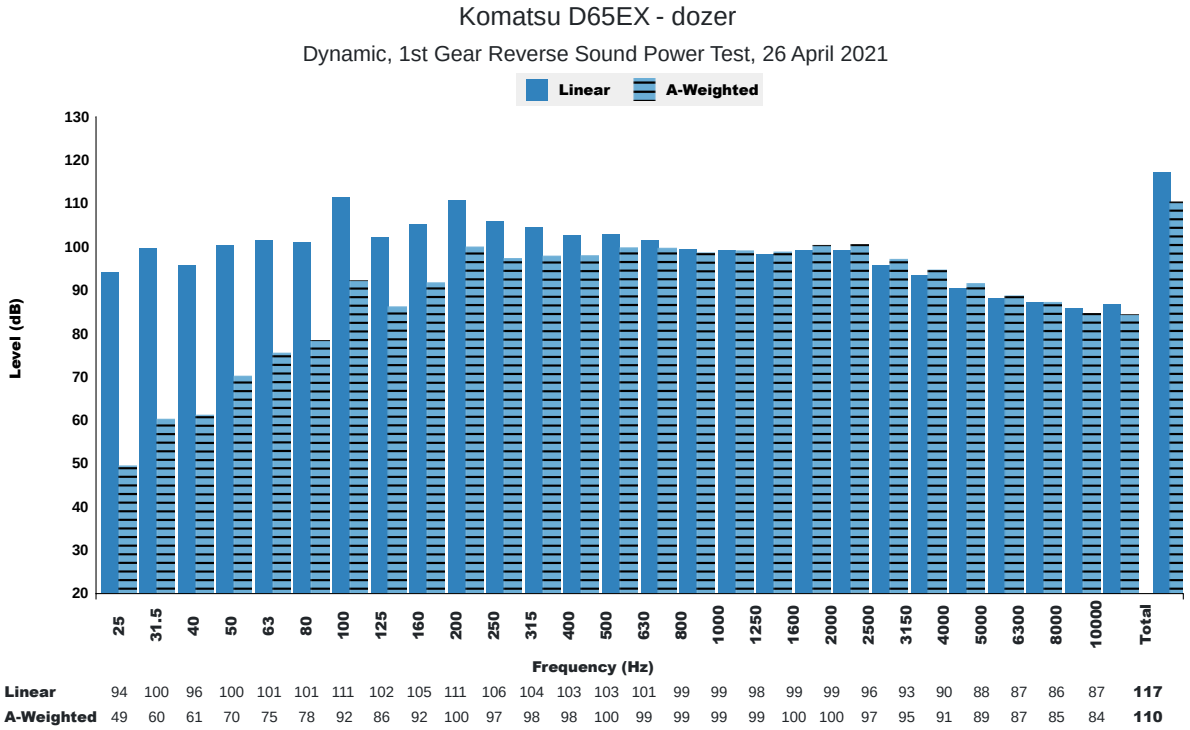
	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	Total
Linear	90	99	94	99	99	100	111	101	104	111	102	101	101	101	97	96	97	96	96	94	92	89	88	86	86	85	87	**116**
A-Weighted	45	60	59	69	73	77	92	85	91	100	93	94	96	98	95	96	97	96	97	95	93	90	89	87	86	84	84	**108**

Figure 6: Dynamic, 1st gear forward L_W (third octaves)



	31.5	63	125	250	500	1000	2000	4000	8000	Total
Linear	102	106	113	113	107	104	103	96	91	**117**
A-Weighted	62	79	96	104	104	104	104	97	90	**110**

Figure 7: Dynamic, 1st gear reverse L_W (single octaves)

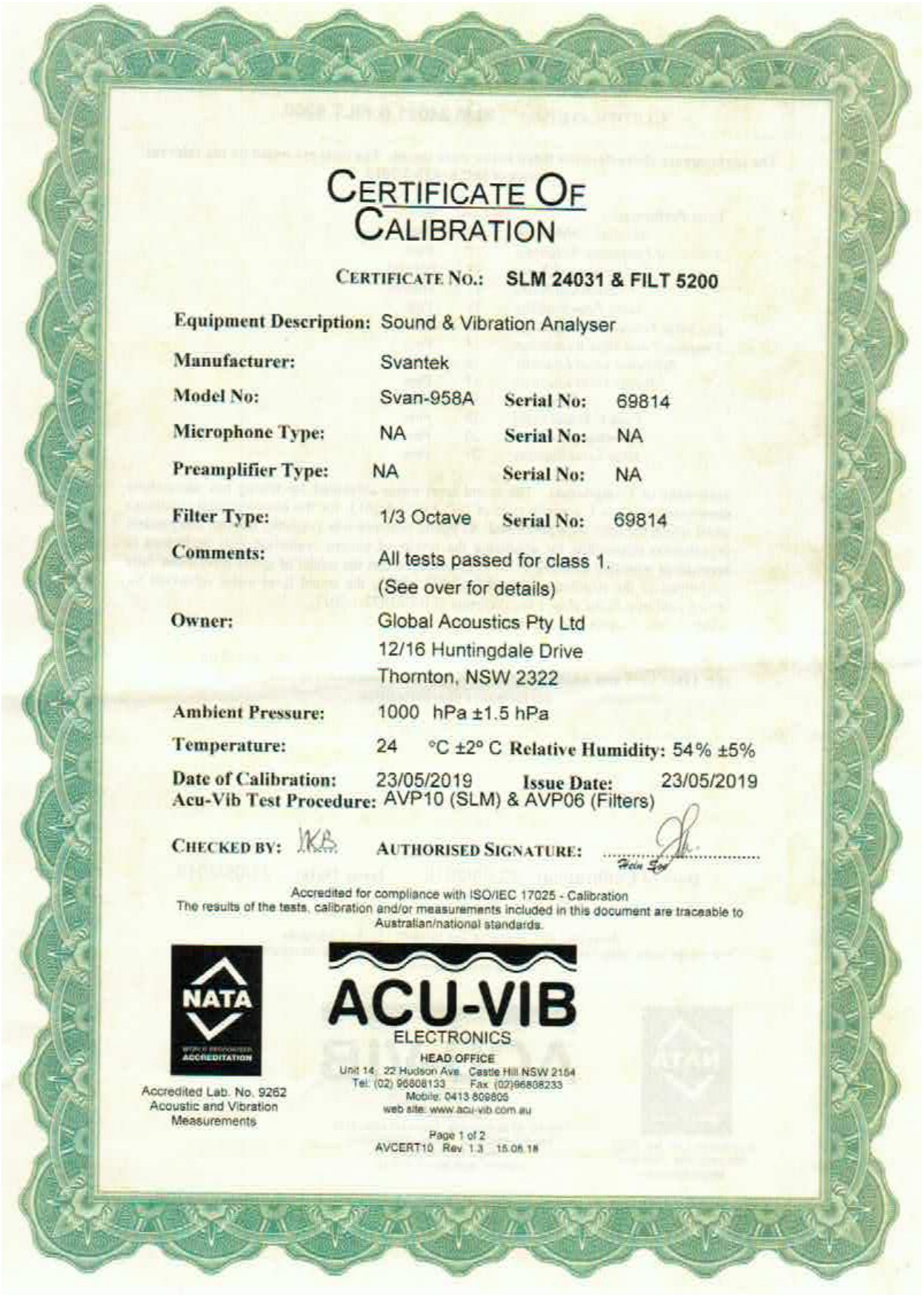


	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	Total
Linear	94	100	96	100	101	101	111	102	105	111	106	104	103	103	101	99	99	98	99	99	96	93	90	88	87	86	87	**117**
A-Weighted	49	60	61	70	75	78	92	86	92	100	97	98	98	100	99	99	99	99	100	100	97	95	91	89	87	85	84	**110**

Figure 8: Dynamic, 1st gear reverse L_W (third octaves)

APPENDIX

B CALIBRATION CERTIFICATES



CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 24031 & FILT 5200**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-958A	**Serial No:**	69814
Microphone Type:	NA	**Serial No:**	NA
Preamplifier Type:	NA	**Serial No:**	NA
Filter Type:	1/3 Octave	**Serial No:**	69814
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Global Acoustics Pty Ltd 12/16 Huntingdale Drive Thornton, NSW 2322		
Ambient Pressure:	1000 hPa ±1.5 hPa		
Temperature:	24 °C ±2° C	**Relative Humidity:**	54% ±5%
Date of Calibration:	23/05/2019	**Issue Date:**	23/05/2019
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

CHECKED BY: MKB **AUTHORISED SIGNATURE:** .....

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA ACCREDITATION

Accredited Lab. No. 9262
Acoustic and Vibration Measurements

ACU-VIB ELECTRONICS
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809805
web site: www.acu-vib.com.au

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AVCERT10 Rev. 1.3 15.06.18

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Calibrator

IEC 60942-2017

Calibration Certificate

Calibration Number C20154

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Dr
Thornton NSW 2322

Equipment Tested/ Model Number : Rion NC-74
Instrument Serial Number : 34483783

Atmospheric Conditions
Ambient Temperature : 23.3°C
Relative Humidity : 53.8%
Barometric Pressure : 101.2kPa

Calibration Technician : Lucky Jaiswal **Secondary Check:** Alannah Squires
Calibration Date : 11 Mar 2020 **Report Issue Date :** 12 Mar 2020

Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	93.99	1002.13

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.14dB*	*Temperature*	*±0.2°C*
Frequency	*±0.09%*	*Relative Humidity*	*±2.4%*
Distortion	*±0.09%*	*Barometric Pressure*	*±0.015kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

* The tests <1000 kHz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.

This calibration certificate is to be read in conjunction with the calibration test report.

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Appendix E Lamberts North Biodiversity Offset Area Flora & Fauna Monitoring Report

Lamberts North Biodiversity Offset Area
Flora and Fauna Monitoring Report 2020

Energy Australia NSW

ecological AUSTRALIA
A TETRA TECH COMPANY

1300 646 131
www.ecoaus.com.au

DOCUMENT TRACKING

Project Name	**Lamberts North Biodiversity Offset Area Flora and Fauna Monitoring Report 2020**
Project Number	**15864**
Project Manager	**Tom Kelly**
Prepared by	**Elise Keane**
Reviewed by	**Tom Kelly; Kalya Abbey**
Approved by	**Kalya Abbey**
Status	**Final**
Version Number	**v2**
Last saved on	**2 February 2021**

This report should be cited as 'Eco Logical Australia 2020. *Lamberts North Biodiversity Offset Area Flora and Fauna Monitoring Report 2020*. Prepared for Energy Australia NSW.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Energy Australia NSW

Template 2.8.1

Executive Summary

The Lamberts North Biodiversity Offset Area (BOA) is located at Thompsons Creek Reservoir and was established as per the condition of approval for the Mt Piper Power Station Ash Placement Project. The Biodiversity Offset Management Plan (BOMP) for the Lamberts North BOA details the management actions to be undertaken within the BOA to enhance habitat for native flora and fauna species through site rehabilitation and revegetation.

Eco Logical Australia (ELA) has been engaged by Energy Australia NSW (EA) to undertake biennial flora and fauna monitoring to assess the progress of management actions undertaken within the BOA, in accordance with the BOMP. This report details the results of monitoring undertaken in September 2020, which forms the third round of monitoring successfully completed to date.

The 2020 flora monitoring results demonstrated an increase in species diversity (for both native and exotic species), as well as an increase in native ground cover when compared to the baseline results from 2016. It is highly likely that the above average rainfall in the months preceding the survey influenced these results, which had followed drought conditions experienced during the 2018 monitoring period.

The 2020 fauna monitoring results showed an increase in bird species compared to those recorded in both 2016 and 2018. Two threatened bird species listed as vulnerable under the NSW Biodiversity Conservation Act 2016 (BC Act), *Calyptorhynchus lathami* (Glossy Black-Cockatoo) and *Haliaeetus leucogaster* (White-bellied Sea-Eagle), were recorded utilising the BOA. Two pest animal species, *Oryctolagus cuniculus* (European Rabbit) and *Sturnus vulgaris* (Common Starling), were also recorded within the BOA.

An assessment of revegetation works undertaken in 2017 recorded 705 successfully established seedlings from approximately 2000 originally planted. The plantings have continued to develop since the initial revegetation works assessment in 2018, with the species composition and stem density characteristic of a native locally occuring woodland.

An assessment of the natural regeneration of canopy species within the BOA recorded five canopy species naturally regenerating, with a total abundance of 49 individuals. The occurrence of canopy seedlings adjacent to remnant vegetation provides a positive indication of the capacity of the BOA to naturally regenerate to a native woodland and contribute to the long-term re-establishment of native fauna habitat.

Contents

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Abbreviations

Abbreviation	Description
BC Act	NSW *Biodiversity Conservation Act 2016*
BOA	Biodiversity Offset Area
BoM	Bureau of Meteorology
BOMP	Biodiversity Offset Management Plan
EA	Energy Australia NSW
ELA	Eco Logical Australia Pty Ltd
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ha	hectare
LWD	Large Woody Debris

1. Introduction

Eco Logical Australia (ELA) was engaged by Energy Australia NSW (EA) to undertake flora and fauna monitoring at the Lamberts North Biodiversity Offset Area (BOA). The BOA was established as a requirement of Project Approval 09_0186 for the Mt Piper Power Station Lamberts North Ash Placement Project.

The Lamberts North BOA is located at Thompsons Creek Reservoir, 14 km north-west of Lithgow, comprising 6.8 ha, including:

- 4.7 ha of Lot 243 of DP 801915
- 2.1 ha of Lot 432 of DP 801915.

EA developed a Biodiversity Offset Management Plan (BOMP) for the Lamberts North BOA (Energy Australia, 2019) as per Schedule 2 Condition B6 of the Project Approval, which sets out the management actions to be undertaken within the BOA.

The objective of the flora and fauna monitoring program is to measure the progress of management actions undertaken within the Lamberts North BOA to enhance habitat for native flora and fauna, including threatened species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and NSW *Biodiversity Conservation Act 2016* (BC Act). The monitoring program also allows for the identification of any management issues requiring attention within the BOA and provides recommendations for addressing such issues. The 2020 monitoring forms the third round of data collection within the BOA, following baseline monitoring conducted in 2016 and subsequent monitoring in 2018 (ELA 2016 and ELA 2018).

2. Methodology

Flora and fauna survey methodologies utilised by ELA during the biodiversity monitoring were consistent with those outlined in section 3.9 of the BOMP.

2.1 Floristic monitoring

Four floristic monitoring plots that were established during 2016 were re-surveyed during spring 2020 (three sites within the BOA and one analogue site – site locations are shown in **Appendix A**). The floristic survey at each site included:

- Full floristic surveys of a 20m x 20m plot recording all vascular plant species within the plot
- Biometric plot data using the BioBanking assessment methodology within a 20m x 50m plot which included an assessment of:
  - Native species richness - within 20 m x 20 m flora plot
  - Native tree cover and native mid-storey cover – at regular 5 m intervals along 50 m transect (10 points)
  - Native ground (grass, shrub, other) and exotic cover – at regular 1 m intervals along 50 m transect (50 points)
  - Habitat features (number of trees with hollows, length of fallen logs) and proportion of over-storey species regeneration – within 20 m x 50 m plot.

2.2 Fauna monitoring

In accordance with the requirements of the BOMP and consistent with best practice and relevant guidelines and standards, fauna surveys were undertaken to provide an inventory of fauna species within the BOA.

