ALISON HUNT & ASSOCIATES PTY LTD

ATF Alison Hunt Family Trust
ABN 76 233 543 751

22 October 2014

Ms Belinda Rayment
EDO NSW
263 Clarence Street
Sydney NSW 2000

By email: Belinda.Rayment@edonsw.org.au

Dear Belinda

Airly Mine Extension Project
Aquatic Ecology Review

Alison Hunt & Associates Pty Ltd (AH Ecology) was commissioned on a *pro bono* basis by EDO NSW on behalf of the Capertee Valley Environment Group Inc to provide expert advice on the aquatic ecology aspects of the Airly Mine Extension Project. The outcomes of this review are detailed in the attachment to this letter.

In general, it is considered that the Cardno (2014) report is adequate for the level of assessment required to support an Environmental Impact Assessment (EIS) for a State Significant Development. It is considered that the sampling methods, analyses and conclusions reached are reasonable provided that the mitigation measures detailed in the report are implemented, and that the expert reports regarding mine design, subsidence, surface water and groundwater resources, on which Cardno necessarily rely in order to determine the level of impact expected, are true and accurate.

It should be noted that this advice is based a brief review of the Cardno (2014) report and with reference to supporting documentation outlined in the attachment to this letter. Alison Hunt & Associates Pty Ltd did not visit any of the sites mentioned in this report, although Alison Hunt & Associates Pty Ltd is familiar with the scientific principles underlying the report.

Should you like to discuss this further please do not hesitate to contact me on 0408 769 315 or alison@ahecology.com.

Yours faithfully
Alison Hunt & Associates Pty Ltd

Dr Alison Hunt
Director

AIRLY MINE EXTENSION PROJECT

AQUATIC ECOLOGY REVIEW

1.0 INTRODUCTION

The Capertee Valley Environment Group Inc is preparing a submission on the Environmental Impact Statement for the proposed Airly Mine Extension Project (the 'Project"). Alison Hunt & Associates Pty Ltd (AH Ecology) (Dr Alison Hunt - *Curriculum Vitae* attached at Appendix A) was commissioned on a *pro bono* basis by EDO NSW on behalf of the Capertee Valley Environment Group Inc to provide expert advice on the aquatic ecology aspects of the Project. The following work was requested:

1. Review of relevant Project documentation and associated literature; and
2. Preparation of a written expert report that reviews the relevant components of the EIS and is prepared in accordance with Division 2 of Part 31 of the *Uniform Civil Procedure Rules 2005* (NSW).

This document is based on the review of the following report:

> Cardno (NSW / ACT) Pty Ltd 2014 Airly Mine Extension Project. Aquatic Ecology and Stygofauna Assessment. 59914168. Prepared for Centennial Airly Pty Limited. Appendix G. 14 August 2014.

With reference to the following supporting documentation:

> Golder Associates 2014 Environmental Impact Statement – Airly Mine Extension Project. Sections:
>
> 1. Chapter 2 Site Description;
> 2. Chapter 9 Identification of Key Environmental Issues; and
> 3. Chapter 10 Assessment and Management of Key Environmental Issues.

This review was based on a desk top assessment undertaken over four hours. Alison Hunt & Associates Pty Ltd did not visit any of the sites mentioned in this report, although Alison Hunt & Associates Pty Ltd is familiar with the scientific principles underlying the report.

2.0 THE REPORT

2.1 Contents

The report is set out in a standard format and it contains those chapters, appendices, tables and figures that are expected in such a report. Of particular note is Chapter 3 which details Conservation Issues, Chapter 4 which provides information relating to the Existing Environment - Surface Water Ecosystems, Chapter 5 Existing Environment - Groundwater Ecosystems, Chapter 6 Assessment of Potential Impacts and Mitigation Measures – Surface Water Ecosystems, Chapter 7 Assessment of Potential Impacts and Mitigation Measures – Groundwater Ecosystems, Chapter 8 Conclusions and Recommendations and in particular Appendix A Detailed Methods Description.

2.2 Methods

A detailed description of the methods used in the assessment is contained at Appendix A of the report, with a summary of methods and analyses contained within each section. The overall methods and analyses are in general in line with accepted methodologies for this type of assessment, although the sampling design is spatially and temporally limited, especially in relation to stygofauna. Nonetheless, the detailed methodologies are adequate to make this initial assessment and the report details areas which still require further investigation and greater clarification. These will be undertaken as a part of the ongoing monitoring of the Project.

