FLORA AND FAUNA MANAGEMENT PLAN

BASELINE MONITORING 2016

CONSULTING & ENVIRONMENTAL SERVICES

NEWNES KAOLIN & SAND MINE, NEWNES JUNCTION

ENVIRONMENTAL SCIENCE AND SOIL SCIENCE SERVICES FOR THE BLUE MOUNTAINS/ CENTRAL WEST DISTRICTS

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Document Version History – Version 01, Final submission - 24th March 2016.

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Cover Letter

25th March 2016

CONSULTING & ENVIRONMENTAL SERVICES

Ron Goldbery,
3 Karingal Court,
Marsfield NSW 2122

Dear Dr Goldbery,

Consulting and Environmental Services Pty Ltd in collaboration with Woodlands & Wetlands Pty Ltd have conducted the flora and fauna baseline monitoring for the Newnes Kaolin & Sand Mine. The site survey work was completed on the 1st and 12th March 2016 and was undertaken as outlined in the project reference document Flora and Fauna Management Plan RPR103669 (September 2012).

Baseline monitoring for flora and fauna was conducted at ten monitoring sites

- two monitoring sites within the 100 m buffer
- four monitoring sites located within 200 m of the common project boundary with the adjoining Greater Blue Mountains World Heritage Area,
- two monitoring sites along the main tributaries to the Wollongambe River, and two monitoring sites along the Wollongambe River.

Each of the ten, 400 m^2 plots was closely inspected using the original survey (RPS Australia East Pty Ltd, 2012) as a guide to likely species and their habitat.

We found all sites in the monitoring program had been severely burnt during State Mine bushfire (17th October 2013). This fire burned for one month tracking from Marrangaroo through Newnes to Bilpin covering over 55,000 ha. The fire through Newnes Junction at Clarence resulted in extreme canopy damage, with total destruction of groundcover, particularly at sites located on the ridges and mid-slopes. Areas in creek line tributaries were better protected, and this is represented in the base line monitoring record for these sites. They have the higher diversity of structural diversity in vegetation, to support presence of birds and wombat. Similarly the site at the Wollongambe River has a diverse ecological system developing based on insects, presence to water and northerly aspect. Of the ridge sites, site 7 is showing the nutrient cycling process is commencing, with the presence of termites starting mound building.

Generally the fire resulted in widespread death of trees. The surviving ones have intense epicormic growth. Species such as banksia which can regenerate rapidly after fire are becoming very prominent. Almost all of the smaller shrubs have been killed. The new growth is in very juvenile stages with no inflorescence or mature foliage to assist identification. There are also some agricultural weeds such as fleabane becoming established on bare, burnt ground. The loss of the litter layer has exposed the sandy surface soil. This is soil very susceptible to erosion during intense rain events.

New species were identified:
Actinotus helianthus (flannel flower) was evident on plot 6
Cynodon dactylon (native couch) was evident on plot 1
Drosera pygmaea (pygmy sundew) was evident on plot 5.

Weed species were identified:
Conyza bonariensis (Flax-leaf fleabane) was evident on plots 1 and 2
Taraxacum officinale Wiggers s.lat. (Dandelion) immature, evident on plots 1, 2, and 6

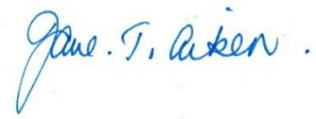
Recommendations include developing a monitoring schedule to cover the Spring-Summer flowering period commencing October through to February.

Closure

Baseline monitoring for the flora and fauna management plan is to provide for primary assessment of impacts from future mine operations. However, due to the significant fire damage to the project area, impact assessment has to include aspects of re-establishment and the subsequent succession of structural diversity within the vegetation community.

Please find attached our 2015-2016 baseline monitoring assessment report. This report specifically addresses the condition 30a of the project approval as outlined in the Flora and Fauna Management Plan 2012.

Yours faithfully,



Dr. Jane T. Aiken PhD, BSc(Hons), BSc, MSusAgr$_{(\text{in prog,}}$ CPSS.

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1.0 Introduction

The Newnes Kaolin mine is accessed from Newnes Junction at Clarence. Project approvals cover a pit work methodology that will cover 25 ha for 20 year supply. Site boundaries are the Clarence Colliery operations, the Rocla sand quarry and national parkland of the Greater Blue Mountains World Heritage Area.

Environmental management during extraction operations will integrate continual assessment and protection to identify and mitigate significant change to habitats for flora and fauna, particularly in the 100 m buffer zone between the mine and the GBWHA as well as within the national park itself.

Monitoring includes sampling for surface water, groundwater, and flora and fauna.

Monitoring for flora and fauna is noted in the project Condition of Consent 30(a) to include "a detailed baseline data on the flora and fauna on the site and adjacent the site, including habitat present in the Greater Blue Mountains WHA and along the Wollangambe River and its tributaries".

Scope for baseline monitoring is outlined in Section 6.0 of the FFMP (RPS Australia East Pty Ltd, 2012). Here reference is provided to a detailed combined flora species record for the site, through data collection surveys in 2003, 2004 and assessment at each of the ten annual monitoring sites in 2011. Additional comparative information is the threatened species lists (RPS Australia East Pty Ltd 2012, p 18) noted at 5 July 2010 for threatened species and Ecological Communities known within 10km of the subject site.

Baseline monitoring was undertaken on 1st and 12th March at the ten monitoring sites notated for the Flora and Fauna Management Plan. Sites were located to these eastings and northings coordinates. Data were recorded on the monitoring checklist sheets provided in the FFMP.

This report provides the methodology of data collation for the baseline monitoring, the results obtained, with commentary and recommendations.