Two fauna sites were surveyed within the BOA. Fauna surveys were focused on species which are good indicators of improvements in habitat structure, with birds being the primary focus. Other fauna assemblages were also recorded opportunistically to inform general site diversity. Two monitoring sites established in 2016 were re-surveyed during spring 2020, with their locations shown in **Appendix A**. **Table 1** below provides the survey methods undertaken at each of the fauna monitoring sites.

Table 1: Fauna methodology

Method	Detail	Requirement per Site
Bird survey	Timed, fixed area surveys for diurnal birds, observing and listening.	20 minute count morning and afternoon over 2 days
Opportunistic Observations	Opportunistic observations recorded for all birds, mammals, reptiles and amphibian species observed. Any evidence of scats, scratchings and digging recorded with all evidence of feral animal activity noted and recorded with a GPS.	Opportunistic

2.3 Revegetation assessment

Field survey of revegetated areas within the BOA was undertaken to assess the success or failure of the revegetation program undertaken to date. The revegetation assessment involved traversing the area and recording the following:

- Plant species that have established
- Presence of exotic weed infestations
- Evidence of feral animals (scats, prints, burrows/warrens)
- Surface stability and erosion issues

All occurrences of successful revegetation were recorded using a handheld GPS. Recommendations for future revegetation works are included in this report.

2.4 Natural regeneration assessment

Field survey of areas of natural regeneration within the BOA was undertaken to assess and map the continued development of natural regeneration within the BOA. The natural regeneration assessment involved traversing the area and recording the following:

- All occurrences of native canopy species regeneration identified to species level in two stem size classes (<5 cm; 5-15 cm – diameter at breast height), mapped using a handheld GPS
- Any evidence of weed or pest animal interference with natural regeneration.

3. Results

3.1 Weather conditions

The monitoring was undertaken on Monday 7 and Tuesday 8 September 2020 by ELA ecologists Tom Kelly and Elise Keane.

The weather data presented below in **Table 2** was taken from the Bureau of Meteorology's Lithgow weather station, 14 km south-east of the BOA (BOM, 2020). The weather conditions during the survey were warm, with low cloud cover on both days. In the three and six-month periods preceding the monitoring, the Lithgow region experienced above average rainfall (BOM, 2020).

Table 1: Weather observations throughout the monitoring period

Date	Minimum Temperature (°C)	Maximum Temperature (°C)	Rain (mm)	Relative Humidity (%)	Cloud Cover (%)	Wind Direction	Wind Speed at 9am (km/h)
07/09/2020	6.4	20.0	0	78	0	NNE	2
08/09/2020	1.8	19.8	0.1	66	3	NNW	7

3.2 Floristic Monitoring

A full list of flora species recorded within the Lamberts North BOA is included in **Appendix E**.

3.2.1 Species richness

A total of 63 flora species (43 native species, 20 exotic species) were recorded across all floristic monitoring sites. All four sites had similar total species richness ranging from 26 to 35 species, whilst native species richness ranged from 15 to 27 species (**Table 3)**. Higher native species richness was recorded at the Analogue site (TD4), reflecting the remnant vegetation present at the site. Overall, species richness increased at all sites compared to previous monitoring, which is to be expected given the above average rainfall experienced across the region prior to the survey being undertaken (**section 4.1**).

Table 2: Total, native and exotic species richness across floristic monitoring sites

Site	Total species richness	Native species richness	Exotic species richness
TD1	30	19	11
TD2	27	15	12
TD3	26	17	9
TD4	35	27	8

3.2.2 Vegetation structure

Vegetation structure data (incorporating the height range and percentage foliage cover of all structural layers within each monitoring site) is presented below in **Table 3**. The absence of canopy (upper-storey) and midstorey species across the majority of the BOA is the main limiting factor for vegetation structure, however, a native upper stratum was present within two monitoring sites (TD1 and TD4) and is developing through eucalypt plantings, at or directly adjacent to the remaining two sites (TD2 and TD3).

Table 3: Vegetation structure of BOA floristic monitoring sites

Site Number	Stratum	Lower Height (m)	Upper Height (m)	Foliage Cover (%)	Dominant Species
TD1	U	4	8	4	*Eucalyptus mannifera, Eucalyptus pauciflora*
	M	0.3	0.5	0.2	*Eucalyptus spp.* (plantings)
	L1	0.01	0.1	30	*Microlaena stipoides, Phalaris aquatica, Rytidosperma sp.*
	L2	0.01	0.2	10	*Hypochaeris radicata, Acetosella vulgaris, Cynoglossum australe*
TD2	L1	0.01	0.1	40	*Rytidosperma sp., Microlaena stipoides, Phalaris aquatica*
	L2	0.01	0.5	6	*Acetosella vulgaris, Cynoglossum australe, Hypochaeris radicata*

Site Number	Stratum	Lower Height (m)	Upper Height (m)	Foliage Cover (%)	Dominant Species
TD3	M	0.4	3	1	*Eucalyptus spp.* (plantings), *Acacia dealbata*
	L1	0.01	0.2	55	*Microlaena stipoides, Panicum effusum, Rytidosperma* spp.
	L2	0.01	0.3	10	*Lomandra* spp., *Hypochaeris radicata, Acetosella vulgaris*
TD4	U	8	15	30	*Eucalyptus dives, Eucalyptus mannifera, Allocasuarina littoralis*
	L1	0.01	0.2	15	*Microlaena stipoides, Rytidosperma* sp., *Austrostipa bigeniculata*
	L2	0.01	0.5	20	*Lomandra* spp., *Hydrocotyle laxiflora, Lepidosperma sp.*

U = upper-storey; M = midstorey; L1 / L2 = lower-storey

3.2.3 Exotic species and cover

A total of 19 exotic species were recorded across the four floristic monitoring sites during 2020 monitoring. These exotic species include both annual and perennial species, with both classes of species increasing in their abundance compared to 2018 monitoring, where only a total of five exotic species were recorded. Exotic cover ranged from 0% at site TD4 to 46% at site TD2 and overall was consistent with 2018, with the exception of site TD1 which increased from 16% to 34%. Three species listed as priority weeds under the *Central Tablelands Regional Strategic Weed Management Plan 2017-2022* (Central Tablelands LLS 2017) were recorded in the BOA, *Hypericum perforatum* (St John's Wort), *Rubus fruticosus* sp. aggregate (Blackberry) and *Nassella trichotoma* (Serrated Tussock). Both Blackberry and Serrated Tussock were previously recorded in the BOA during baseline monitoring in 2016, however, were not recorded during 2018 monitoring, likely due to the drought conditions preceding the 2018 survey, along with weed control works undertaken by EA. St John's Wort had not been previously recorded within the BOA, however, was only present in the form of two individual plants at one monitoring site (TD2) and was not recorded opportunistically across other areas within the BOA.

3.3 Fauna Monitoring

3.3.1 Bird Surveys

A total of 27 individual species were recorded during the bird surveys completed as part of 2020 monitoring. This included one species listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act), *Haliaeetus leucogaster* (White-bellied Sea-eagle).

Both species diversity and abundance were similar across both fauna monitoring sites and both morning and afternoon survey periods, as evidenced by the results tabulated below in **Table 5** and **Table 6**. *Acanthiza chrysorrhoa* (Yellow-rumped Thornbill) was the most commonly recorded species, recorded at both sites during all survey periods and in highest total abundance (18 individuals). Whilst the overall

assemblage of bird species recorded during the surveys is indicative of the mostly cleared nature of the BOA, a range of native woodland bird species were recorded including multiple individuals of *Acanthiza lineata* (Striated Thornbill, 12 individuals) and *Lichenostomus chrysops* (Yellow-faced Honeyeater, 16 individuals) (see **Appendix F**). One pest bird species, *Sturnus vulgaris* (Common Starling) was recorded within the BOA, with a total of 12 individuals of this priority pest species recorded (Central Tablelands Local Land Services 2018).

Table 4: Bird survey species diversity results

Site	Species diversity		
	Morning survey	Afternoon survey	Total
Fauna 1	16	15	21
Fauna 2	14	11	17

Table 5: Bird survey bird abundance results

Site	Bird abundance		
	Morning survey	Afternoon survey	Total
Fauna 1	54	44	98
Fauna 2	41	41	82

3.3.2 Opportunistic Observations

An additional ten bird species were recorded opportunistically within the BOA, along with four mammal and three amphibian species. These were identified through direct observation and identification of scats, tracks and calls. *Calyptorhynchus lathami* (Glossy Black-Cockatoo), listed as vulnerable under the BC Act, was identified through chewings of *Allocasuarina littoralis* (Black She-oak) fruit.

Macropus giganteus (Eastern Grey Kangaroo) was recorded frequently across the BOA, along with the previously recorded priority pest *Oryctolagus cuniculus* (European Rabbit) (Central Tablelands Local Land Services 2018). Given the increased ground cover resulting from above average rainfall, there was no indication that either species was applying grazing pressure within the BOA.

A list of all fauna observed during monitoring is included in **Appendix F**. Locations of threatened and pest species observations are displayed in **Appendix B**.

3.4 Revegetation assessment

Revegetation works undertaken across the BOA in 2017 included planting of approximately 2,000 seedlings. Assessment of the plantings identified a total of 705 successfully established seedlings across both the eastern and western portions of the BOA subject to revegetation works. **Table 7** outlines the revegetation species planted in 2017 and whether they were still alive and present in the planting area, with 10 of the 15 species originally planted recorded during 2020 monitoring. **Table 8** lists the species which have successfully established in the planting area along with their respective abundance.

The results listed in both **Table 7** and **Table 8** indicate that of the species planted, the eucalypts, including key canopy species characteristic of the surrounding vegetation communities, have been most

successful in establishing. Several species were recorded in the planting area which were not included in the revegetation species list, most notably *Eucalyptus melliodora* (Yellow Box).

The plantings appear to have responded well to the above average rainfall experienced within the region following a prolonged period of drought, with most plantings above 1 m in height and multiple *Acacia falciformis* (Mountain Hickory) and *Eucalyptus mannifera* (Brittle Gum) individuals exceeding 3 m in height. Despite the presence of exotic species, including perennial pasture species across the planting area, there was no evidence that they are impacting upon the development of the plantings and no erosion or surface stability issues were recorded in the BOA.

Table 6: Revegetation species list

Scientific Name	Common Name	Presence
Eucalyptus dives	Broad-leaved Peppermint	✓
Eucalyptus mannifera	Brittle Gum	✓
Eucalyptus viminalis	Ribbon Gum	✓
Eucalyptus pauciflora	Snow Gum	✓
Eucalyptus dalrympleana	White Gum	✓
Eucalyptus goniocalyx	Long-leaved Box	x
Acacia falciformis	Mountain Hickory	✓
Exocarpos strictus	Dwarf Cherry	x
Pultenaea microphylla		✓
Dillwynia phylicoides		x
Acacia irrorata subsp. *Irrorata*	Green Wattle	x
Acacia dealbata	Silver Wattle	✓
Lissanthe strigosa	Peach Heath	✓
Leucopogon pilifer	Thready Beard-heath	✓
Indigofera australis	Australian Indigo	x

Table 7: Revegetation assessment results

Scientific Name	Common Name	Abundance
Eucalyptus dives / Eucalyptus dalrympleana	Broad-leaved Peppermint / White Gum	60
Eucalyptus mannifera	Brittle Gum	108
Eucalyptus viminalis	Ribbon Gum	245
Eucalyptus pauciflora	Snow Gum	72
Eucalyptus melliodora	Yellow Box	94
Eucalyptus sp.		83
Hardenbergia violacea	False Sarsaparilla	2

Scientific Name	Common Name	Abundance
Pultenaea microphylla		5
Acacia dealbata	Silver Wattle	9
Acacia falciformis	Mountain Hickory	21
Acacia implexa	Hickory Wattle	5
Leucopogon pilifer	Thready Beard-heath	1
Total		**705**

3.5 Natural regeneration assessment

Assessment of the natural regeneration of canopy species within the BOA identified a total of five canopy species as naturally regenerating, with a total abundance of 49 individual seedlings present (**Table 9**). *Eucalyptus viminalis* (Ribbon Gum) was the most successful regenerating canopy species, with 29 individuals recorded.

Table 8: Natural regeneration assessment results

Scientific Name	Common Name	Abundance
Eucalyptus dives	Broad-leaved Peppermint	12
Eucalyptus mannifera	Brittle Gum	1
Eucalyptus pauciflora	Snow Gum	29
Eucalyptus viminalis	Ribbon Gum	6
Eucalyptus sp.		1
Total		**49**

4. Discussion and Recommendations

4.1 Floristic monitoring

When compared to the monitoring results obtained in 2018, total species diversity has increased across all four monitoring sites, with 63 species recorded in 2020 compared with 38 species in 2018. This is also an increase compared to the baseline results obtained in 2016, where 58 species were recorded. Native species richness recorded in 2020 was also the highest recorded across all floristic monitoring sites, compared with 2016 and 2018 monitoring (**Figure 1**). Exotic ground cover results from 2016 to 2020 are variable, however, a general declining trend is visible at all monitoring sites with the exception of TD1 (**Figure 2**). Given the BOA's history of disturbance, seasonal fluctuations in exotic ground cover are likely to continue, and as more data is collected during subsequent monitoring periods, greater insight into the patterns of both exotic and native will be possible.

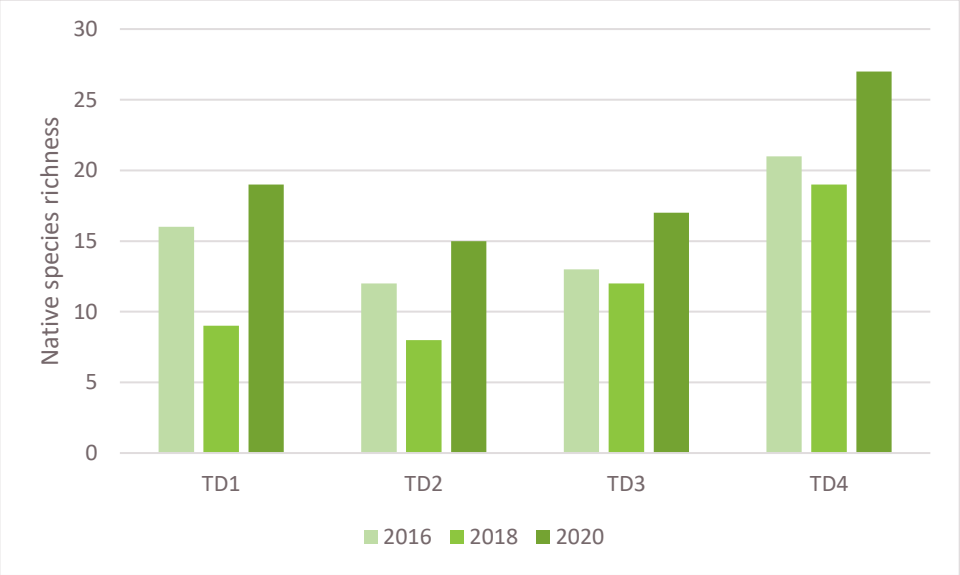

Figure 1: Native species richness at floristic monitoring sites

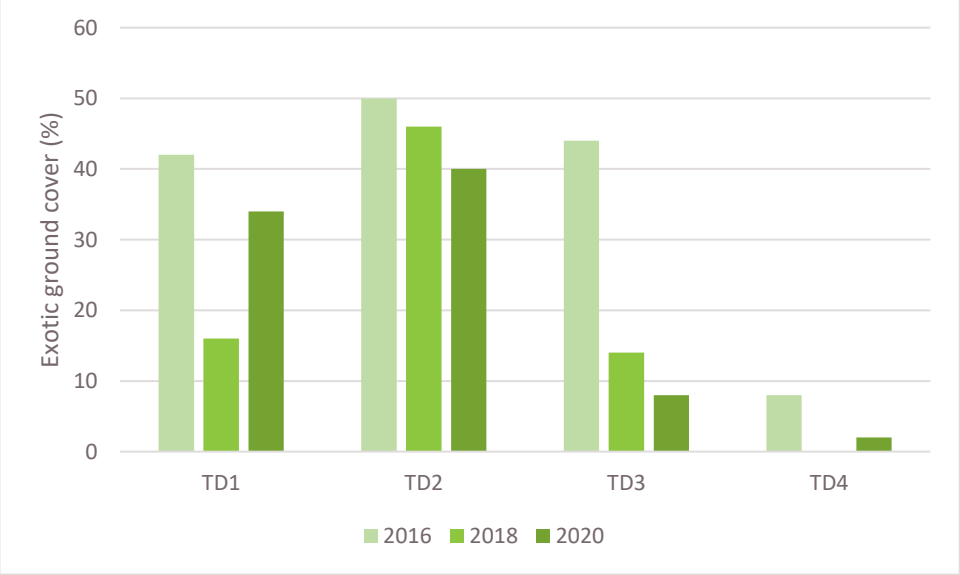

Figure 2: Exotic ground cover at floristic monitoring sites

Three listed weed species, Blackberry, Serrated Tussock and St John's Wort were recorded in the BOA. Both St John's Wort and Serrated Tussock were recorded at only one location, whilst Blackberry was scattered throughout the western portion of the BOA (see **Appendix B**), as was observed during 2016 monitoring. Targeted herbicide application is recommended for these listed weed species, with manual removal of Blackberry also recommended post-herbicide treatment to avoid the potential of re-shooting.