2.3 Existing Environment –Surface Water Ecosystems

Section 4 details the background information regarding the surface water ecosystems of the Project and catchment area. Section 4.4 Monitoring Methods also outlines the aims of the aquatic ecology sampling for the Project. The sites chosen for the assessment and ongoing monitoring are adequate to establish baseline aquatic ecology and to implement a Before-After-Control-Impact monitoring program to assess potential impacts as the Project progresses. Parameters measured included water quality, aquatic habitats, aquatic macroinvertebrates and fish species. All of these parameters demonstrate that the Airly Creek and Torbane Creek sites were the most biologically impacted and that this impairment is most likely due to existing factors, including extensive deforestation, agriculture and mining.

2.4 Existing Environment –Groundwater Ecosystems

Section 5 documents the hydrogeology and surface expressions of the Project Application Area. This section necessarily relies heavily on the findings detailed in the following reports to determine the likely level of impact on surface water, groundwater resources and subsidence:

1. GHD 2014a Airly Mine Extension Project Surface Water Impact Assessment. Report prepared for Centennial Airly Coal, reference 22/16787 104162;
2. GHD 2014b Airly Mine Extension Project Groundwater Impact Assessment Report for Centennial Airly Coal, reference 22/16787 104170;
3. GHD 2014c Airly Mine Extension Project: Water and Salt Balance Assessment. Report for Centennial Airly Coal, reference 22/16787, July 2014;
4. Golder Associates 2013 Subsidence predictions and impact assessment for the Airly Mine (Draft Copy). Report prepared for Airly Mine, Centennial Coal Pty. Ltd. and

5. RPS Aquaterra (2012) Airly Mine – Annual surface and groundwater monitoring report 2012. Report for Centennial Coal Airly, February 2013.

The stygofauna sampling did not locate any stygofauna. The report notes that the absence of stygofauna in the samples may be due to the severely limited sampling effort and location of bores available for sampling. No attempt was made to sample hyporheic fauna but mention was made of the likely availability of habitat.

2.5 Potential Impacts And Mitigation Measures

Sections 6 and 7 adequately detail the potential impacts and required mitigation measures. The report clearly identifies the primary potential impact on creek habitat and aquatic organisms during construction as mobilisation of sediment and aquatic contaminants. Hydrological changes during construction to Airly Creek have also been flagged as well as degradation or loss of aquatic habitat during construction. The report recommends the implementation of a suite of measures, the majority of which are commonly used in the industry and if implemented correctly would be likely to mitigate against these potential risks.

The report identified the potential for impacts associated with the operational phase relating to subsidence. Cardno (2014) has necessarily relied upon the findings detailed in Golder Associates (2013) which conclude that there would be minimal subsidence impacts, these being limited to 100 mm and not exceeding 125 mm. The report identifies sensitive receptors, including Genowlan Creek, Gap Creek, Village Spring and Grotto Creek, and acknowledge that there is the potential for disruption of these ecosystems.

Potential impacts to groundwater resources during construction were also flagged and included construction of boreholes which could potentially penetrate groundwater resources and sediment, and contaminant infiltration to groundwater. Further assessment and monitoring of groundwater and stygofauna to inform adaptive management is included as one of the mitigation measures. The potential for operation impacts associated with groundwater ecosystems are also discussed as being ground movements, groundwater drawdown and water extractions. Mitigation measures proposed include adaptation of the mine design and an adaptive management approach to mining operations as well as ongoing monitoring of ecosystem health for adaptive management. These mitigation measures are considered appropriate and manageable.

2.6 Impacts On Threatened Species

The matters identified under the FM Act, TSC Act and EPBC Act as having the potential to be impacted by this Project were considered by Cardno (2014) to be unlikely to be significantly impacted by this Project. Whilst Assessments of Significance for species listed under the TSC Act with at least some potential to occur or to be impacted by this Project, have been undertaken (i.e. Macquarie Perch, Adams Emerald Dragonfly and Giant Dragonfly) (refer to Table 3-1, page 13) there appears to be no assessment of the impacts using the Significant Impact Criteria detailed in *Matters of National Environmental – Significant Impact Guidelines 1.1* (Department of the Environment 2013) for the Macquarie Perch which is listed under the EPBC Act. This is an omission and this assessment should have been included to assist with the determination of the likely level of impact on the Macquarie Perch. Nonetheless, it is likely that the conclusions reached (i.e. the lack of significant impacts on this species) would not have been altered and Alison Hunt & Associates Pty Ltd in general concurs with the findings.

2.7 Conclusions and Recommendations

The report concludes that although the extent of surface watercourses is limited, they are important resources for local aquatic and terrestrial fauna. Similarly, groundwater habitats are also likely to be important both locally and regionally important and they acknowledge that sampling of groundwater habitats was both spatially and temporally limited. The report further details recommendations for ongoing monitoring including key components of aquatic ecosystems, visual assessment of creek beds and a more extensive stygofauna sampling program.