2.0 Method

Consulting and Environmental Services Pty Ltd (Dr. Jane Aiken) in collaboration with Woodlands & Wetlands Pty Ltd (Dr. Peter Bacon) have conducted the flora and fauna baseline monitoring for the Newnes Kaolin & Sand Mine. The site survey work was completed on the 1st and 12th March 2016.

For each of the ten monitoring sites site data were recorded using the template of the FFMP (RPS Australia East Pty Ltd, 2012) Vegetation Monitoring Plot Results (Appendix 1.) and the Fauna Habitat Assessment Record Sheet (Appendix 3).

Monitoring sites were located as denoted on the plan of monitoring locations available at http://www.sydneyconstructionmaterials.com.au/news-environmentplan.html reference: 105716-14B (Sydney Construction Materials Pty Ltd, 22/2/2016).

A 20 m x 20 m sampling and identification quadrant was defined at the monitoring location Easting: Northing as the centre of the quadrant (Table 2-1).

Table 2-1 Flora and Fauna Monitoring Locations

Id	Easting	Northing
1	244983	6292989
2	245029	6293511
3	245161	6293667
4	245155	6293250
5	245563	6293607
6	245497	6293333
7	245321	6293376
8	245341	6293284
9	245057	6293029
10	245026	6292811

2.1 Evaluation of Vegetation species presence

The surveys were undertaken using a modified Braun-Blanquet methodology. In addition to recording presence/ absence as per the original survey (RPS Australia East Pty Ltd, 2012) each species identified as being present in the original, pre-bush fire survey was 'scored' on abundance in March 2016. The classification is as below:

NE- Not evident
R- Rare: one or two specimens
O- Occasional: a few isolated specimens
C- Common: occurs throughout the plot
A-Abundant: numerous individuals throughout the plot
D-Dominant: the major species present at the time of the survey

2.2 Evaluation of Canopy Tree health

Stand health was assessed using the methodology of Grimes, (1978) Tree health was scored to provide a maximum total of 27 for:

- A- Crown position using a score of 1-5
- B- Crown size using a score of 1-5
- C- Crown density using a score of 1-9
- D- Occurrence of dead branches using a score of 1-3
- E- Epicormic growth using a score of 1-5

2.3 Evaluation of Fauna Habitat

Fauna habitat was recorded on the basis of topographic position, plot quality, ecological resources, species diversity, ground-cover by trees and shrubs, canopy, geology and soils. Presence of birds, invertebrates, and vertebrate species were noted. Data records included a photographic record by north, south, east and west views and a summary description.

Data presented comprise a general identification summary and site photograph. Detailed site information was as recorded on the habitat record sheets.

2.4 Weed Identification and Management Actions

If weeds were recorded in the baseline monitoring, then the presence and identification is recorded on the Fauna Habitat Assessment Record Sheet. Further management actions will be defined by protocols within the Flora and Fauna Management Plan (RPS Australia East Pty Ltd, 2012, Section 5.0).

Reference texts include Lamp and Collet (2002).

2.5 Unidentified and or New Species

Unidentified species were recorded with either a photographic record or as a small frond sample from the monitoring sites. Samples and sites were listed for future identification. Reference texts include Lollback *et al* (2014), Wilson (2012) and Fairley (2004).

New and identified species were listed together with the records of Vegetation Species Presence.

2.6 Records

Data submissions include hard copy reports and electronic files.

3.0 Results

3.1 Vegetation Species Presence

Table 3.1 Occurance and abundance of species within each plot (NE-not evident, R-rare, O-occasional, C-common, A-abundant and D-dominant)

Family/Class Name	Species Scientific Name	Species Common Name	Plot Number									
			1	2	3	4	5	6	7	8	9	10
Class LYCOPSIDA	Clubmosses and Quillwarts											
GLEICHENIACEAE	*Gleichenia dicarpa*	Pouched Coral-fern			R		R					
	Pteridium esculentum	Bracken	C	A	C		A	C	C	C		
LINDSAEACEAE	*Lindsaea linearis*	Screw Fern										
SCHIZAEACEAE	*Schizaea bifida* s. str.	Forked-comb fern	R									
BLECHNACEAE	*Blechnum cartilagineum*	Gristle Fern					R	R				
	Blechnum nudum	Fishbone Water-fern	NE									
OSMUNDACEAE	*Todea barbara*	King Fern			O							
Class	Flowering Plants											
RANUNCULACEAE	*Clematis aristata*	Toothed Clematis						O				
RHAMNACEAE	*Pomaderris*	-	R		R	NE						
EUPHORBIACEAE	*Amperea xiphoclada*	Broom Spurge		C			R	O	O		O	O
VIOLACEAE	*Viola hederacea*	Ivy-leaf Violet	C	O								
	Viola sieberiana		NE	O	R		R					
CASUARINACEAE	*Allocasuarina littoralis*	Black She-oak		NE								
CUNONIACEAE	*Callicoma serratifolia*	Black Wattle		NE	NE							
	Bauera rubioides	River Rose						R	Rx			
MALACEAE	*Cotoneaster*	Cotoneaster										
PROTEACEAE	*Banksia marginata*	Silver Banksia					C					
	Banksia serrata	Saw Banksia		C					C	O		
	Banksia spinulosa var.	Hairpin Banksia	C	C		R	R	R	C	R	C	O
	Grevillea laurifolia	Laurel Grevillea				O			R			NE
	Hakea dactyloides						R		R			
	Hakea laevipes ssp.	-				R						
	Hakea sericea						R					
	Isopogon prostratus	Prostrate Drumstick			NE							
	Isopogon anemonifolius	Broad-leaf Drumsticks	O	R		R			C	R		
	Lomatia silaifolia	Crinkle Bush				O	C	R	R	R		O
	Persoonia lanceolata	Lance Leaf Geebung			R			R	O		R	NE
	Persoonia laurina subsp.	Laurel-leaf Geebung	R									
	Persoonia levis	Broad-leaf Geebung		O	R	R		R	NE	NE		O
	Persoonia myrtilloides	Myrtle Geebung										
	Petrophile canescens	Conesticks				R			O		O	O
	Petrophile pulchella	Conesticks										