4.2 Fauna monitoring

Bird species richness recorded during 2020 bird surveys showed an increase at both sites compared to both 2016 and 2018 monitoring results, with 27 species recorded in 2020, compared to 19 species in 2016 and 17 species in 2018 (**Figure 3**). The overall bird species richness (including opportunistically recorded species) was also higher than previous years, with a total of 37 species recorded overall in 2020, compared to 26 species recorded during both 2016 and 2018. This included seven species of previously unrecorded native woodland birds, including the threatened Glossy Black-Cockatoo (**Appendix B**) and more common species such as Red Wattlebird (**Appendix G**).

There were no reptile species recorded (opportunistically) throughout monitoring. At present, there is limited habitat available for reptile and other ground-dwelling fauna in the form of large-woody debris (LWD) or surface rock.

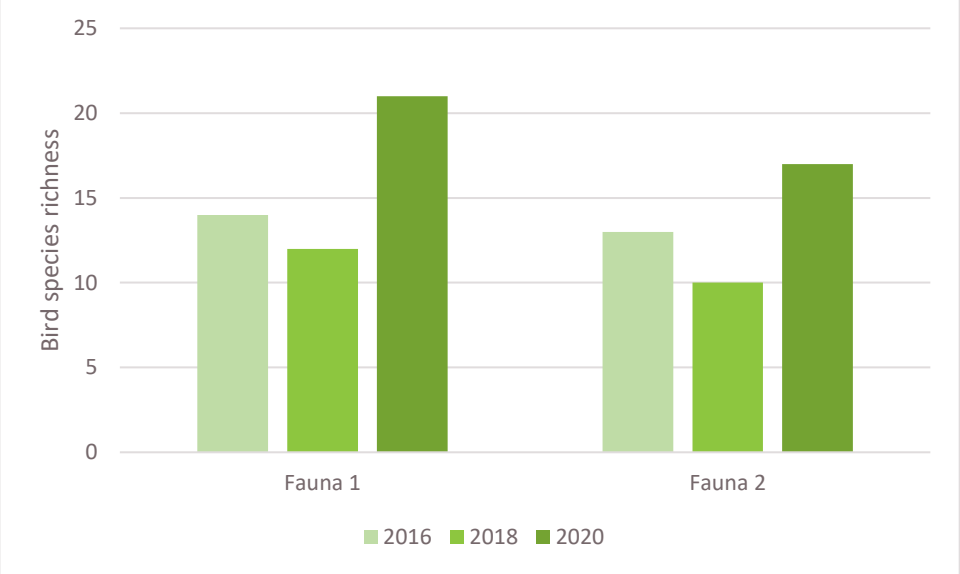

Figure 3: Bird species richness at fauna monitoring sites, 2016-2020

4.3 Revegetation assessment

The revegetation works conducted within the BOA have developed substantially since their initial assessment in 2018. The 2020 assessment recorded a total of 705 successfully established plants, representing an increase of 158 plants from the 547 individuals recorded in 2018. The growth of the plantings has also been substantial since 2018 where the majority of plantings were <0.5 m in height, compared to the present height of the majority of plants which exceed 1 m, including multiple individuals from several species which are >3 m in height. Additionally, the density and species composition of the plantings is consistent with surrounding native remnant vegetation. Whilst exotic

species are present within the revegetation area, they are not limiting the continued development of the plantings.

A direct seeding revegetation program was undertaken following the completion of 2020 monitoring and will be assessed during the next round of monitoring in 2022. The presence of European Rabbits requires ongoing management in line with the BOMP, particularly to reduce potential grazing pressure from this species on the recent direct seeding revegetation works.

4.4 Natural Regeneration assessment

Natural regeneration of native, locally indigenous canopy species continues to develop within the BOA, with a total of 49 seedlings from five canopy species recorded. The species recorded naturally regenerating in 2020 is consistent with those recorded in 2016, with the exception of *Acacia dealbata* (Silver Wattle) which was not included in the 2020 assessment (though it is noted that this species is naturally regenerating extensively across the BOA). The total abundance of natural regeneration has decreased slightly since 2016 (68 seedlings recorded), with this likely a result of dieback following extensive drought conditions between the 2016 and 2020 monitoring periods.

Consistent with the pattern of natural regeneration observed throughout central west NSW, seedlings are concentrated around remnant trees and patches within and bordering the BOA and it is recommended that these areas be allowed to continue to develop without management intervention (i.e. revegetation). Whilst exotic species are present within areas undergoing natural regeneration, they are not limiting the capacity of the BOA to naturally regenerate.

4.5 Assessment of Performance and Completion Criteria

Table 6 of the BOMP provides the performance and completion criteria for key management actions undertaken within the BOMP, with **Table 9** below providing an assessment of the relevant criteria against the results of 2020 monitoring.

Table 9: Assessment of BOMP performance and completion criteria

Action	Management Action	Performance criteria	Completion criteria	Comment
Vertebrate pest control	Undertake vertebrate pest control program	Vertebrate pests eradicated and no non-target species affected	Levels of vertebrate pests do not pose a risk to revegetation works	**Control of European Rabbit recommended to minimise grazing pressure on recent direct seeding.**
	Monitor pest animal populations	Undertake biannual inspections Complete biennial monitoring	Monitoring is ongoing, to determine continuing effectiveness of control program	**One (1) European Rabbit recorded during monitoring and burrow identified.**
Weed control	Ongoing inspections and monitoring of BOA for weed presence	Undertake biannual inspections and biennial monitoring	Ongoing inspections and monitoring to determine continuing effectiveness of treatment	**Three listed weed species, Blackberry, Serrated tussock and St John's Wort recorded during monitoring.**
	Treat any state or regional priority weeds observed	Control of serrated tussock and blackberry in BOA Records of treatment retained	No listed weeds present within BOA No areas of high density weed infestations present which limit regeneration/ revegetation of the BOA	**Targeted herbicide treatment of the above three listed species recommended.** **Weeds / exotic species are not limiting the development of revegetation / regeneration.**
Assisted Natural Regeneration	Assist natural regeneration through weed and pest animal management strategies	Undertake weed and pest animal inspections and monitoring Control weed and pest animal levels to reduce competition and grazing pressure	Weed and pest animals controlled to a level that does not impact on natural regeneration	**Weed and pest animal presence is not limiting the development of natural regeneration. Listed weed and pest species recorded are recommended for management.**
	Monitor natural regeneration	Natural regeneration levels recorded during biennial monitoring	Monitoring records continued development of natural regeneration and identifies any requirement for management intervention	**Natural regeneration of 49 seedlings from five canopy species recorded throughout the BOA.**
Active revegetation	Undertake direct seeding	No plantings in the 30 m buffer zone commencing at the edge of the high water mark or 10 m buffer zone from natural regeneration areas	Establishment of locally native species at a density greater than 160 stems/ha	**Direct seeding has been undertaken post-monitoring in 2020.**
	Monitoring of revegetated works	Undertake biennial monitoring	Monitoring confirms establishment of native species and densities consistent with the surrounding vegetation communities	**A total of 705 successfully established native and locally indigenous plantings recorded. Plantings have developed substantially since 2018, having increased in abundance and size.**

Action	Management Action	Performance criteria	Completion criteria	Comment
Re-establishment of fauna habitat	Re-establish fauna habitat through assisted natural regeneration and active revegetation of the BOA	Re-establishment of native woodland consistent with surrounding vegetation communities	Establishment of locally native species at a density greater than 160 stems/ha	**Direct seeding has been undertaken post-monitoring in 2020.** **2020 bird monitoring recorded a range of native woodland bird species, including seven species not previously recorded.**
Offset Monitoring	Undertake flora monitoring	Establish permanent monitoring plots and undertake baseline monitoring Biennial floristic monitoring undertaken	Ongoing flora monitoring completed and results reported and implemented for adaptive management of the BOA	**Biennial monitoring successfully completed for 2020.**
	Undertake fauna monitoring	Undertake baseline monitoring Develop a list of key indicator bird species representative of improvements in habitat structure Undertake biennial systematic fauna monitoring, focusing on bird surveys, as well as opportunistic observations	Ongoing fauna monitoring completed and results reported and implemented for adaptive management of the BOA	**Biennial monitoring successfully completed for 2020.** **Indicator bird species list to be developed once additional data is captured in future monitoring.**

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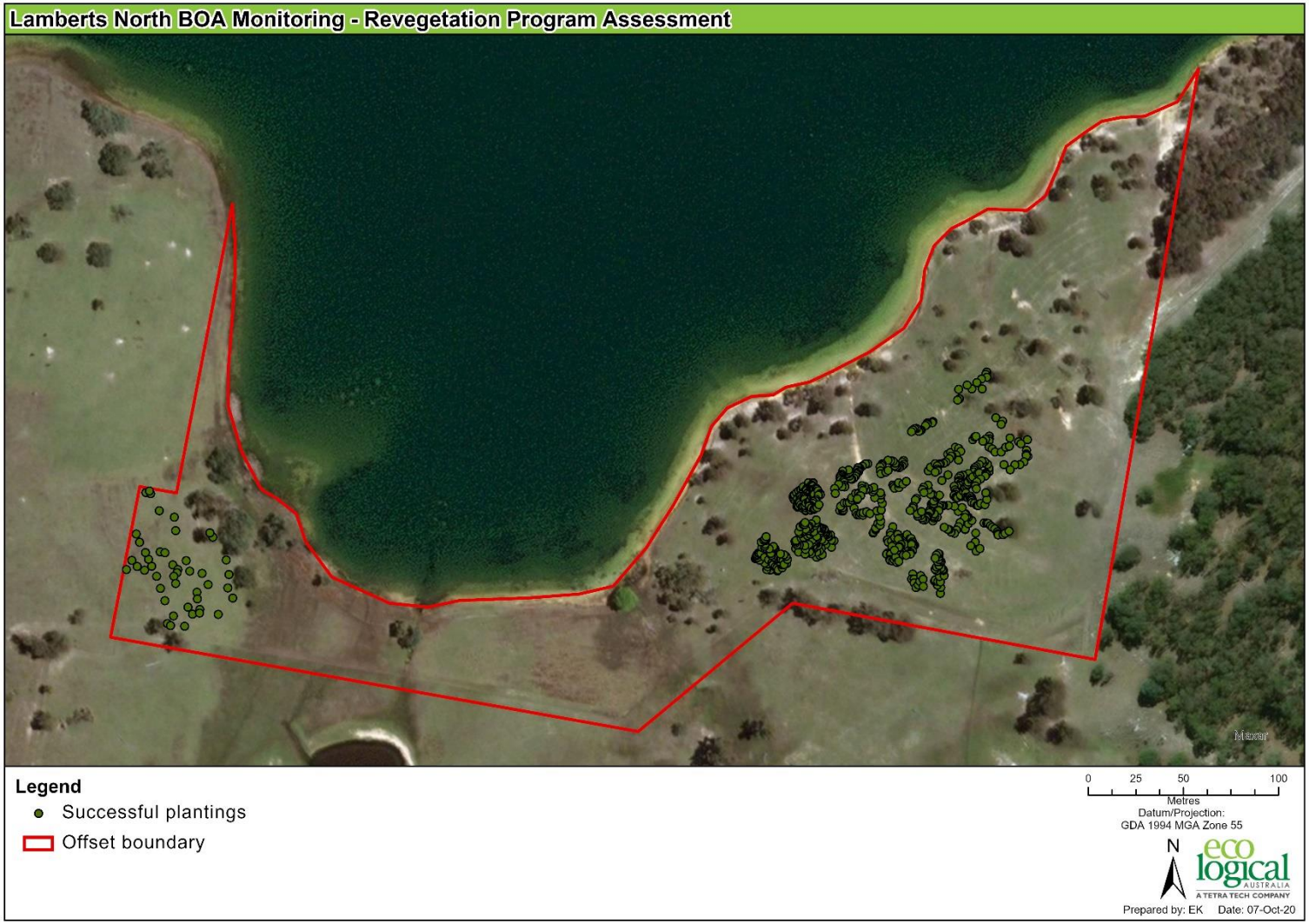
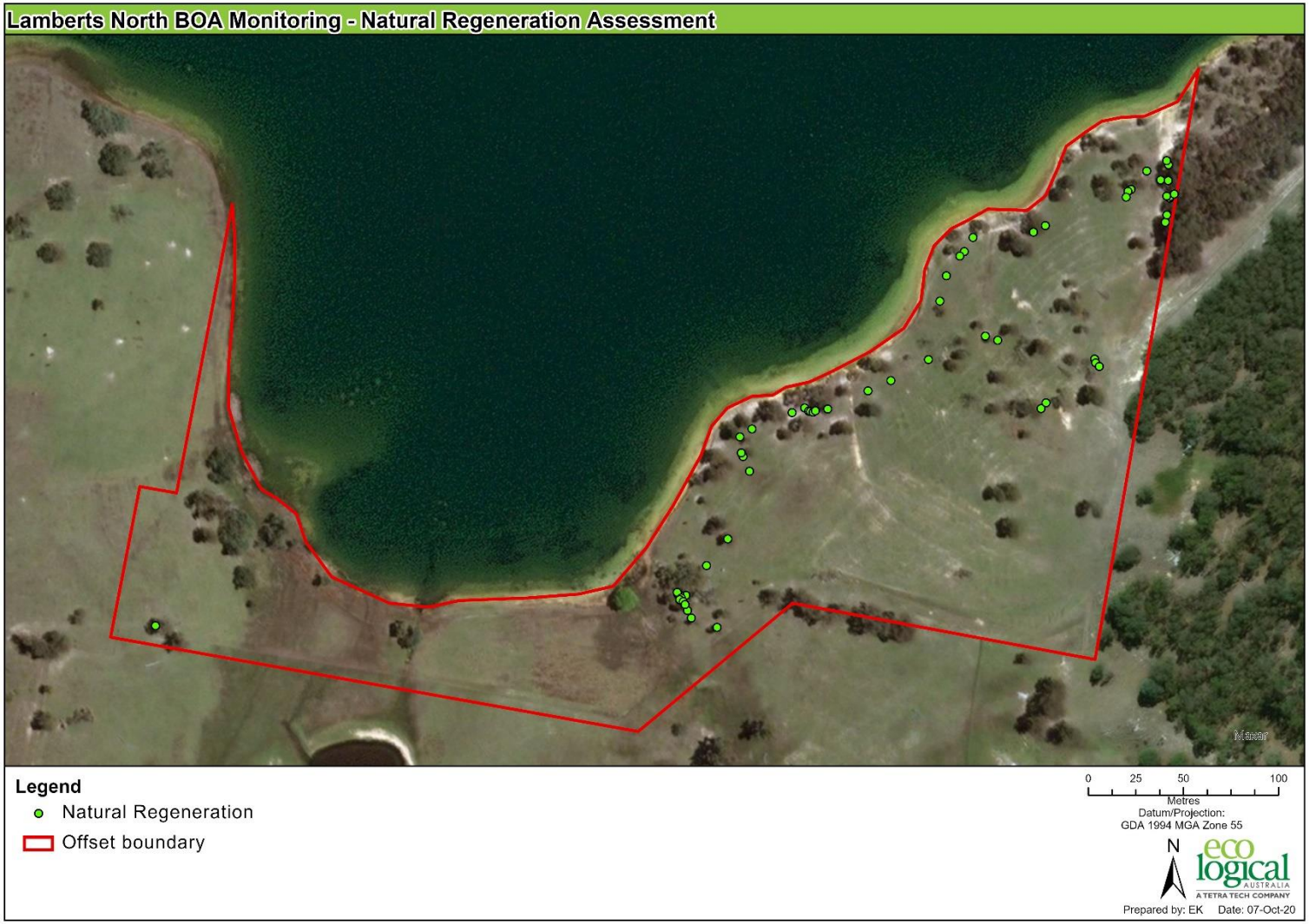
Appendix A Floristic and Fauna Monitoring Sites