3.0 OUTCOME OF THIS REVIEW

The purpose of this review was to determine the veracity of the aquatic assessment undertaken and report prepared by Cardno (2014) in regards to the Airly Mine Extension Project. Despite concerns in relation to the limited spatial and temporal sampling of aquatic ecosystems, of both surface water and groundwater communities, the overall methods and analyses are in general in line with accepted methodologies for this type of assessment. The recommendations contained within the report in regards to additional assessment, especially for stygofauna and hyporheic fauna, would provide additional data for these groups over time and hence add to the scientific robustness of assessment.

Alison Hunt & Associates Pty Ltd essentially agrees with the authors of the report that the Project is unlikely to significantly impact aquatic ecosystems, either surface water or groundwater resources, and aquatic matters listed under the FM Act, TSC Act and EPBC Act. It should also be noted that the assessment of impacts undertaken by Cardno (2014) necessarily rely on data and views contained in expert reports on *inter alia*, subsidence, groundwater and surface water. The author's conclusions seem reasonable given that these reports indicate that impacts to surface water and groundwater resources are unlikely to be significant and that subsidence is likely to be minor.

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Dr Alison Hunt

Dr Alison Hunt has over 25 years experience in providing environmental and ecological services in Australia and the USA. She has a Bachelor of Science (Honours) with a major in ecology and a PhD in conservation and population genetics. She is a committed environmental professional with a broad knowledge base of environmental and ecological planning issues. Alison was Senior Ecologist for ERM Pty Ltd and Principal and head of Ecology NSW for GHD Pty Ltd before starting her own consultancy in 2006.

- Marina developments along the east coast of NSW including Port Macquarie, Sydney Harbour, Batemans Bay with a focus on impacts at the estuarine / marine interface and development of mitigation methods to protect both of these sensitive environment.
- Ecological assessment of the Kooragang Port and Transport Corridor including Aquatic Ecology, Water Bird Surveys, Green & Golden Bell Frog Monitoring Study and Species Impact Statement for Premier's Department & Austeel Pty Ltd.
- Assessment of the Tomago Trunkmain Upgrade (Ash Island) for Hunter Water Corporation.
- Mapping and assessment of Coastal Endangered Ecological Communities along 150 km of coastline of the Shoalhaven LGA in conjunction with the Southern Rivers Catchment Authority.
- Monitoring of the instream health of the Morwell River Diversion at the Yallourn Power Station in Victoria after completion of the diversion. This project involved testing different artificial substrates to determine the success in recruitment of macroinvertebrates into the system.
- Scientific advisor for a number of clients in the coal seam gas industry in NSW.
- Principal scientist for the assessment of the potential impacts of the construction and operation of a coal seam gas pipeline from Gloucester in the north to Hexham in the south for AGL since 2009 to present.
- Design and conduct of surveys for Kogarah City Council which addressed the potential effects of leachate on marine benthos within Georges River, Botany Bay.
- Advisor to Australian Federal Marine Authority on the likely impacts of disposal of illegal fishing boats at Torres Strait, Nhulunbuy, Darwin and Broome.

She has also worked in an international setting undertaking ecological research, environmental assessment and as a limited-term assistant professor in the USA where she lectured in Biology and Ecology. Alison has also lectured in Marine Biology at the University of Technology Sydney and tutored Genetics and Biology at the University of Sydney. Alison is a recognised expert in her field through publishing in international scientific journals (from 1987 – 2011) as well as peer reviewer for these journals.

Areas of Expertise

Assessment of major impacts	TSC Act, FM Act,
BioBanking certified	Part 3A legislative requirements
Wetland surveys	Commonwealth EPBC referrals
Water quality	Environmental study design & analysis
Habitat restoration & conservation strategies	AUSRIVAS certified

Examples of Relevant Projects

Ariadne Australia Pty Ltd – Batemans Bay Marina, Batemans Bay
Ariadne Australia Pty Ltd – Pt Macquarie Marina, Port Macquarie
These projects have involved constraints and opportunities analyses of the proposed redevelopment of these two very different marinas. At both sites seagrass beds and mangrove forests dominate and important habitat for a range of threatened species are located within the locality. These projects have involved mapping of species distribution and advising on innovative ways in which some development may proceed whilst still protecting these valuable resources.