Family/Class Name	Species Scientific Name	Species Common Name	Plot Number									
			1	2	3	4	5	6	7	8	9	10
	Petrophile sessilis	Conesticks					R	O				O
	Telopea speciosissima	Waratah		O	C	NE		O	O	O	R	O
MYRTACEAE	*Eucalyptus blaxlandii*	Blaxland's Stringybark			O			R			R	
	Eucalyptus laophila	-										
	Eucalyptus mannifera	Brittle Gum	O									
	Eucalyptus piperita	Sydney Peppermint	R	C				C		O		
	Eucalyptus radiata ssp. radiata	Narrow-leaved Peppermint						R	R			
	Eucalyptus sclerophylla	Hard-leaved Scribbly Gum				O	R					
	Eucalyptus sieberi	Silvertop Ash		O	R				C		O	C
	Eucalyptus sparsifolia	Narrow-leaved Stringybark							R			
	Baeckea linifolia	Swamp Baeckea	R									
	Leptospermum	Swamp Tea-tree									O	
	Leptospermum	Spider Teatree	O									
	Leptospermum	Twin-flower Tea-tree	O									
	Leptospermum	Wooly Tea-tree	O									
	Leptospermum	Yellow Tea-tree	O				O					
	Leptospermum	Round-fruited Tea-				O			C	C		
	Leptospermum trinervium	Flaky-bark Tea-tree			R							
RUTACEAE	*Boronia anemonifolia*									R		
	Boronia microphylla	Small-leaved Boronia			R		C	O	O		R	C
FABACEAE	*Bossiaea heterophylla*	Variable Bossiaea										
	Daviesia latifolia	Broad-leaf Bitter Pea					R				R	O
	Gompholobium latifolium	Broad-leaf Wedge-pea					R	O				
	Pultenaea scabra	Rough Bush-pea			R				O			
	Platylobium formosum					NE						
	Dillwynia floribunda					NE						
MIMOSOIDEAE	*Acacia longifolia*	Sydney Golden Wattle	R	O	O	O	O	O		O		
	Acacia obtusifolia	-										
	Acacia terminalis	Sunshine Wattle	O	O	O	R	R	O		O	R	C
	Acacia ulicifolia	Prickly Moses				R	R		R			
SANTALACEAE	*Leptomeria acida*	Native Currant			R				R	NE		
PITTOSPORACEAE	*Billardiera scandens*	Apple-berry	NE				NE	NE				NE
ARALIACEAE	*Polyscias sambucifolia*	Elderberry Panax						NE				
	Astrotricha latifolia						NE					
	Astrotricha longifolia							R				
APIACEAE	*Platysace lanceolata*	Native Parsnip			R							
	Platysace linearifolia	Narrow-leaf Platysace					R		O	O	O	

Family/Class Name	Species Scientific Name	Species Common Name	Plot Number									
			1	2	3	4	5	6	7	8	9	10
	Xanthosia pilosa	Hairy Xanthosia						R		R		
ASTERACEAE	*Arrhenechthites mixtus*	Purple Fireweed			O						R	
	Ozothamnus ferrugineus	Tree Everlasting		NE	R					NE		
EPACRIDACEAE	*Epacris microphylla*	Small-leaf Heath	NE		NE							
	Epacris pulchella	Coral Heath	R	NE	R		R	O		NE	R	R
	Epacris purpurascens var onosmiflora	Port Jackson Heath					NE					
	Leucopogon lanceolatus	Lance-leaf Beard-			O						NE	
	Monotoca scoparia	Prickly Broom-heath						O	R		O	O
RUBIACEAE	*Pomax umbellata*	Pomax		R	R	R		O		NE		
Family/Class	**Species Scientific Name**	**Species Common**	**Plot number**									
			1	2	3	4	5	6	7	8	9	10
SCROPHULARIACE	*Veronica plebeia*	-									NE	
ERICACEAE	*Dracophyllum secundum*				NE							
	Lissanthe strigosa	Peach Heath			R					NE		R
STYLIDIACEAE	*Stylidium graminifolium*	Grass Trigger-plant			R		O	R		R		
PODOCARPACEAE	*Podocarpus spinulosis*	Spiny-leaf Podocarp					R					
LOBELIACEAE	*Lobelia anceps*									R		R
Subclass LILIDAE	Monocotyledons											
LOMANDRACEAE	*Lomandra glauca subsp.*	Glaucous Mat-rush		O	O			R	R	R	R	R
	Lomandra longifolia subsp. longifolia	Spiny Mat-rush	C	O	O		A	O		R	O	R
XANTHORRHOEAC	*Xanthorrhoea media*	Sydney Grass-tree							NE			
PHORMIACEAE	*Dianella caerulea var.*	Rough Flax Lily									NE	
	Dianella prunina	-					R	O				
IRIDACEAE	*Patersonia sericea*	Silky Purple-flag					NE		O	C O	O	R
	Patersonia fragilis	Glabrous Purple-flag										
	Patersonia glabrata	Cauline-leaf Purple-				R	O	O	R	C		R
XYRIDACEAE	*Xyris gracilis subsp.*	Slender Yellow-eye	R									
CYPERACEAE	*Caustis flexuosa*	Curved Caustis				NE	NE		NE	O		
	Gahnia sieberiana	Red-fruited Saw-sedge	C	Ox			C	R				
	Lepidosperma laterale	Variable Sword-sedge		O								
RESTIONACEAE	*Empodisma minus*	Spreading Rope-rush	R									
	Lepyrodia scariosa	Chaffy Scale-rush										NE
POACEAE	*Austrostipa bigeniculata*						NE					
	Entolasia stricta	Wiry Panic					R					
	Microlaena stipoides var. stipoides	Weeping Grass				R					O	O
	Poa labillardieri	Tussock Grass				R					O	O