Appendix B Threatened Species and Management Issues recorded

Appendix C Revegetation assessment results



Appendix D Natural regeneration assessment results



Appendix E Flora species recorded

Family	Scientific Name	Species	Native/Exotic
Araliaceae	*Hydrocotyle laxiflora*	Stinking Pennywort	Native
Asteraceae	*Carthamus lanatus*	Saffron Thistle	Exotic
Asteraceae	*Cassinia sifton*	Sifton Bush	Native
Asteraceae	*Cirsium vulgare*	Spear Thistle	Exotic
Asteraceae	*Euchiton sp.*		Native
Asteraceae	*Euchiton sphaericus*		Native
Asteraceae	*Gamochaeta sp.*		Exotic
Asteraceae	*Hypochaeris radicata*	Cat's Ear	Exotic
Asteraceae	*Pseudognaphalium luteoalbum*	Jersey Cudweed	Native
Asteraceae	*Senecio hispidulus*	Hill Fireweed	Native
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed	Native
Asteraceae	*Solenogyne bellioides*		Native
Asteraceae	*Sonchus sp.*		Exotic
Boraginaceae	*Cynoglossum australe*		Native
Boraginaceae	*Echium vulgare*	Vipers Bugloss	Exotic
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak	Native
Crassulaceae	*Crassula sp.*		Native
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge	Native
Cyperaceae	*Lepidosperma sp.*		Native
Dilleniaceae	*Hibbertia riparia*	Erect Guinea-flower	Native
Ericaceae	*Lissanthe strigosa*	Peach Heath	Native
Fabaceae (Faboideae)	*Trifolium sp.*		Exotic
Fabaceae (Mimosoideae)	*Acacia dealbata*	Silver Wattle	Native
Gentianaceae	*Centaurium sp.*		Exotic
Geraniaceae	*Geranium sp.*		Native
Haloragaceae	*Gonocarpus tetragynus*		Native
Haloragaceae	*Haloragis heterophylla*	Rough Raspwort	Native
Hypericaceae	*Hypericum perforatum*	St John's Wort	Exotic
Juncaceae	*Juncus sp.*		Native
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush	Native
Lomandraceae	*Lomandra glauca*	Pale Mat-rush	Native
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	Native
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	Native
Myrtaceae	*Eucalyptus dives*	Broad-leaved Peppermint	Native

Family	Scientific Name	Species	Native/Exotic
Myrtaceae	*Eucalyptus sp.*		Native
Myrtaceae	*Eucalyptus mannifera*	Brittle Gum	Native
Myrtaceae	*Eucalyptus pauciflora*	Snow Gum	Native
Myrtaceae	*Eucalyptus viminalis*	Manna Gum	Native
Orchidaceae	*Pterostylis sp.*		Native
Oxalidaceae	*Oxalis sp.*		Native
Phyllanthaceae	*Poranthera microphylla*		Native
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	Exotic
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell	Native
Poaceae	*Anthoxanthum odoratum*	Sweet Vernal Grass	Exotic
Poaceae	*Aristida ramosa*	Purple Wiregrass	Native
Poaceae	*Austrostipa bigeniculata*		Native
Poaceae	*Cynodon dactylon*	Couch	Native
Poaceae	*Elymus scaber*	Common Wheat Grass	Native
Poaceae	*Microlaena stipoides*	Weeping Meadow Grass	Native
Poaceae	*Nassella sp.*		Exotic
Poaceae	*Panicum effusum*	Hairy Panic	Native
Poaceae	*Paspalum dilatatum*		Exotic
Poaceae	*Phalaris aquatica*	Phalaris	Exotic
Poaceae	*Phalaris sp.*		Exotic
Poaceae	*Poa sieberiana*	Snow Grass	Native
Poaceae	*Rytidosperma racemosum*		Native
Poaceae	*Rytidosperma sp.*		Native
Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel	Exotic
Primulaceae	*Lysimachia arvensis*	Scarlet Pimpernel	Exotic
Pteridaceae	*Cheilanthes sieberi*	Rock Fern	Native
Rosaceae	*Acaena echinata*	Sheep's Burr	Native
Rosaceae	*Rubus fruticosus*	Blackberry	Exotic
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	Exotic

Appendix F Fauna species recorded

Classification	Scientific Name	Common Name
Amphibian	*Crinia signifera*	Common Eastern Froglet
Amphibian	*Limnodynastes tasmaniensis*	Spotted Marsh Frog
Amphibian	*Uperoleia laevigata*	Smooth Toadlet
Bird	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill
Bird	*Acanthiza lineata*	Striated Thornbill
Bird	*Acanthiza reguloides*	Buff-rumped Thornbill
Bird	*Anthochaera carunculata*	Red Wattlebird
Bird	*Anthus novaeseelandiae*	Australasian Pipit
Bird	*Aythya australis*	Hardhead
Bird	*Calyptorhynchus lathami^*	Glossy Black-Cockatoo
Bird	*Colluricincla harmonica*	Grey Shrike-thrush
Bird	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
Bird	*Corcorax melanorhamphos*	White-winged Chough
Bird	*Cormobates leucophaeus*	White-throated Treecreeper
Bird	*Corvus coronoides*	Australian Raven
Bird	*Cracticus tibicen*	Australian Magpie
Bird	*Dacelo novaeguineae*	Laughing Kookaburra
Bird	*Eolophus roseicapillus*	Galah
Bird	*Eopsaltria australis*	Eastern Yellow Robin
Bird	*Falco cenchroides*	Nankeen Kestrel
Bird	*Fulica atra*	Eurasian Coot
Bird	*Grallina cyanoleuca*	Magpie-lark
Bird	*Haliaeetus leucogaster^*	White-bellied Sea-Eagle
Bird	*Hirundo neoxena*	Welcome Swallow
Bird	*Lalage sueurii*	White-winged Triller
Bird	*Lichenostomus chrysops*	Yellow-faced Honeyeater
Bird	*Malurus cyaneus*	Superb Fairy-wren
Bird	*Melithreptus brevirostris*	Brown-headed Honeyeater
Bird	*Pardalotus punctatus*	Spotted Pardalote
Bird	*Pardalotus striatus*	Striated Pardalote
Bird	*Petrochelidon nigricans*	Tree Martin
Bird	*Phalacrocorax varius*	Pied Cormorant
Bird	*Platycercus elegans*	Crimson Rosella
Bird	*Platycercus eximius*	Eastern Rosella

Classification	Scientific Name	Common Name
Bird	*Podiceps cristatus*	Great Crested Grebe
Bird	*Rhipidura leucophrys*	Willie Wagtail
Bird	*Strepera graculina*	Pied Currawong
Bird	*Sturnus vulgaris**	Common Starling
Bird	*Tachybaptus novaehollandiae*	Australasian Grebe
Bird	*Vanellus miles*	Masked Lapwing
Mammal	*Macropus giganteus*	Eastern Grey Kangaroo
Mammal	*Oryctolagus cuniculus**	European Rabbit
Mammal	*Trichosurus vulpecula*	Brushtail Possum
Mammal	*Vombatus ursinus*	Common Wombat

^ Threatened Species, * Introduced Species

Appendix G Fauna monitoring photos

Red Wattlebird. Photo Credit: Tom Kelly, 2020

Striated Thornbill. Photo Credit: Tom Kelly, 2020

Crimson Rosella. Photo Credit: Tom Kelly, 2020

Eastern Grey Kangaroos. Photo Credit: Tom Kelly, 2020

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Appendix F Wangcol Creek Ecological Monitoring Program – Spring 2020

Wangcol Creek Ecological Monitoring Program

Wangcol Creek EMP Spring 2012 to Spring 2020

59919010

Prepared for

EnergyAustralia NSW

16 February 2021

Cardno

Shaping the Future

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9 - The Forum
203 Pacific Highway
Suburb State 2065
Australia

www.cardno.com
Phone +61 2 9496 7700
Fax +61 2 9496 7748

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Daniel Pygas
Principal Aquatic Ecologist

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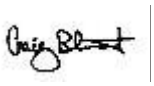

Dr Craig Blount
Senior Principal Aquatic Ecologist

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A	21/12/2020	Draft for Review	Dan Pygas	Dr Craig Blount Alicia de Vos (EnergyAustralia)
0	16/02/2021	Final	Dan Pygas	

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 spring 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, spring (December) 2018, autumn (May) 2020 and most recently in spring (November) 2020.

The spring 2020 monitoring consisted of surveys of aquatic habitat, water quality and macroinvertebrate assemblages (using the AUSRIVAS protocol) by Cardno on 18 November 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 spring 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 spring 2020 and compared with those from previous spring surveys in 2013, 2015, 2016 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 Score (a biotic index of water pollution).

Changes in the structure of macroinvertebrate assemblages in all samples collected in spring of 2012, 2013, 2014, 2015, 2016, 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 no evidence of any change in spring 2020 data that would suggest an impact due to the Project. None of the statistical tests indicated any change through time at NCR2 that could otherwise have indicated an impact. In particular there was no evidence of a change in SIGNAL2 Score in spring 2020 following the apparent reduction in this indicator observed previously in autumn 2020. The apparent elevations in EC and concentrations of some metals that occurred in early 2020 (generally following relatively low rainfall and flow) do not appear to have affected macroinvertebrate indicators sampled later in November (spring) 2020. There was also no indication in spring 2020 of a reduction in SIGNAL2 Score that was observed previously in autumn 2020. The capture of a native mountain galaxiid in the AUSRIVAS dip net at one of the control sites in autumn and spring 2018 indicates Wangcol Creek provides habitat for at least one native species of fish.

Examination of long-term water quality data from Wangcol Creek showed variability in the location, timing and magnitude of several measures. This is likely to be related to the heavily modified catchment associated with coal mining, energy generation and other industries, local rainfall, flow and hydrology in Wangcol Creek, and the relative effect of evaporation and dilution occurring during low and high flow conditions, respectively. Background concentrations of many metals, some of which often exceed guidelines for the protection of aquatic ecosystems, would be one of the factors influencing the type and abundance of macroinvertebrates and other aquatic biota in Wangcol Creek.

The complex interactions that exist between the various types of disturbance experienced in Wangcol Creek (e.g. those affecting habitat, water quality and flow) make any changes in indicators of ecological health difficult to distinguish from those that could be due to the Project. Nevertheless, the Environmental Monitoring Program 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 annually in spring during ash placement and for at least two years thereafter. Undertaking surveys in spring (rather than autumn) will also maximise the validity of comparisons among data collected following Project commencement and between these data and baseline data collected in spring 2012. Data from these surveys will allow more confident conclusions to be made on the presence and duration of any potential impact in Wangcol Creek due to ash placement activities.
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 ameliorative 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 spring 2020 monitoring in accordance with the EMP.

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 spring 2020;

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

> Assess whether any impacts to the aquatic ecology of Wangcol Creek occurred since the last spring survey (in December 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), spring of 2014 (Cardno Ecology Lab 2015a), 2015 (Cardno 2016) and 2016 (Cardno 2017), autumn 2018 (Cardno 2018), spring 2018 (Cardno 2019) and autumn 2020 (Cardno 2020) (**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	Cardno (2020a)

*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.

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.

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 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 was 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. There was limited evidence to suggest a change in one indicator (SIGNAL2 Score) that occurred at NCR2 in autumn 2020 could be associated with the Project (Cardno 2020a). Detailed examination of trends in this indicator at other sites and of the individual taxa did not provide convincing evidence of an impact. In any case, the observed small magnitude of the reduction in this indicator does not raise concern for aquatic ecology in Wangcol Creek at that time.