Birkenhead Point Marina Pty Ltd – Birkenhead Point Marina, Sydney Harbour, Drummoyne.
Assessment of the ecological impacts on the marine environment as a consequence of the redevelopment of Birkenhead Point Marina, Sydney Harbour, Drummoyne. Involved detailed assessment of the local marine ecology, including mapping of seagrass beds and existing jetty pylons and assessment of the likely impacts of the redevelopment on matters of conservation significance.

Eco Villages Australia Pty Ltd - Currawong Beach, Pittwater
The Currawong Beach Resort previously owned by the NSW Labour Council is undergoing redevelopment and whilst direct impacts on the marine environment are not anticipated important seagrass beds are located offshore. This project involved seagrass identification and mapping of their distribution and advising the development team of appropriate measures to protect these beds and other marine organisms within Pittwater.

Australian Fisheries Management Authority – Torres Strait, Nhulunbuy, Darwin & Broome
This project focused on advising AFMA on the likely impacts of disposal of illegal fishing boats at Torres Strait, Nhulunbuy, Darwin and Broome and field surveys to identify the most suitable disposal sites with due consideration to protection of the marine environments. This challenging project also involved consultation with relevant stakeholders.

Department of Environment and Heritage
Dr Alison Hunt worked in collaboration with the Department of Environment and Heritage (DEH) to prepare *EPBC Policy Statement 1.2 Significant Impact Guidelines: Actions on, or impacting upon Commonwealth land, and actions by Commonwealth agencies.* These guidelines direct agencies in deciding whether a referral is required under the EPBC Act and steers environment risk management by Commonwealth agencies. In particular her role was advising DEH on matter relating to ecological assessment for terrestrial and marine matters.

Sydney Water Corporation – Kurnell, Botany Bay

Dr Alison Hunt, whilst Principal Ecologist with GHD Pty Ltd, investigated the ecological impacts of the proposed Sydney Water Desalination Plant at Kurnell. These studies included the mapping of remnant vegetation communities on site and an assessment of the likely impacts of the Desalination Plant on the site and the overall conservation values of the Kurnell Peninsula. She was also responsible for the assessment of the effects on marine population of the ocean inlet associated with this plant off the Kurnell Peninsula.

Australian Federal Police – North Head

Dr Alison Hunt has undertaken ecological assessment and is ecological advisor for the protection of the Little Penguin during the proposed redevelopment of the Australian Institute of Police Management at their North Head, Sydney site. The Little Penguin which nests along the sandstone cliffs of the site is the only remaining mainland population of this species. Ensuring protection of this population and the neighbouring marine environment are key issues for the Commonwealth and the local community. Alison has prepared Ecological Assessment reports for this site, been involved in the development management plans, participated in a PWC Hearing and prepared a referral under the EPBC Act.

Sydney Harbour Foreshore Authority – Botany Bay

Dr Alison Hunt was project manager and lead scientist in the terrestrial and aquatic assessment of Spring Creek Wetland and Marsh Street Wetlands for the proposed Cooks Cove development site, Botany Bay, NSW. Surveys included fish, benthos and mapping of terrestrial and wetland vegetation communities across the proposed site.

Department of Defence – Darwin, NT

Dr Alison Hunt was lead scientist for the marine and terrestrial ecological assessment for the extension of Department of Defence harbour wharf, Darwin NT whilst with ERM. Of particular importance was the examination of potential impacts of the proposed wharf extension on the migratory patterns of Cetacean populations and fisheries. A management plan for the proposed works was implemented to assist in the protection of whales, dugongs and fish species during construction and operation.

UTS Rowing Club – Sydney Harbour

Dr Alison Hunt surveyed and mapped the distribution of seagrass and other marine flora and fauna to determine the likely impacts of the proposed redevelopment of the UTS Rowing Club, Iron Cove in Sydney Harbour.

Kogarah City Council – Botany Bay

Whilst Principal Ecologist with GHD Pty Ltd, designed and undertook a survey for Kogarah City Council which addressed the potential effects of leachate on marine benthos within Georges River, Botany Bay. This project included a modified BACI sampling design, remote collection of benthic samples, identification of benthos, and statistical analyses which allowed differences in benthos from several locations to be compared.

Australian Federal Police – North Head

Dr Alison Hunt has undertaken ecological assessment and is ecological advisor for the protection of the Little Penguin during the proposed redevelopment of the Australian Institute of Police Management at their North Head, Sydney site. The Little Penguin which nests along the sandstone cliffs of the site is the only remaining mainland population of this species. Ensuring protection of this population and the neighbouring marine environment are key issues for the Commonwealth and the local community. Alison

has prepared Ecological Assessment reports for this site, been involved in the development management plans, participated in a PWC Hearing and prepared a referral under the EPBC Act.