Family/Class Name	Species Scientific Name	Species Common Name	Plot Number									
			1	2	3	4	5	6	7	8	9	10
	Poa sieberiana	-					R				R	
Additional Observations Recorded Baseline Monitoring March 2016												
Family/Class Name	**Species Scientific Name**	**Species Common Name**	**Plot Number**									
			1	2	3	4	5	6	7	8	9	10
Class	Flowering Plants											
	Actinotus helianthus	Flannel Flower						O				
Class	*Grasses and Sedges*											
	Cynodon dactylon	Native couch	O									
Class	Carnivorous											
	Drosera pygmaea	Pygmy Sundew					O					

Code:

NE- not evident.

R- rare: one or two specimens

O- occasional: a few isolated specimens

C- common: occurs throughout the plot

A- Abundant: numerous individuals throughout the plot

D- The major species present at the time of the survey

3.2 Canopy Tree Health

The entire area was burned in the 2014 bushfire. Virtually all the trees had suffered fire damage. Many had fallen over, leaving charred stumps. Fire damage was evident over the entire trunks of most trees. This made species identification difficult. However it also provided an opportunity to assess stand health some 29 months after the fire. The results of the evaluation are shown below (Table 3-1).

Table 3-2 Evaluation of Canopy Tree Health

Plot number	Crown position	Crown size	Crown density	Occurrence of dead branches	Occurrence of epicormic growth	Total stand health score
	Score of 1 to 5	Score of 1 to 5	Score of 1 to 9	Score of 1 to 5	Score of 1 to 3	Max score is 27
1	4	2	7	3	1.5	17.5
2	4	2	5	2	1.5	17.5
3	2	1	6	1	1.5	11.5
4	5	2	7	2	1.5	17.5
5	5	3	7	4	1.5	20.5
6	4	2	3	2	1.5	12.5
7	3	2	5	2	1.5	13.5
8	3	2	5	1	1.5	12.5
9	3	3	8	3	1	18
10	4	3.5	5	3	2	17.5
Average	3.7	2.3	5.8	2.3	1.5	15.6

Table 3-3 Comments on tree stand health

Stand Health Attribute	March 2016 Comment
Crown position	The average crown score of 3.7 suggests reasonably even tree heights, that until the 2013 fire reflected lack of water and nutrients rather suppression because of competition for light.
Crown size	Crown size has been severely impacted by the fire and it is likely that virtually all the crown foliage was burnt. The crowns are re-establishing themselves. Plot 3 was particularly severely burned. The trees therefore have minimal crown at present.
Crown density	Crown density is effectively the thickness of the foliage against the sky. Very thick foliage usually means little of the sky can be seen. Much of the foliage was epicormic, however there is sufficient to achieve a reasonable score on several plots.
Occurrence of dead branches	Most of the dead branches were obviously due to the fire. The scores of 1 out of 5 indicate that dead branches were a dominant feature of these plots.
Epicormic growth	Epicormic growth is a survival response to a severe stress. The short multi-stemmed emerge from the main trunk. This is often seen in eucalypts following insect attack, drought and fire. All the plots except 10 had vigorous epicormic growth. The growth is designed to assist the tree in surviving until the crown is re-established.
Total health scores	Total health scores averaged just over half of the potential score (15.6/27). This suggests severe stress (Stone and Bacon, 1994). It is expected that the health scores will be higher at the time of the next survey.

3.3 Flora and Fauna Habitat

Habitat for flora and fauna were severely damaged in the October 2013 State Mine Bushfire. Images from satellite view over Line 6 in 2009 and 2014 show the fire impact and the areas (Fig 3-1a,b)

Satellite view over line 6 on 30.6.2009

Satellite view over line 6 on 16.11.2014 approximately 13 months after the State Mine fire.

Figure 3-1a, b Comparison post fire damage vegetation 2009 and 2014 over Line 6.

Tables 3-3 and 3-4 provide data record for each monitoring site. Table 3-3 present highlight observations of habitat with each site identified with the relevant east facing photograph.

Table 3-4 General characterisation/ descriptions of ten the monitoring sites March 2016

Plot	Site identification photograph of the 'East' view.	Summary observations
1		A dry, intermittent drainage line, without pools or holes. Groundcover is a highly diverse mixture of grasses, (couch, microlena, stipoides) and shrub *Acacia terminalis* common seedlings at 200 mm height. Shrubs at 1.5-1.8 m height. Sedge plants at 2.0 m height. Butterfly, copper/orange and black.
2		A mid-slope site, with permanent drainage flow from the north east. Groundcover includes moss, leaf litter, some grasses, and charcoal. Leaf litter was abundant and bark was common. Seedling regeneration was at 50-60 cm heights, with a signficant amount of sapling regeneration at 2 m and by epicormic budding on trees 5-10 m height. The soils were clay, loam with some sand. The area was moist. Within the drainage path were yellow everlasting daisy (*Coronidium scorpioides*), and False Sarsaparilla (*Hardenbergia violacea*). Logs of sizes up to 300 mm were moderate to common abundance.
3		Rocky head of the north creek tributary on the downslope from the ridge level. Highly weathered sandstone, very narrow creek (1m width), small pools. Very steep on north and steep on southern side. Observed sticky Sword-sedge (*Lepidosperma viscidum*) flat leaf, serrated edge. Abundant rocks, with flat lichen
4		Ridge area upper-mid-slope, open vegetation community, severely burnt, epicormic budding on all trees, remnant logs.