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

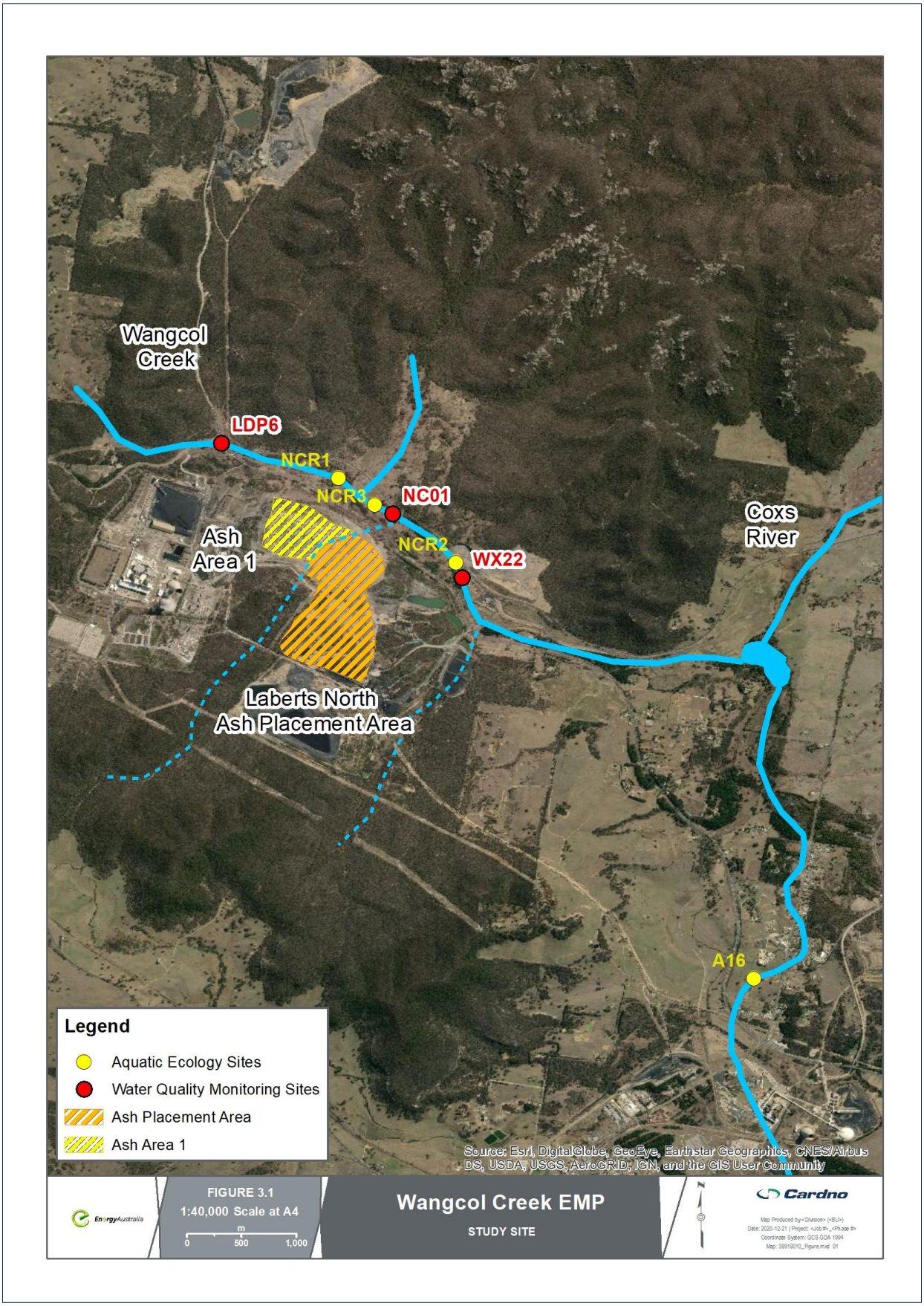


Figure 3-1 Aerial image identifying the location of the Project (Lamberts North), the previous ash depository (Ash Area 1), Wangcol Creek, the Coxs River, aquatic ecology monitoring sites and long-term water quality monitoring sites. Note CR0 was not sampled in the current study due to low water level.

> 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 on 18 November 2020 within the spring 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; and

> 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).

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 2020

Date	AUSRIVAS Season	NCR1		NCR2 (Impact Site)		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		
18 November 2020	Spring 2020	3		3		3	3		

Note, only spring 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 November 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 LDP6 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 30 November 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 spring. 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 spring

Band	Description	Spring OE50 Score
X	Richer invertebrate assemblage than reference condition	>1.16
A	Equivalent to reference condition	0.84 to 1.16
B	Sites below reference condition (i.e. significantly impaired)	0.52 to 0.83
C	Sites well below reference condition (i.e. severely impaired)	0.20 to 0.51
D	Impoverished (i.e. extremely impaired)	≤0.19

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 Score. The SIGNAL2 Score 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 Score was calculated using un-weighted SIGNAL2 grade data. Weighting SIGNAL2 grades according to abundance may bias the SIGNAL2 Score 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 site 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 statistical designs were utilised according to the availability of replicate sampling (i.e. two or more AUSRIVAS samples per site). The first used data collected from NCR1 and NCR2 in spring of 2013, 2015, 2016, 2018 and 2020 and the second, data from NCR1, NCR2, NCR3 and A16 sampled in 2015, 2016, 2018 and 2020 (**Section 4.6.3.2**). The first design enabled changes since 2013 (albeit following commencement of the Project) at NCR1 and NCR2 to be examined, the second design also included additional control sites NCR3 and A16 also (albeit only from 2015 onwards) to help place any changes at NCR2 in the context of the wider catchment area.

Differences in univariate indicators among AUSRIVAS macroinvertebrate assemblages sampled in edge habitat at each site in spring of each year sampled (2012, 2013, 2014, 2015, 2016, 2018 and 2020) were also explored.

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 spring of 2013, 2015, 2016, 2018 and 2020 (NCR1 and NCR2 only):
   - Year: A fixed factor with five levels: 2013, 2015, 2016, 2018 and 2020; and
   - Site: A fixed factor with two levels: NCR1 and NCR2.
2. Comparison among all sites sampled in spring of 2015, 2016, 2018 and 2020:
   - Year: A fixed factor with four levels: 2015, 2016, 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 spring of 2013, 2015, 2016, 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 (Impact Site)

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 Spring 2020 Water Quality

The mean values for each water quality indicator for each site measured in spring 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 16.7 °C to 20.0 °C on Wangcol Creek and was 22.6 °C on Coxs River;

> EC ranged from 322 µS/cm to 534 µS/cm on Wangcol Creek and was 758 µS/cm on Coxs River. It was above the upper DTV at NCR2 and A16;

> pH ranged from 7.4 to 8.5 on Wangcol Creek and was 7.4 on Coxs River. It was above the upper DTVs at NCR1;

> ORP ranged from -96 mV to -90 mV on Wangcol Creek and was 22.3 mV on Coxs River;

> Dissolved oxygen ranged from 67.2% to 88.5 % and was below the lower DTV on Wangcol Creek. Dissolved oxygen was 93.1% and within DTVs on Coxs River; and.

> Turbidity raged from 1.3 to 36 on Wangcol Creek and was 0.7 ntu on Coxs River. It was above the upper DTV at NCR1 and NCR3 and below the lower DTV at NCR2 and A16.

5.2.2 Long Term Data

Daily discharge data from NOW station 212055 (WX22) from January 2012 to November 2020 on Wangcol Creek (WaterNSW 2020) are presented in **Figure 5-1**. WX22 is located immediately downstream of impact site NCR2 (see **Figure 3-1**). 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, located further upstream from WX22 (see **Figure 3-1**), 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). During the majority of 2020 EC was comparable among all sites.

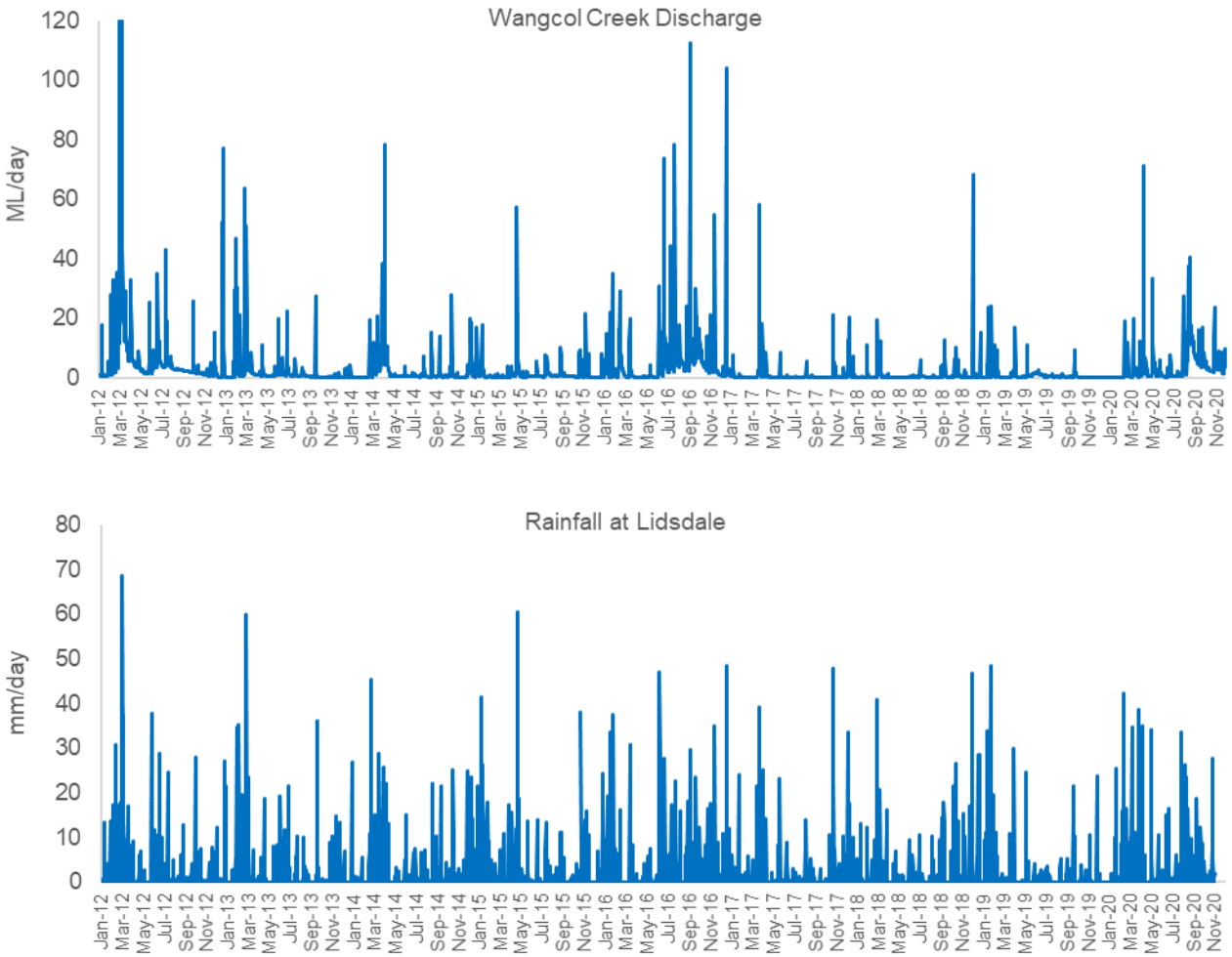
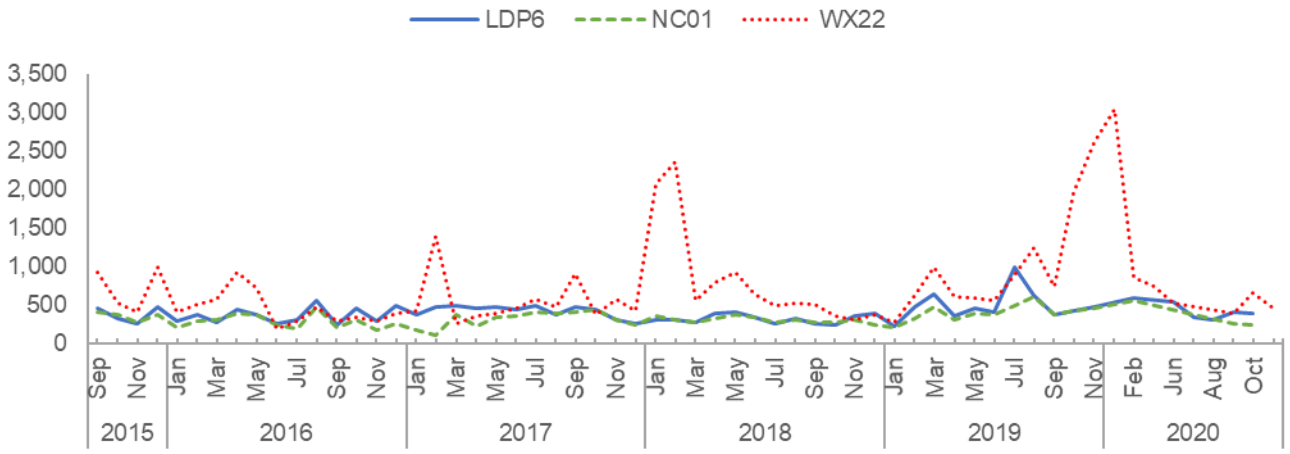


Figure 5-1 Daily rainfall at BOM Lidsdale station 063132 and daily discharge at NSW DPI (Water) station 212055 at WX22 on Wangcol Creek, January 2012 to 30 June 2020. The peak discharge in March 2012 was reported as 2,841 ML/day (NOW 2015). To enable easy interpretation of the other discharge data, the Y axis scale is limited to 120 ML/day

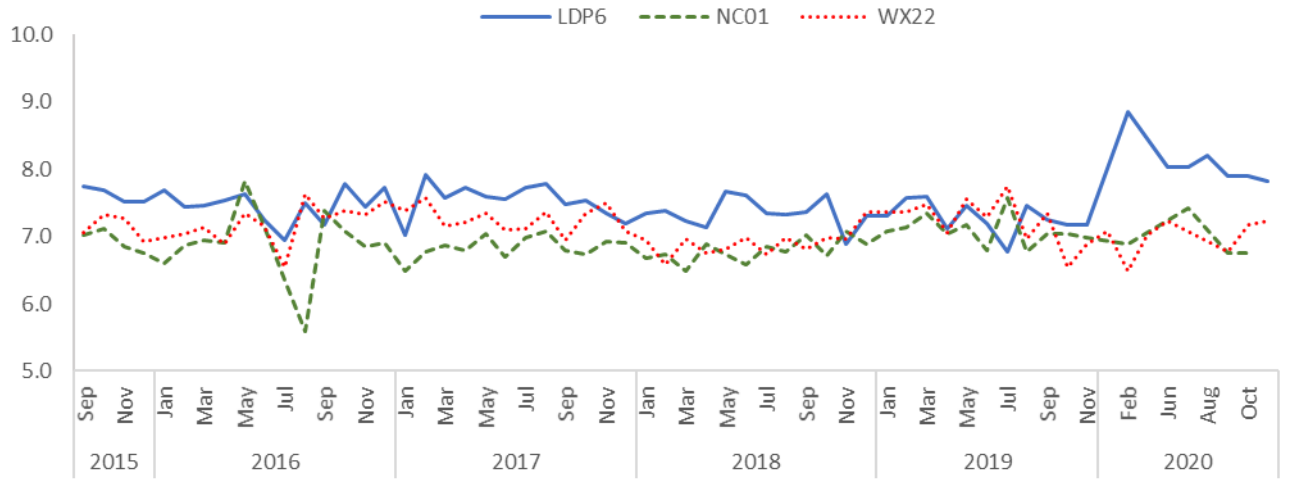
The spring 2012 to 2015 surveys were undertaken following several months of low to moderate rainfall and discharge, and show correspondingly low ECs at WX22 (approximately 200 µS/cm to 700 µS/cm) (**Figure 5-2a**). The December 2016 survey was undertaken following a relatively greater amount of rainfall and discharge in Wangcol Creek and lower ECs at WX22 (200 µS/cm to 500 µS/cm). The December 2018 survey was undertaken approximately 2 weeks following a rainfall event in late November 2018, also during correspondingly low ECs. pH at LDP6, NC01 and WX22 largely remained within DTVs (pH 6.5 to 8.0) (**Figure 5-2b**). The November 2020 survey was undertaken following approximately 0.2 mm of rainfall in the previous 24 hours and 13 mm in the previous 7 days. On occasion, there was relatively great differences among the pH measured at each site, sometimes close to 1 pH unit and in 2020 up to 2 pH units. The pH at LDP6 was generally greater than that at NC01 and WX22 and appeared elevated at LDP6 in 2020.