Eastern Star Gas / Santos – Coolah-Newcastle Gas Pipeline
Dr Alison Hunt has worked closely with ESG during alignment selection from Coolah in western NSW through to Kooragang Island and Hexham Swamp for a coal seam gas pipeline from Coolah to Newcastle.

AGL Pty Ltd – Gloucester-Hexham Gas Pipeline
Dr Alison Hunt has assessed the potential impacts of the construction and operation of a coal seam gas pipeline from Gloucester in the north to Hexham in the south. This Part 3A assessment has included detailed surveys and negotiation with a range of stakeholders including government departments, Biobanking assessments, offset site selection, targeted surveys.

Hunter Water Corporation - Tomago Trunkmain Upgrade (Ash Island)
Dr Alison Hunt undertook the ecological assessment of the Tomago Trunkmain Upgrade when she was Principal and head of Ecology NSW for GHD Pty Ltd. She was responsible for the stakeholder liaison, ensuring the scientific integrity of the study, field assessments and report preparation.

Premier's Department & Austeel Pty Ltd - Kooragang Port and Transport Corridor
Aquatic Ecology, Water Bird Surveys, Green & Golden Bell Frog Monitoring Study and Species Impact Statement. Dr Alison Hunt carried out the Aquatic Ecology assessment for this project and assisted with water bird surveys, Green and Golden Bell Frog monitoring and provided scientific review for the Species Impact Statement produced for this report when she

Coal & Allied Pty Ltd - Pre-mining areas in the Hunter Valley
Aquatic assessment for freshwater streams and wetlands in pre-mining areas in the Hunter Valley, Coal & Allied Pty Ltd. AUSRIVAS assessments across these streams, drainage lines and rivers. Wetlands were assessed to provide information on likely outcomes for these ecosystems with nearby mining.

Qualification and Affiliations

- PhD, University of Wollongong, 1993
- BSc (Hons. I), University of Wollongong, 1987
- Royal Zoological Society of NSW, since 1983
- Australian Marine Sciences Association, since 1984
- Ecological Society of Australia, since 1984
- AUSRIVAS Certified
- Biobanking Assessor

Academic Awards

- Victorian Institute of Marine Sciences – Research Grant
- Genetics Society of Australia – Smith-White Award
- Ecological Society of Australia – Student Research Award
- Linnean Society of NSW – Joyce Vickery Research Support Grant.

Selection of Scientific Publications

Ayre DJ, Hunt A & Sherman C 2011 Random mating, long distance treks, population persistence and the stability of genetic variation across generations in star fish *Parvulastra exigua*. Submitted.

Sherman C, Hunt A & Ayre DJ 2008 Is Life-History a Barrier to Dispersal? Contrasting Patterns of Genetic Differentiation along an Oceanographically Complex Coast. Biological Journal of the Linnean Society, 2008, 95, 106–116.

Hunt A, Karlson RH & McDonald JH (1997) Nuclear DNA sequence polymorphism analysis of population structure and geographic variation in a freshwater bryozoan with dimorphic dispersal capabilities. Ecological Society of America (USA);

Hunt A, Karlson RH & McDonald JH (1996) Analysis of population structure and geographic variation in a freshwater bryozoan with dimorphic dispersal capabilities using DNA sequence polymorphisms. Society for the Study of Evolution (USA);

Hunt A (1995) Genetic consequences of contrasting dispersal strategies for populations of two Australian species of intertidal starfish. Marine Benthic Ecology Meeting (USA);

Hunt A (1993) Effects of contrasting patterns of larval dispersal on the genetic connectedness of local populations of two intertidal starfish, *Patiriella calcar and P. exigua*. Mar. Ecol. Prog. Ser. 92: 179-186;

Hunt A (1992) Philopatry and the genetic structure of populations. Genetics Society of Australia;

Hunt, A (1991) Restricted versus widespread dispersal of *Patiriella calcar* and *P. exigua.* Australian Marine Sciences Association;

Hunt, A (1991) The consequence of broadcast spawning versus philopatry for the genetic structure of Australian starfish. Society for the Study of Evolution (USA);

Hunt A & Ayre DJ (1989) Population structure in the sexually reproducing sea anemone, *Oulactis muscosa.* Mar. Biol. 102: 537-544;

Hunt A (1989) Some preliminary data describing the structure of several populations in two co-occurring species of starfish. Ecological Society of Australia;

Hunt A (1988) Geographic variation in the sea anemone *Oulactis muscosa*. Genetics Society of Australia; and

Hunt A, Dickens HJ & Whelan RJ (1987) Movement of mammals through tunnels under railway lines. Aust. Zool. 24: 89-93.