Plot	Site identification photograph of the 'East' view.	Summary observations
5	  1  2  3  4	Wollongambe River, in the riparian zone, open grassland/forbland, eastern aspect, shallow soils, highly abundant flies, locust, and small water lizard. Groundcover revegetated, high diversity, presence of carnivorous Sundew on northern aspect. Maybe *Gahnia subaequiglumis*, (Bog Saw-sedge) Site pictures include: 1. Water lizard 2. Pygmy Sundew (carnivorous) 3. White bud-flowered red-stemmed grass/ herb vine 4. Microfern (Gristle fern) in pencil sedge, and Ghania. 5. View north to river cutting 6. View west over the monitoring site.  5  6

Plot	Site identification photograph of the 'East' view.	Summary observations
6		Intense ground cover with leaf litter, shrub layer, Banksia fronds, bracken, fallen logs, emergent banksia seedlings (20 cm height), waratah. Area with wombat burrow. Green/brown Thornbill in the shrub cover of the creek line.
7		Open, low shrub and herb regeneration with exposed sands, without leaf litter cover. All trees burnt, epicormic budding. Saplings growing in clumps. Shrubs all < 1.0 m tall. Presence of termites, ants and flies.
8		Leaf litter sparse, shrub regrowth *Acacia longifolia*, soil leaf litter as soil wash, thin layer sand overlying yellow sandy clay,. No organic layer, accept as micro-terraces of rainfall wash.
9		Intermittent drainage, bracken, vigorous regrowth, epicormic growth, saplings 2-4 cm diameter, high abundant typical banksia shrub regeneration, trees, slope 2 % to the north ridge. Regenerating shrub species at 1-2 to 1.5 m height, established bracken, last fire October 2013.
10		Regenerating open forest. Trees have epicormic budding and stems. Trees of 100-200 mm diameter have epicormic stems from the base to the top. The herb layer has regenerated consisting of bracken and lomandra. *Acacia terminalis* immature seedlings are at 100-200 mm height in a sparse density. Waratah common at 1.2-1.5 m height.

Table 3-5 Habitat Record Sites 1 – 10, Observations March 2016, Baseline.