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, 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. The concentration of Nickel was greater at WX22 than that LDP6 and NC01 during the majority of sampling events. Boron also appeared to be elevated upstream of here (at NC01 and LDP6) at this time. Concentrations of zinc, aluminium and copper were elevated above guidelines at LDP6 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.

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)

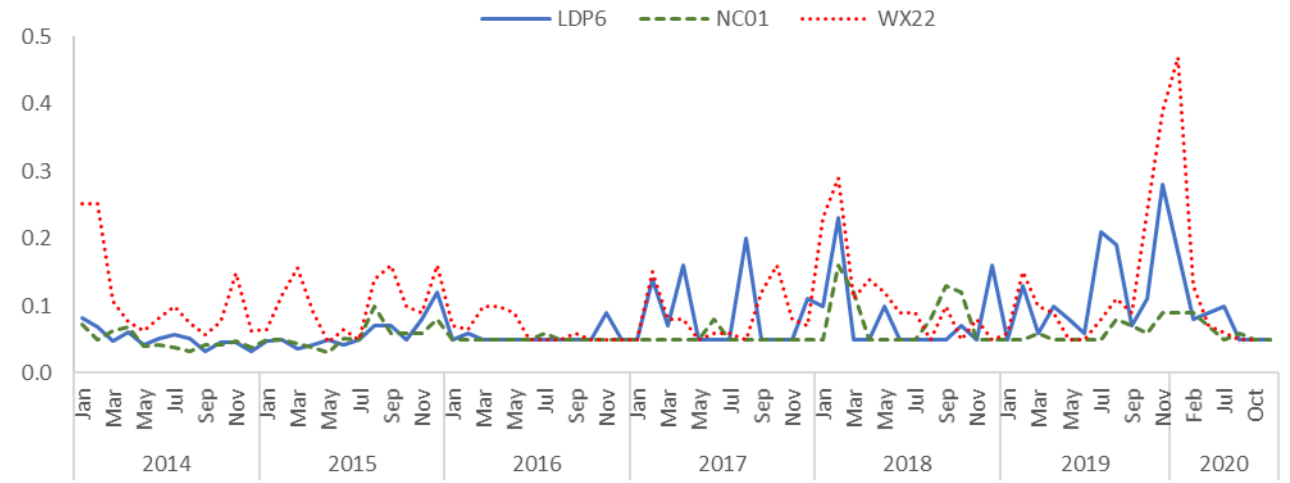
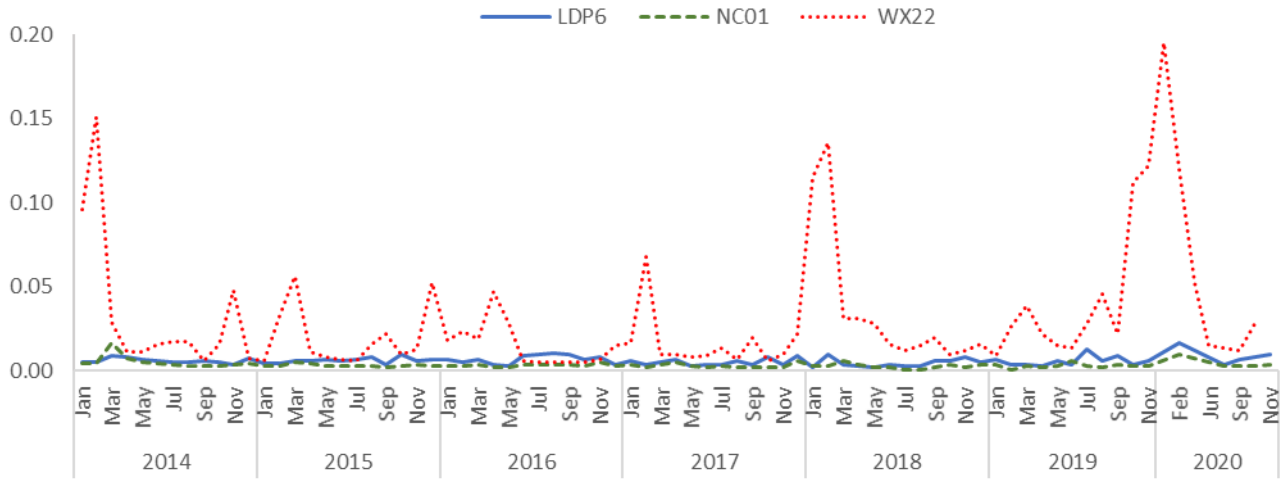
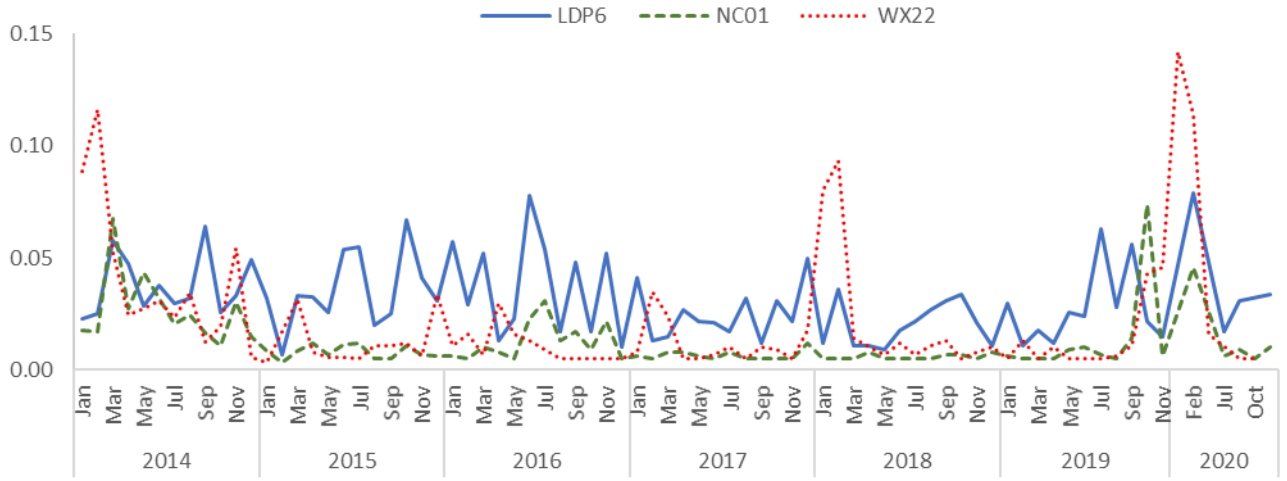


Figure 5-2 a) Electrical conductivity (EC), b) pH and c) concentration (mg / L) of boron measured at LDP6, NC01 and WX22 on Wangcol Creek by EnergyAustralia from January 2014 to June 2020.

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)

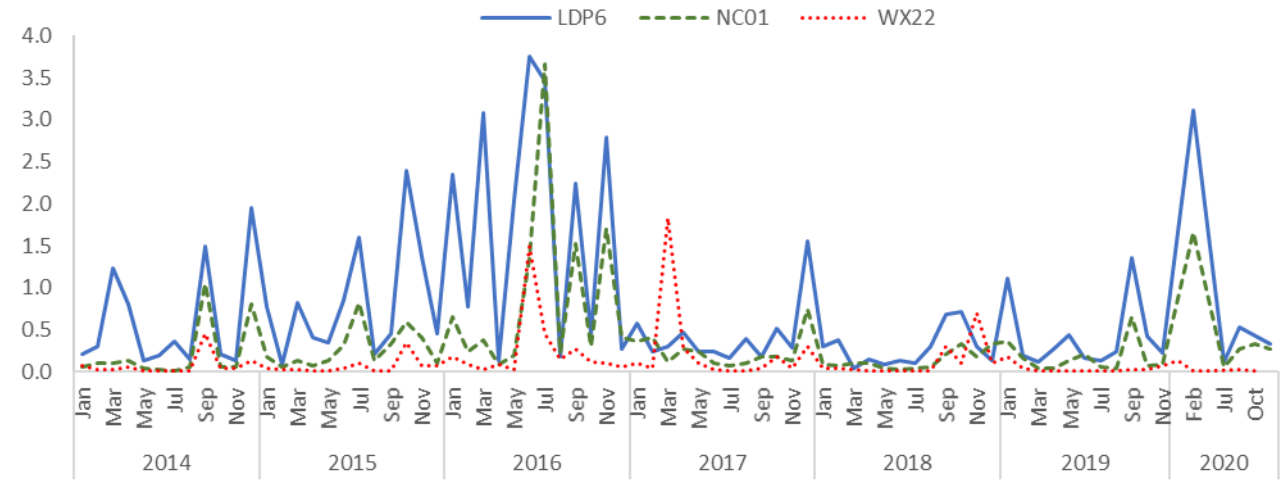


Figure 5-3 Concentrations (mg / L) of a) nickel, b) zinc and c) aluminium measured at LDP6, NC01 and WX22 on Wangcol Creek by EnergyAustralia from January 2014 to June 2020.

Copper (ANZECC/ARMCANZ (2000) 95 % Species Protection Trigger Value = 0.0014 mg/L)

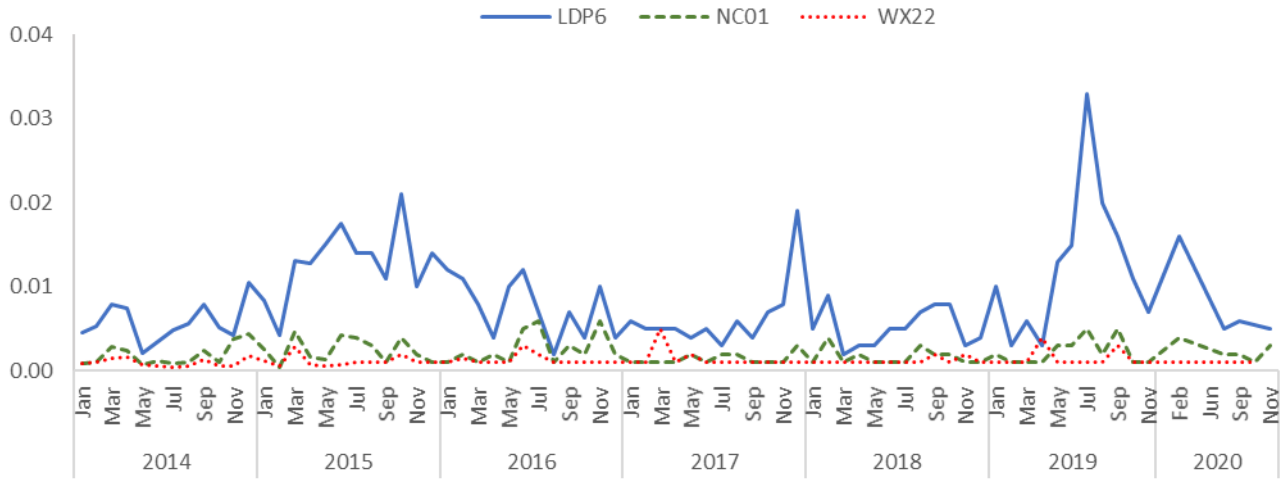


Figure 5-4 Concentrations (mg / L) of copper measured at LDP6, NC01 and WX22 on Wangcol Creek by EnergyAustralia from January 2014 to June 2020.

5.3 AUSRIVAS Macroinvertebrates

5.3.1 General Findings

5.3.1.1 Identified Taxa

A total of 49 taxa were identified from the 12 samples collected in spring 2020 (**Appendix F**). Over the course of the EMP, a total of 93 macroinvertebrate taxa have been identified from the 43 edge samples collected in spring. Out of the 80 taxa assigned a SIGNAL2 grade, 61 were assigned a grade of 5 or lower, indicating that the majority of taxa are moderately to very tolerant of pollution. Seven taxa (Athericidae, Gripopterygiidae, Hydrobiosidae, Leptophlebiidae, Telephlebiidae, Glossosomatidae and Philopotamidae) have a SIGNAL2 grade of 8 to 9, indicating they are sensitive to pollution. Leptophlebiidae were found at the majority of samples collected from NCR1 and NCR2.

The most common taxa identified from edge samples (those identified in over half all samples from Wangcol Creek and Coxs River) included Dytisidae (diving beetles), Leptophlebiidae (mayflies), Chironomidae (non-biting midge) (consisting of the subfamilies: Chironominae, Orthocladiinae and Tanypodinae) and Corixidae (backswimmers). Leptophlebiidae are pollution sensitive, however, most of the other taxa are pollution tolerant (SIGNAL2 grade 2 to 4). Few taxa appeared to be restricted to individual sites or separate watercourses. There was some evidence to suggest that Caenidae are uncommon at NCR1, and that Atyidae, are uncommon at A16. These taxa have been assigned SIGNAL2 Grades of 1 to 4. 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.

5.3.1.1 Number of Taxa

The number of macroinvertebrate taxa identified from edge samples collected at NCR1 has ranged from 14 to 25, 14 to 29 at NCR2, 13 to 25 at NCR3 and 7 to 24 at A16 (**Appendices F** and **G; Figure 5-5**). No site had consistently more or fewer taxa though there was slight evidence of a decrease in number of taxa at NCR2 and NCR3 through time.

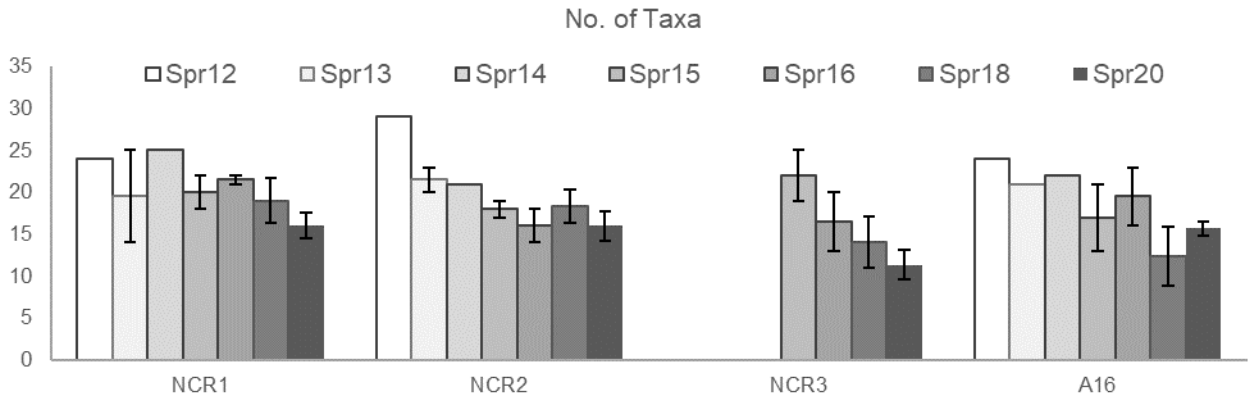


Figure 5-5 Number of Taxa identified in AUSRIVAS samples from each site sampled between spring 2012 and spring 2020 Standard error bars are displayed where n ≥ 2.

5.3.1.2 Number of EPT Taxa

The number of EPT taxa identified from edge samples collected from NCR1 has ranged from 1 to 4, 2 to 6 at NCR2, 0 to 3 at NCR3 and 1 to 8 at A16 (**Appendices F** and **G**; **Figure 5-6**). The number of EPT taxa sampled at NCR1 and NCR2 has been relatively consistent, except a larger number were sampled at NCR2 in spring 2012. Overall, more EPT taxa have been sampled at A16 than at the other sites sampled, particularly NCR3.