Easting	244983	245029	245161	245153	245563	245497	245321	245341	245057	245026
Northing	6292989	6293511	6293667	6293241	6293607	6293333	6293376	6293284	6293029	6292811
Date	12/3/2016	12/3/2016	12/3/2016	1/3/2016	1/3/2016	12/3/2016	12/3/2016	12/3/2016	12/3/2016	12/3/2016
Site #	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	**Site 9**	**Site 10**
Description	South Creek Upstream Wollongambe River tributary, within Newnes Kaolin Mine Allotment within the 100 m buffer zone	North Creek Upstream Wollongambe River tributary within Newnes Kaolin Mine Allotment within the 100 m buffer zone	North Creek Upstream Wollongambe River tributary, about 100 m east of the project boundary, into the GBWHA/Blue Mountains National Park	On the primary ridge line access, north side, about 100 m east of the project boundary into the GBWHA	Wollongambe River, in the riparian zone, just above the primary bench and on the eastern side adjacent to a permanent drainage line as denoted by 1.5 -2 m height (convex) a sharp sword edge swath of plants.	South Creek Downstream and about 400-500 m from the project site boundary and east into the GBWHA, riparian zone of the creek.	On the primary ridge line access, north side, about 250 m east of the project boundary into the GBWHA	On the primary ridge line access, about 400m east of the project boundary into the GBWHA, 100 m south of site 7.	South Creek Upstream drainage shallow flat Wollongambe River tributary, about 100 m east of the project boundary, into the GBWHA/Blue Mountains National Park, and about 500 m upstream on the South creek tributary from site 6	Mid-slope ridge about 100 m of a secondary south creek tributary, at southern side about 50 m east of the south eastern corner of the project southern boundary and into the GWHA/National Park as a ridge, mid-slope site
Topographic position	gully/drainage line	Mid-slope	gully/drainage line	upper slope	mid-lower slope	gully/drainage line-lower slope	upper slope	mid-slope	gully/drainage line	mid-slope
Slope	11-20%, eastern aspect	21-30 %, south east aspect	30+ %, east aspect	6-10 %, north-east aspect	21-35 %, northern aspect	21-30 %, north-east, east aspect	5-10 %, north east aspect	11-20 %, south east aspect	0-5 %, eastern aspect	6-10 %, east, south east aspect
Fire/ Cut stumps	Fire Minor, no cut stumps	Fire moderate, no cut stumps	Fire, moderate, no cut stumps	Fire moderate to severe, no cut stumps	Fire moderate, no cut stumps	Fire moderate, no cut stumps	fire severe, no cut stumps	Fire severe, no cut stumps	Fire minor to moderate, no cut stumps	Fire severe, no cut stumps
Grazing/ Grazing by	nil	nil	nil	nil	nil	nil-slight, wombat burrow	nil	nil	slight, kangaroos,	slight, kangaroos, wombats?
Erosion/ type	nil	nil	nil	nil	moderate, sheet	nil	nil	nil	nil	nil
Dumping/ water within 100 m	no dumping, no water within 100m, not wet.	nil, no water within 100 m, not wet	nil, yes water within 100 m puddles as headwaters	no dumping no water within 100 m	no dumping, water in river	no dumping, creek within 10 m	no dumping, creek within 10 m	no dumping, no water within 100m, not wet.	no dumping, no water within 100 m, not wet	no dumping, no water within 100 m
Weeds / Dominant species	immature dandelion, flowering	immature dandelion rosettes in north east drainage line	nil	nil	nil	slight, dandelion rosettes, flowers	nil	nil,	nil	nil
Seedling	**20 cm height, few, (Acacia)**	**50-60 cm height, few**				**abundant, Banksia seedlings 20 cm**			**< 1 m height, abundant, Banksia**	
Logs <100mm	few, solid no bark, burnt	common, solid no bark, burnt	scarce, solid no bark	common-abundant, solid no bark, burnt	nil	abundant, solid no bark, abundant banksia branches	scarce, hollow rotten, burnt	common, solid no bark, burnt	common, solid no bark, burnt	moderate-common, solid no bark, burnt
Logs 100-300	few, solid no bark, burnt	moderate, solid no bark, burnt	scarce, solid no bark	few, hollow, burnt	nil	common, solid no bark	scarce, solid no bark burnt	moderate, solid no bark, burnt	common, solid no bark, burnt	moderate, solid no bark, burnt
Logs >300mm		common, solid no bark, burnt	few, hollow, burnt	scarce (count 1), solid no bark, burnt	nil	few, solid no bark	non-scarce, solid no bark, burnt	nil	scarce, hollow, burnt	scarce, solid no bark, burnt
Natural Stumps	none	none	scarce, hollow, burnt	few natural stumps, hollow	nil	scarce natural stumps	no natural stumps	none	few natural stumps, burnt	few, solid no bark, burnt
Stags	none	none	none	none	none	none	none	none	none	none
Soil/ Rock (50-500mm)	Soil 1-5 % cover, 51-75mm depth, no rock 50-500 mm	Soil 1-5% cover, 51-75 mm depth, 1-5 % rock 50-500mm	1-5 % cover, very shallow soils, 1-5 % rock 50-500 mm	Soil 50 % cover, no rock 50-500 mm	Soil 1-5 % cover, 26-75 mm depth, 1-5 % rock 50-500 mm	1-5 % soil cover, 26-75 mm depth, 1-5 % rock 50-500mm	6-25 % cover, no rock 50-500 mm	Soil 26-50 % cover, no rock 50-500 mm	Soil 26-50 %, 1-5 % rock (50-500 mm)	6-25 %, no rock 50-500mm
Lichen - Boulder/solid rock	No lichen, no boulders	no lichen, no boulders	6-25 % lichen, 96-100 % boulder/solid rock	no lichen, no boulders	no lichen, boulders 6-25 %	no lichen, no boulders (in quadrant)	no lichen, no boulder rock	no lichen, no boulders	no lichen, no boulders	no lichen, no boulders
Litter - Rock on rock	Litter 1-5%, no rock on rock	Litter 26-50 % , no rock on rock	6-25 % litter, abundant rock on rock	Litter 6-25 %, no rock on rock	no litter, few rock on rock	litter 76-95 %, no rock on rock	litter 1-5 %, no rock on rock	1-5 % leaf litter, no rock on rock	76-95 % litter, no rock on rock	76-95% litter, no rock on rock
Herb, forbs herbaceous (not woody), broadleaf plants that are not grass-like/ Overhangs/caves	Herbs 6-25 %, no rock overhangs	Herbs 26-50 %, no rock overhangs	Herbs 1-5 %, overhangs/caves scarce	Herbs 6-25 %, no rock overhangs	Herbs 76-95 % , no rock overhangs	Herbs 26-50 %, no rock overhangs	Herbs 1-5 %, no rock overhangs	Herbs 1-5 %, no rock overhangs	Herbs 6-25 %, no rock overhangs, well established bracken fern	Herbs, 1-5 % cover, bracken fern, no overhangs/caves

Easting	244983	245029	245161	245153	245563	245497	245321	245341	245057	245026
Northing	6292989	6293511	6293667	6293241	6293607	6293333	6293376	6293284	6293029	6292811
Date	12/3/2016	12/3/2016	12/3/2016	1/3/2016	1/3/2016	12/3/2016	12/3/2016	12/3/2016	12/3/2016	12/3/2016
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Grasses and condition	51-75 %, native	26-50 %, native	1-5 %, native	1-5 %, native	76-95 %, native	1-5 %, native	1-5 %, native	1-5 %, native	1-5 %, native	1-5 % , native
Grassland height	2 - 50 cm height	20-30 cm height,	2-15 cm height	12-30 cm height	70 cm height	20-50 cm height	2-15 cm height,	2-15 cm height,	~20 cm height	10-12 cm height
Grassland Species Diversity	Low	high	moderate	moderate	low	low	low	poor	high	low
Dieback - Mistletoe	no dieback, Mistletoe present adjacent to plot, epicormic growth on trees	no dieback, no mistletoe, epicormic growth on trees	none/scarce dieback, no mistletoe	no dieback, no mistletoe, epicormic growth	no dieback, no mistletoe, epicormic growth on trees	no dieback, no mistletoe	no dieback, no mistletoe	no dieback, no mistletoe,	no dieback, no mistletoe, no scratches, epicormic growth on all trees.	no dieback, no mistletoe
Scratches on smooth tree trunks	few -nil	? tree scratches	few - nil	no tree scratches	no tree scratches	no tree scratches	no tree scratches	no tree scratches	no tree scratches	tree scratches not noticed
Litter tree base	moderate	abundant	moderate	moderate	scarce	moderate	few	few	common	common
Loose tree bark	moderate	common	moderate	few-moderate	scarce	none	few	none	common	scarce, solid no bark, burnt
Terrestrial termite mounds/Arboreal termite mounds	none	terrestrial termite mounds scarce in progress, no arboreal termite mounds	none	none	none	none	few, terrestrial termite mounds in progress, no arboreal termite mounds	none	none	none
DBH Range										
N/A - Shrub layer	75-90 % cover	51-75 % cover, 1.2 m height	1-5 % cover, ? Height	6-25 %, 1 m height	26-50 % cover	51-75 % cover, banksia, waratah	5-25 % cover,	5-25 % cover,	51-75 % cover,	1-5 % cover, waratah, banksia
< 100mm Sapling	1-5 %, (count 8)	1-5 % in 2 m and 5-10 m height range	1-5 % cover (count 2), 5 m height	6-25 %, (count ?) 3 m height	1-5 %, (count ?)	6-25 % (count 4), ~ 2-3 m height	1-5 % (count 4) 3m height	1-5% cover (count 4), 4m height	1-5 %, regrowth only	1-5 % (count 7)
100 - 200 mm Regenerating	1-5 % (count 4)	1-5 % (count 4) 20 m height	6-25 % cover (count 7), 10 m height	26-50 % (count ?), 10-15 m, no hollows	1-5 % (count ?) 6 m, no hollows	1-5 % (count 2) 8 m height, no hollows	6-25 % (count 8) 10-15 m height	1-5 % (count 6) 10 m height	51-75 % (count ?)	1-5 % (count 3)
200 - 400 mm Middle aged	1-5 % (count 2), 15-20 m height, no hollows	1-5 % (count 3) 25 m height, some hollow niches	1-5 % (count 1), 20-25 m height, maybe small hollows	6-25 % (count ?), 25 m height, no hollows	1-5 % (count ?) 20 m, no hollows	1-5 % (count 3) 20 m height	6-25 % (count 7) 15-20 m height, some hollow niches	1-5 % (count 2) 15 m height	51-75 % (count ?)	1-5 % (count 2)
400 – 600 mm Mature	1-5 % (count 1), 15-20m height, no hollows	1-5 % (count 3) 25-30 m height, some hollow niches	1-5 % (count 4), 25-30 m height, maybe small hollows	nil	nil	1-5 % (count 2) 2-25 m height	1-5 % (count 5) 15 m height	1-5 % (count 1) 20 height, yes hollow niches	6-25 % (count ?), yes hollow niches	1-5 % (count 2), yes hollow niches
600+ - Old Growth	1-5 % (count 2), >20 m height, yes hollows	nil	1-5 % (count 2), 30-40 m, maybe small hollows.	nil	nil	1-5 % (count 1) 20 m height, yes hollows	1-15 % (count 2) 15 m height, no hollows	1-5 % (count 1) 10-15 m height, no hollows	1-5 % (count ?)	6-25 % (count 8)
Shrub layer species diversity	high	high	low	moderate	moderate	high	low-moderate	low	high	low

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Date	12/3/2016	12/3/2016	12/3/2016	1/3/2016	1/3/2016	12/3/2016	12/3/2016	12/3/2016	12/3/2016	12/3/2016
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Shrub layer structural diversity	high	high	moderate	moderate	very high	high	moderate	low	High	Moderate-
Canopy layer species diversity	high	moderate, solid no bark, burnt	low	poor	nil	low-moderate	poor	low	moderate	moderate
Canopy layer structural diversity	low, burnt	poor, burnt	low	poor	nil	poor-low, burnt	poor, burnt	low	poor	poor, burnt
Patch health	pristine	pristine, very good	pristine	very good, fire recovery	very good, juvenile fire recovery	pristine	pristine	pristine	pristine	pristine
Structure	open woodland (<10 %) , forbland	open woodland (<10 %), forbland	open woodland (<10 %)	open woodland (<10 %)	forbland	woodland (10-30 %)	woodland (10-30%)	open woodland (<10 %)	woodland (10-30%)	woodland (10-30 %)
Patch size/shape	1-5 ha, shape semi-irregular	5-20 ha, semi-irregular	5-20 ha, semi-irregular	5-20 ha, linear	1-5 ha	20-50 ha?, semi-rregular	5-50 ha, semi-irregular	50-250 ha, semi-irregular	20-50 ha, shape semi-irregular	50-250 ha, semi-irregular
Linear type/width	not linear	not linear	not linear	width 75-150 m	not linear	not linear	not linear	not linear	not linear	not linear
Connectivity	continuous	continuous	continuous	continuous	continuous	continuous	continuous	continuous	continuous	continuous
Geology	coarse sedimentary	coarse/ fine sedimentary	coarse/fine sedimentary	coarse sedimentary	coarse/fine sedimentary	sand, course sedimentary	coarse sedimentary	coarse/fine sedimentary	coarse/ fine sedimentary	coarse sedimentary
Soil colour	whitish, sand	whitish sand, loam, clay	whitish, sandy	whitish yellow, sand, with sandstone/ironstone fragments	whitish yellow, sand/loam	whitish, loam, sand	whitish, sand/ gravelly sand.	whitish, sand/gravelly sand	whitish, sand/gravelly sand	whitish, sand, gravelly sand.
Birds	none heard/seen, time 8:30-9:30 am	none heard/seen, time 10:30 am to 11:30 am	none heard/seen, time 1:00-2:45 pm	none heard/seen, 3:30-4:30 pm	none heard/seen, time 10:30 am-12:30 pm	One species seen, 4:15-5.00 pm	none heard/seen, time 4:15-5-15 pm	none heard/seen, time 3:00-4:00 pm	Six species heard, 1 species sighted in *Eucalyptus sieberi* : 8:00 am-9:30 am	none heard/seen, time 10:00-11:00 am
Weather, Rain, Cloud, Wind,	no rain, no cloud, no wind, 18 ^{o}C	no rain, some cloud, no wind, 18 ^{o}C	no rain, some cloud, no wind, 20 ^{o}C	no rain, light cloud, no wind, 25 ^{o}C	no rain, no cloud, no wind, 20 ^{o}C	no rain, 60 % cloud, no wind, 18 ^{o}C	no rain, 60 % clound, no wind, 18 ^{o}C	no rain, moderate cloud, no wind, 15 ^{o}C	no rain, no cloud, no wind, 15 ^{o}C	no ranin, no cloud, no wind, 18 ^{o}C
Wind direction	-	-	-	-	-	thunder storm passing	thunder storm passed to the north east	thunder storm brewing	-	-
Groundcover			Observed sticky Sword-sedge (*Lepidosperma viscidum*) flat leaf, serrated edge.			Cover of leaf litter, shrub layer, Banksia fronds, bracken, fallen logs, emergent banksia seedlings 20 cm height, waratah.	Open, low shrub and herb regeneration with exposed sands, without leaf litter cover. All trees burnt, epicormic budding. Saplings growing in clumps, shrubs all < 1.0 m tall.	Seedling *Acacia longifolia*, no organic layer accept micro terraces.	Abundant Banksia, saplings, and regenerating shrubs	Bracken, lomandra, *Acacia terminalis* seedlings, waratah common.