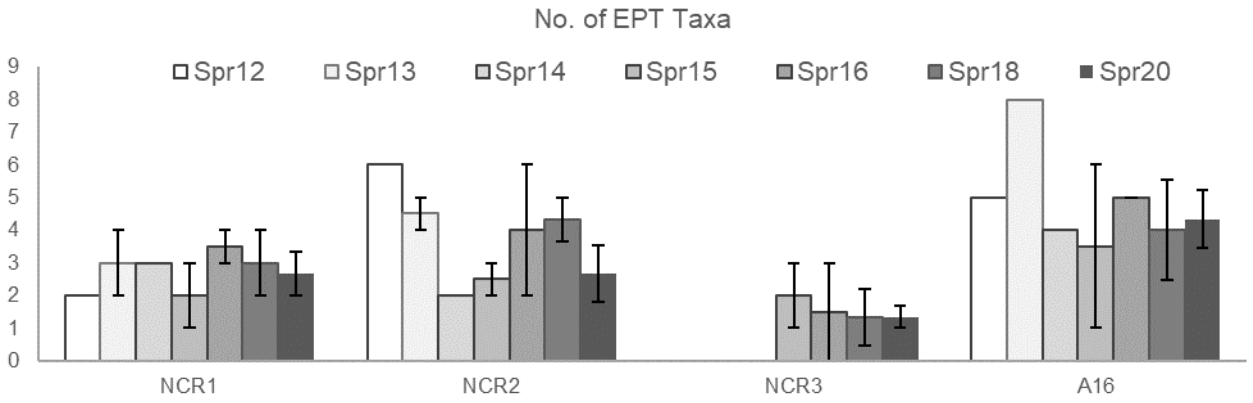


Figure 5-6 Number of EPT Taxa identified in AUSRIVAS samples from each site sampled between spring 2012 and spring 2020 Standard error bars are displayed where n ≥ 2.

5.3.1.3 OE50 Taxa Score

The OE50 Taxa Score at NCR1 has ranged from 0.36 to 0.95, 0.43 to 1.04 at NCR2, 0.19 to 0.85 at NCR3 and 0.36 to 0.91 at A16 (**Appendices F** and **G**; **Figure 5-7**). OE50 Scores from below 0.20 indicate extremely impaired habitat, 0.20 to 0.51 indicate severely impaired habitat (Band C), those from 0.52 to 0.83 indicate significantly impaired habitat (Band B) and those from 0.84 to 1.16 indicate habitat equivalent to reference condition (Band A). These results indicated that on all but one occasion (NCR2 in spring 2012) the macroinvertebrate assemblages sampled were less diverse than predicted (i.e. OE50 Taxa Score < 1.0). There was limited evidence to suggest a decrease in OE50 Taxa Score between spring 2012 and spring 2016 at NCR2, however, the OE50 Taxa Score in Spring 2018 was relatively high. OE50 Taxa Scores at control sites NCR1 and NCR3 in spring 2020 were also the lowest recorded during the EMP.

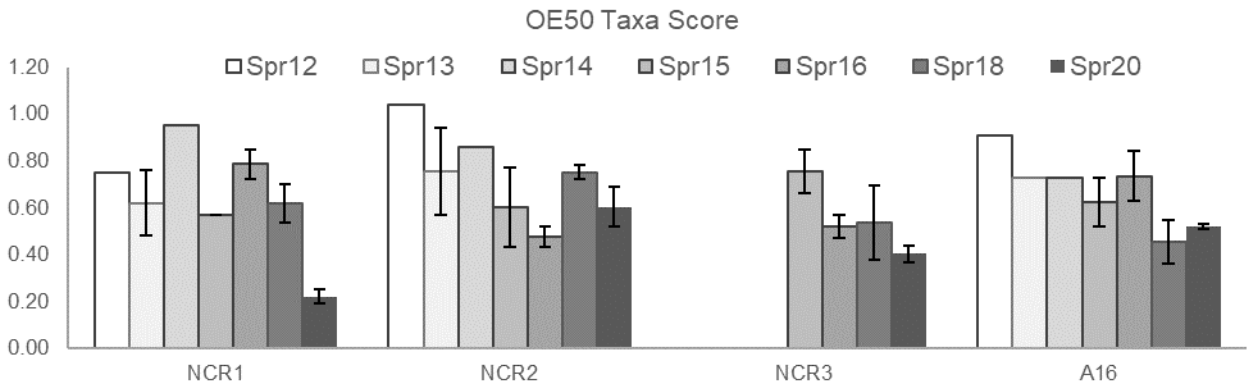


Figure 5-7 OE50 Taxa Scores from AUSRIVAS samples from each site sampled between spring 2012 and spring 2020. Standard error bars are displayed where n ≥ 2.

5.3.1.4 SIGNAL2 Score

The SIGNAL2 Score at NCR1 ranged from 3.1 to 4.2 (indicative of severe to moderate pollution), 3.6 to 4.9 (indicative of severe to moderate pollution) at NCR2, 2.9 to 4.5 (indicative of severe to moderate pollution) at NCR3 and 3.6 to 5.0 (Indicative of severe to mild pollution) at A16 (**Appendices F** and **G; Figure 5-8**). The SIGNAL2 Score at NCR3 in 2015 was 2.9 and 3.2 (indicative of severe pollution). These results suggest that Wangcol Creek and the Coxs River at these sites experience some degree of environmental stress due to poor water quality. There were no obvious trends in SIGNAL2 data.

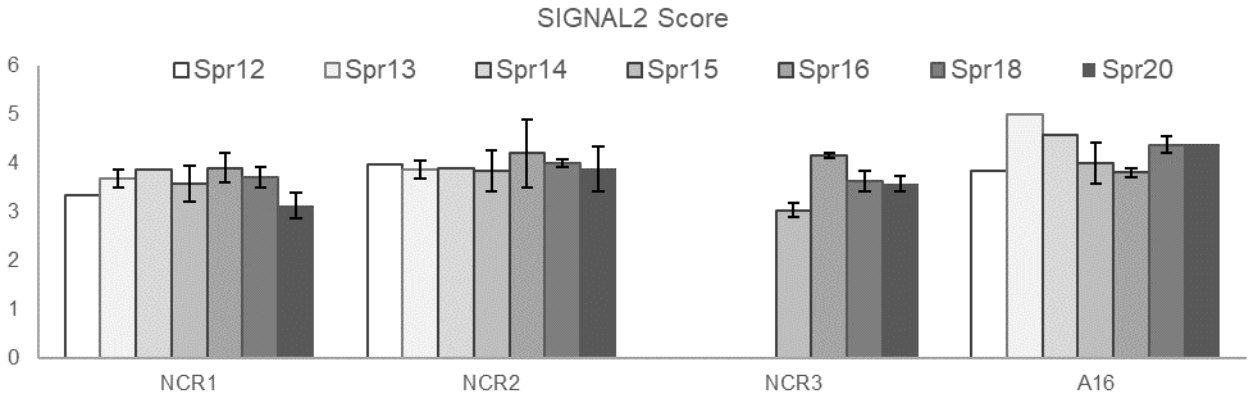


Figure 5-8 SIGNAL2 Scores from AUSRIVAS samples from each site sampled between spring 2012 and spring 2020. Standard error bars are displayed where n ≥ 2.

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 5-9**). Oligochaetes and hydracarina were absent from one of the samples collected at NCR2 in spring 2016, however, neither is sensitive to water pollution.

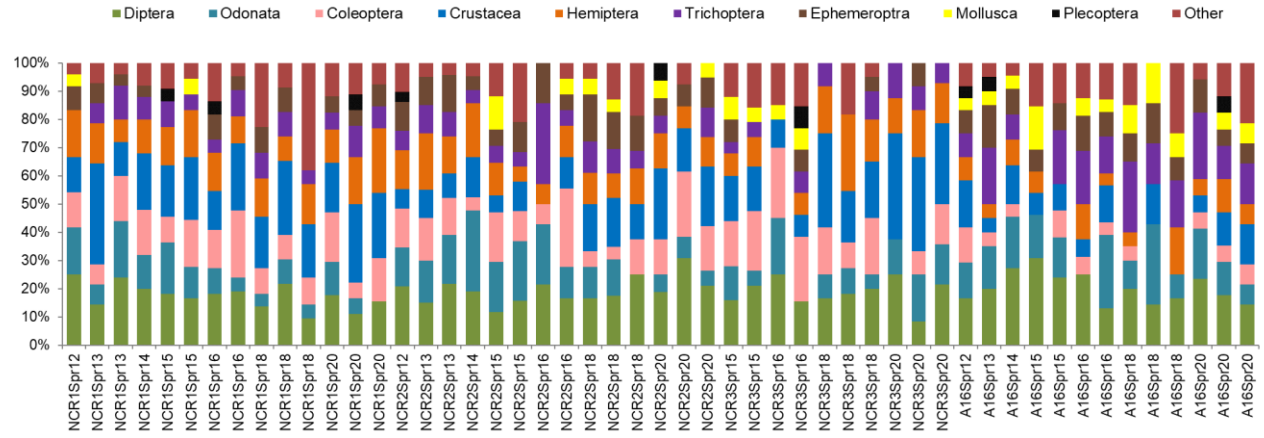


Figure 5-9 Relative contribution of major taxonomic groups identified from AUSRIVAS edge samples collected at NCR1, NCR2 and NCR3 on Wangcol Creek and A16 on the Coxs River during spring of 2013, 2014, 2018 and 2020. 'Other' includes taxa in the Families Pyralidae and Dugesiidae, the Order Temnocephalidae, Subclasses Oligochaeta and Collembola and the taxonomic group Hydracarina.

5.3.3 Statistical Analyses

None of the PERMANOVA tests undertaken using data collected from NCR1 and NCR2 in spring of 2013, 2015, 2016, 2018 and 2020 indicated a statistically significant interaction between Survey and Site (**Table 5-1**). There was also a statistically significant effect of Survey for Number of EPT Taxa and SIGNAL2 Score. None of these differences indicated an impact.

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	ns
Number of EPT Taxa	*	ns	ns
OE50 Taxa Score	ns	ns	ns
SIGNAL2 Score	*	ns	ns
Assemblage	***	***	**

One of the PERMANOVA tests (that for multivariate assemblage structure) undertaken using data collected from all sites in spring of 2015, 2016, 2018 and 2020 indicated a statistically significant interaction between Survey and Site (**Table 5-2**). Differences between pairs of Sites and Surveys could not be resolved using pairwise tests (**Appendix H vi and vii**). There was also a statistically significant effect of Survey for Number of EPT Taxa, SIGNAL2 Score and multivariate assemblage structure and of Site for multivariate assemblage structure. None of these differences indicated an impact.

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	*	ns	ns
OE50 Taxa Score	ns	ns	ns
SIGNAL2 Score	*	ns	ns
Assemblage	***	***	**

The PCO undertaken for all edge assemblages sampled (except at CR0) during spring of 2012, 2013, 2014, 2015, 2016, 2018 and 2020 is presented in **Figure 5-10a**. There is 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 left of the PCO away from those at the other sites. There was little evidence of other distinct groupings. The results of the CLUSTER diagram **(Figure 5-10b**) are reflective of the PCO, with generally little evidence of distinct groupings of samples from particular Surveys and Sites. The only exception evident in the PCO was two of the samples from A16 in spring 2018, which were relatively dissimilar from each other and all other assemblages sampled.

Replicate samples tended to be most similar to each other (e.g. those from NCR3 in spring 2015), though several replicate samples were also relatively dissimilar (e.g. NCR2 in spring 2015). Differences among replicates could indicate relatively great natural variation in macroinvertebrate assemblages at the time of sampling.

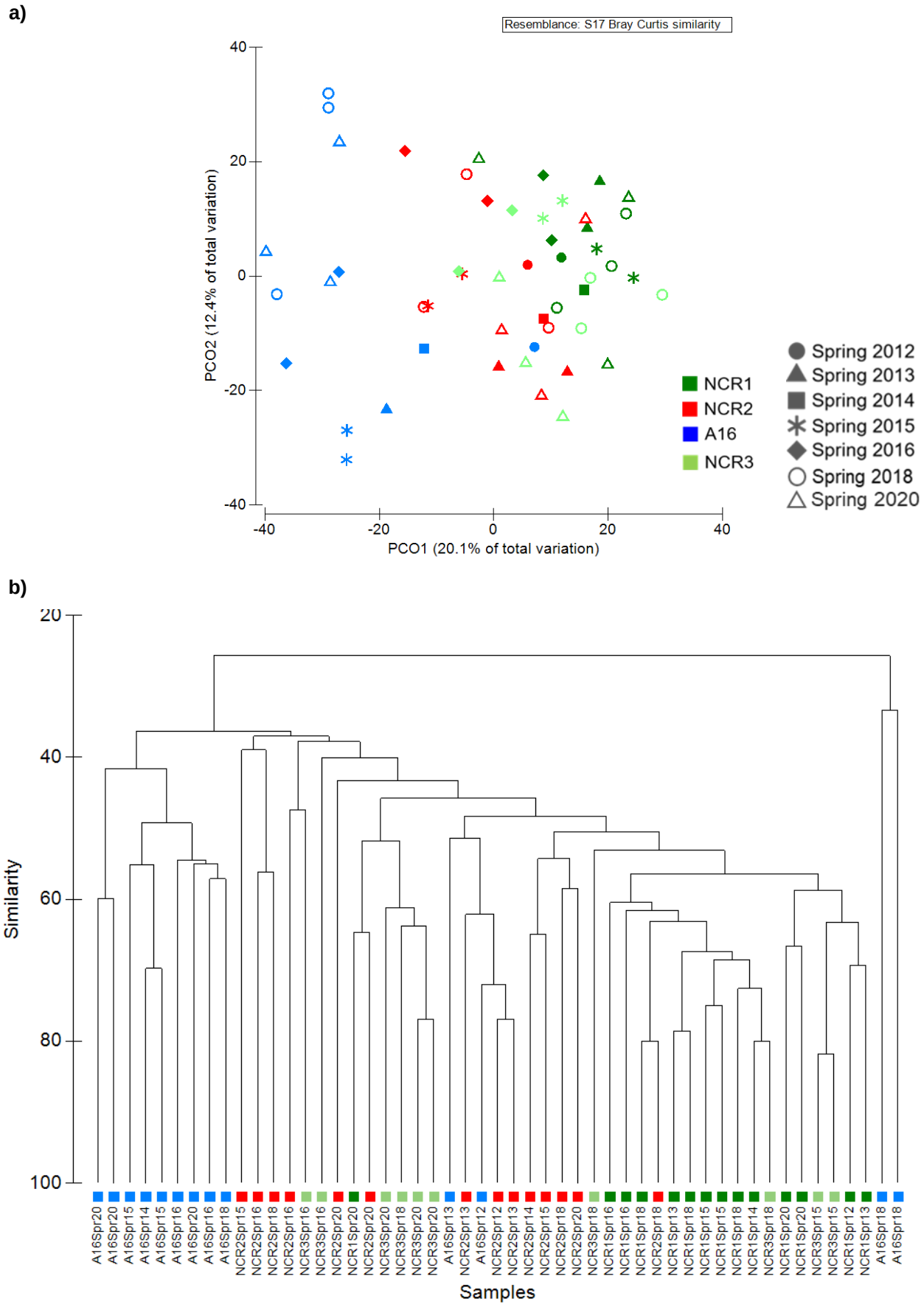


Figure 5-10 a) Principle Component Ordination (PCO) and b) CLUSTER diagram of AUSRIVAS edge macroinvertebrate assemblages sampled using AUSRIVAS at NCR1, NCR2 and NCR3 on Wangcol Creek and at A16 on Coxs River in spring of 2012, 2013, 2015, 2016, 2018 and 2020, .

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 may partly explain any differences in the structure of macroinvertebrate assemblages sampled at these sites. The presence of the mountain galaxiid in the dip net at NCR3 in autumn of 2017 and spring of 2018 also indicates that the creek is providing habitat for at least one native species of fish.

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 by Cardno in spring 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**). 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 6.2**).

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 and at one of the three samples in spring 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

None of the PERMANOVA tests indicated a change in spring 2020 that could be attributed to a Project related impact. Likewise, there was no evidence of any trends in data collected in spring that could be indicative of an impact occurring. This is consistent with the findings of previous investigations in spring (**Section 2.3**). There was also no indication in spring 2020 of a reduction in SIGNAL2 Score that was observed previously in autumn 2020 (Cardno 2020a). Overall, data collected over the course of the EMP does not suggest any impact to macroinvertebrates in Wangcol Creek has occurred due to the Project. There were also no changes in macroinvertebrate indicators sampled from autumn 2013 to autumn 2018 that indicate an impact (Cardno 2018). Although the total number of taxa and number of EPT taxa at NCR2 was lower in autumn 2018 than in autumn of 2013 and 2014, similar changes were also observed at the control location NCR1 (Cardno 2018). The apparent reduction in OE50 Taxa Score at control sites NCR1 and NCR3 in spring 2020 is not related to the project.

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 no conclusive evidence to suggest a change in macroinvertebrate indicators occurred at NCR2 in spring 2020 that could be associated with the Project. Furthermore, the condition of aquatic habitat and biota at NCR2 did not differ substantially from the habitat upstream of the Project. There was also no evidence that the reduction in SIGNAL2 Score that occurred at NCR2 in autumn 2020 persisted in spring 2020.

The complex interaction that exists between the various types of disturbances 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 annually in spring during operation of the Project and for at least two years after completion of all activities that could impact aquatic ecology.
2. There would be merit in undertaking annual sampling in autumn. Although baseline data is not available from autumn, the results of monitoring in autumn would complement that undertaken in spring and provide further confidence regarding the presence or absence of a potential impact associated with the Project.
3. Sampling should continue at the additional control sites established on Wangcol Creek (NCR3). While no baseline data is available from this site, 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.
4. 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.
5. The use of quantitative macroinvertebrate sampling methods should be incorporated to provide more robust data and additional confidence surrounding the findings of the EMP.

At this stage no Project specific mitigation, impact minimisation or ameliorative 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

Cardno
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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

Cardno
Shaping the Future

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
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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

Cardno
Shaping the Future

River, Channel and Environmental (RCE) Category in spring 2020)				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 SPRING 2020

Cardno
Shaping the Future

Measure	DTVs	Site							
		NCR1		NCR2		NCR3		A16	
		Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Temperature (°C)	n/a	16.7	0.0	20.0	0.0	17.7	0.0	22.6	0.0
Conductivity (µS/cm)	30-350	322	0	534	0	340	0	758	0
pH	6.5-8.0	8.5	0.0	7.5	0.0	7.4	0.0	7.5	0.0
ORP (mV)	n/a	-96	0.0	-96	0.0	-90	0.0	22.3	0.0
DO (% Sat)	90-110	67.2	0.0	88.5	0.0	75.1	0.0	93.1	0.0
Turbidity (NTU)	2-25	36	0.0	1.3	0.0	26	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

APPENDIX F

RAW AUSRIVAS DATA SPRING 2020

Cardno
Shaping the Future

Taxon	A16	A16	A16	NCR1	NCR1	NCR1	NCR2	NCR2	NCR2	NCR3	NCR3	NCR3
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Order or Family												
Dugesiidae	1	2	1	1		1						
Platyhelminthes					1							
Corbiculidae		1	1									
Lymnaeidae							1					
Physidae									1			
Oligochaeta			1	1				1				
Cladocera				2	10	7				5	6	5
Copepoda		1			10		10	5	1	1	3	6
Ostracoda	1	2	5	4	10	10	3	6	1	10	10	10
Atyidae			5	1	1	4	1		1			
Parastacidae					1		1		1			1
Decapoda larvae											1	
Hydracarina			1									
Hypogastruridae					1							
Caenidae	1				1		2		1			
Baetidae	6	1	10	1					2		1	
Leptophlebiidae						2		6				
Coenagrionidae				1	1			1			2	2
Protoneuridae	1											
Megapodagrionidae									2			
Gomphidae		2	1									
Aeshnidae	1											
Cordulephyidae		2		3			3					
Hemicorduliidae	1									2	1	3
Gripopterygiidae		1			1		1					
Veliidae				2	6	2		2	4			
Gelastocoridae	3	1	1									
Corixidae		2			10	10	4		3	2	10	10
Notonectidae				1	6	2	1				2	2
Dytiscidae		1		2	10	1	10	10	1		10	3
Gyrinidae	1											
Hydrochidae				1			2		1			1
Hydrophilidae			1	10		1		1				
Scirtidae (=								1	1			
Dixidae								1	1			
Culicidae					1			2				
Chironomidae/Chiron	1	1		2		4			3	3		8
Chironomidae/Tanyp	2		3	5	10	7	10	10	10	2	1	10
Ceratopogonidae							7	2				
Simuliidae	10	6	7	1								
Tipulidae	2						2		1			
Tabanidae												1
Empididae		1										
Hydrobiosidae									2			
Hydroptilidae	1	1	1		10		4				1	1
Philopotamidae	1											
Hydropsychidae	5											
Ecnomidae					1	2						
Leptoceridae	6	5	3	1					4	1		

Note: a maximum of 10 individuals were counted per sample

Wangcol Creek EMP Spring 2012 to Spring 2020

APPENDIX

G

BIOTIC INDICES RAW DATA

Cardno
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Date	AUSRIVAS Season	No. of Taxa	No. of EPT Taxa	OE50 Taxa Score	AUSRIVAS Band	SIGNAL2 Score
NCR1						
8 Nov 2012	Spring 2012 Rep 1	24	2	0.75	B	3.3
12 Dec 2013	Spring 2013 Rep 1	14	2	0.48	C	3.5
12 Dec 2013	Spring 2013 Rep 2	25	4	0.76	B	3.9
19 Nov 2014	Spring 2014 Rep 1	25	3	0.95	A	3.9
14 Dec 2015	Spring 2015 Rep 1	22	3	0.57	B	3.9
14 Dec 2015	Spring 2015 Rep 2	18	1	0.57	B	3.2
1-2 Dec 2016	Spring 2016 Rep 1	22	4	0.85	A	3.6
1-2 Dec 2016	Spring 2016 Rep 2	21	3	0.72	B	4.2
11 Dec 2018	Spring 2018 Rep 1	20	4	0.75	B	3.9
11 Dec 2018	Spring 2018 Rep 2	23	4	0.63	B	3.9
11 Dec 2018	Spring 2018 Rep 3	14	1	0.47	C	3.3
18 Nov 2020	Spring 2020 Rep 1	17	2	0.47	C	3.1
18 Nov 2020	Spring 2020 Rep 2	18	4	0.36	C	3.2
18 Nov 2020	Spring 2020 Rep 3	13	2	0.38	C	3.1
NCR2						
8 Nov 2012	Spring 2012 Rep 1	29	6	1.04	A	4.0
12 Dec 2013	Spring 2013 Rep 1	20	4	0.57	B	3.7
12 Dec 2013	Spring 2013 Rep 2	23	5	0.94	A	4.0
19 Nov 2014	Spring 2014 Rep 1	21	2	0.86	A	3.9
14 Dec 2015	Spring 2015 Rep 1	17	2	0.43	C	3.4
14 Dec 2015	Spring 2015 Rep 2	19	3	0.77	B	4.3
1-2 Dec 2016	Spring 2016 Rep 1	14	6	0.52	B	4.9
1-2 Dec 2016	Spring 2016 Rep 2	18	2	0.43	C	3.5
11 Dec 2018	Spring 2018 Rep 1	18	5	0.69	B	3.9
11 Dec 2018	Spring 2018 Rep 2	22	5	0.78	B	4.1
11 Dec 2018	Spring 2018 Rep 3	15	3	0.78	B	4.0
18 Nov 2020	Spring 2020 Rep 1	16	3	0.52	B	3.5
18 Nov 2020	Spring 2020 Rep 2	13	1	0.52	B	3.7
18 Nov 2020	Spring 2020 Rep 3	19	4	0.77	B	4.4
NCR3						
14 Dec 2015	Spring 2015 Rep 1	25	3	0.85	A	3.2
14 Dec 2015	Spring 2015 Rep 2	19	1	0.66	B	2.9
1-2 Dec 2016	Spring 2016 Rep 1	20	0	0.47	C	4.2
1-2 Dec 2016	Spring 2016 Rep 2	13	3	0.57	C	4.1
11 Dec 2018	Spring 2018 Rep 1	12	1	0.38	C	3.8
11 Dec 2018	Spring 2018 Rep 2	10	0	0.38	C	3.2
11 Dec 2018	Spring 2018 Rep 3	20	3	0.85	A	3.9
18 Nov 2020	Spring 2020 Rep 1	8	1	0.28	C	4.5
18 Nov 2020	Spring 2020 Rep 2	12	2	0.19	D	3.1
18 Nov 2020	Spring 2020 Rep 3	14	1	0.19	D	3.1
A16						
8 Nov 2012	Spring 2012 Rep 1	24	5	0.91	A	3.9

Date	AUSRIVAS Season	No. of Taxa	No. of EPT Taxa	OE50 Taxa Score	AUSRIVAS Band	SIGNAL2 Score
12 Dec 2013	Spring 2013 Rep 1	20	8	0.73	B	5.0
19 Nov 2014	Spring 2014 Rep 1	22	4	0.73	B	4.6
14 Dec 2015	Spring 2015 Rep 1	13	1	0.52	B	3.6
14 Dec 2015	Spring 2015 Rep 2	21	6	0.73	B	4.4
1-2 Dec 2016	Spring 2016 Rep 1	16	5	0.84	A	3.7
1-2 Dec 2016	Spring 2016 Rep 2	23	5	0.63	B	3.9
11 Dec 2018	Spring 2018 Rep 1	19	7	0.64	B	4.4
11 Dec 2018	Spring 2018 Rep 2	7	2	0.36	C	4.7
11 Dec 2018	Spring 2018 Rep 3	11	3	0.36	C	4.1
18 Nov 2020	Spring 2020 Rep 1	17	6	0.50	C	4.6
18 Nov 2020	Spring 2020 Rep 2	16	4	0.53	B	4.5
18 Nov 2020	Spring 2020 Rep 3	14	3	0.53	B	4.1

EPT = Ephemeroptera, Plecoptera and Trichoptera

APPENDIX H

RESULTS OF PERMANOVAS

Cardno
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A) Comparison between NCR1 and NCR2 sampled in spring of 2013, 2015, 2016, 2018 and 2020:

i) No. of Taxa

Source of Variation	df	SS	MS	*F*	*P*
Survey	1	8.776	8.776	0.674	0.426
Site	4	54.542	13.635	1.048	0.419
Survey x Site	4	31.875	7.969	0.612	0.666
Residual	14	182.170	13.012		
Total	23	275.630			

ii) No. of EPT Taxa

Source of Variation	df	SS	MS	*F*	*P*
Survey	1	3.391	3.391	1.609	0.231
Site	4	9.042	2.260	1.073	0.410
Survey x Site	4	2.042	0.510	0.242	0.905
Residual	14	29.500	2.107		
Total	23	43.958			

iii) SIGNAL2 Score

Source of Variation	df	SS	MS	*F*	*P*
Survey	1	0.753	0.753	3.925	0.064
Site	4	0.774	0.194	1.009	0.435
Survey x Site	4	0.273	0.068	0.356	0.839
Residual	14	2.687	0.192		
Total	23	4.638			

iv) OE50 Taxa Score

Source of Variation	df	SS	MS	*F*	*P*
Survey	1	0.001	0.001	0.077	0.779
Site	4	0.176	0.044	2.874	0.067
Survey x Site	4	0.195	0.049	3.176	0.055
Residual	14	0.215	0.015		
Total	23	0.587			

v) Assemblage

Source of Variation	df	SS	MS	*F*	*P*
Survey	**1**	**4350**	**4350**	**4.079**	**0.001**
Site	**4**	**9257**	**2314**	**2.170**	**0.001**
Survey x Site	4	3334	834	0.782	0.797
Residual	14	14932	1067		
Total	23	31839			

B) Comparison among NCR12, NCR2, NCR3 and A16 sampled in spring of 2015, 2016, 2018 and 2020

i) No. of Taxa

Source of Variation	df	SS	MS	*F*	*P*
Survey	3	60.979	20.326	1.318	0.292
Site	3	127.430	42.478	2.754	0.068
Survey x Site	9	137.100	15.233	0.988	0.472
Residual	24	370.170	15.424		
Total	39	709.980			

ii) No. of EPT Taxa

Source of Variation	df	SS	MS	*F*	*P*
Survey	**3**	**36.183**	**12.061**	**4.135**	**0.016**
Site	3	5.058	1.686	0.578	0.637
Survey x Site	9	7.042	0.782	0.268	0.976
Residual	24	70.000	2.917		
Total	39	120.980			

iii) SIGNAL2 Score

Source of Variation	df	SS	MS	*F*	*P*
Survey	**3**	**2.329**	**0.776**	**3.835**	**0.025**
Site	3	0.806	0.269	1.327	0.288
Survey x Site	9	2.030	0.226	1.115	0.388
Residual	24	4.858	0.202		
Total	39	10.589			

iv) OE50 Taxa Score

Source of Variation	df	SS	MS	*F*	*P*
Survey	3	0.099	0.033	1.366	0.276
Site	**3**	**0.438**	**0.146**	**6.045**	**0.003**
Survey x Site	9	0.436	0.048	2.010	0.083
Residual	24	0.579	0.024		
Total	39	1.598			

v) Assemblage

Source of Variation	df	SS	MS	*F*	*P*
Survey	**3**	**16861**	**5621**	**4.970**	**<0.001**
Site	**3**	**10665**	**3555**	**3.144**	**<0.001**
Survey x Site	**9**	**16449**	**1828**	**1.616**	**0.002**
Residual	24	27140	1131		
Total	39	71904			

vi) Assemblage – Pairwise Tests - Sites

Sites	t	P
NCR1, NCR2	1.313	0.290
NCR1, NCR3	2.035	0.103
NCR1, A16	2.658	0.070
NCR2, NCR3	1.627	0.181
NCR2, A16	1.635	0.160
NCR3, A16	2.768	0.055

vii) Assemblage – Pairwise Tests - Surveys

Sites	t	P
Spr15, Spr16	1.204	0.324
Spr15, Spr18	1.188	0.301
Spr15, Spr20	1.461	0.169
Spr16, Spr18	1.095	0.356
Spr16, Spr20	1.366	0.196
Spr18, Spr20	1.480	0.137