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Insects / Invertebrates	Butterfly, copper/orange and black			Small black files biting	Locust, small black flies biting, very large flies	Green/brown Thornbill (pair) in the thickets at the creek line	Termites, ants, flies			
Vertebrates	nil	nil	nil	nil	75-100 mm lizard (photo)	wombat burrow	nil	nil	Nil	nil

3.4 Weeds

Weed species were identified:

Conyza bonariensis (Flax-leaf fleabane) was evident on plots 1 and 2

Taraxacum officinale Wiggers s.lat. (Dandelion) immature, evident on plots 1, 2, and 6

3.5 Recently Identified Species

Actinotus helianthus (flannel flower) was evident on plot 6

Cynodon dactylon (native couch) was evident on plot 1

Drosera pygmaea (pygmy sundew) was evident on plot 5.

3.5.1 Unconfirmed Species

Nine plant specimens were collected from plots 1, 7, 8, 9, 10 for confirmation of identification (Table 3-6). Plant specimens were not collected from plot 5. At this time, a total of 8 plants remain for identification confirmation (Table 3-6).

Table 3-6 Plant samples collected for identification

Sample	Plot	Sample and tentative description	Initial identification (similar to)
A	1	Groundcover, climber? Leaves alternate over 35 mm long, stem attached to lower surface of leaf, woody stem.	
B	5	Climber on grasses, red stems, leaf-less, small creamy white bud shaped flowers in bracts of 3 and 5.	
C	7_1 - 8_1	Dark yellow, pea like terminal flower on woody round single frond stem, branched at tips. Woody stem, carrying single alternate slender narrow leaf 8-9 mm length at even intervals along stem. (Flowers not evident with orange or red markings). Flowering March.	*Dillwynia*
D	8_2	Woody stem shrub, slender, pointed leaf in pairs, alternate along the stem. Very small rounded flower.	
E	8_3	Flat leaved herb within a single bract woody stem, large pointed flow petals containing three seed pods 15-20 mm length	
G	9	Rough, thick dark green leaf, shrub, woody stem	
H	9_1, 10_1	Purple, saw edge leaf herb with fine white silky fine petals	
I	10_2	Grass, semi angular (three-edge) single frond	

4.0 Action and Management Protocols

The centre point of each plot has been geo-positioned, enabling repeat samplings.

The plots are expected to change significantly over the next few years with a gradual replacement of pioneer species with species that are re-established once the site commences to return to pre-fire conditions. This will be achieved by a combination of stabilisation of the soil profile, increased soil organic carbon accumulation leading to increased soil moisture availability.

We note the difficulty in recording the impacts, if any, of nearby quarry activities plots where there are concurrent relatively large and rapid changes in the vegetation structure, its complexity, and the re-colonisation of the native fauna.

Baseline monitoring provides for the ongoing development of protocols relevant to project approval parts 30(b), (c) and (d)

5.0 Recommendations

Future monitoring - The field work for this baseline study was undertaken in early March 2016, after the October to February (Spring – Summer) period when a wider range of species are flowering. Similarly the November to February period is noted as a higher rainfall period. It is recommended that for annual monitoring, an ongoing program be developed to incorporate this range of flowering season; for example for consecutive years a program commencing early December, and the following year in January and then February to March.

Unconfirmed species - At the time of submission, this report contains a record of eight unconfirmed species. It is recommended that additional advice is sought though the Lithgow & District Community Nursery. The community nursery is a project partners in the development of the project offset planting program.

Protocols for weed management – For all weeds recorded the actions for their management are as defined within the project Flora and Fauna Management Plan.

Report Dated: 25th March 2016.

Baseline Monitoring – Newnes Kaolin and Sand Quarry

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APPENDIX 1

Reference to conditions of consent (RPS Australia East Pty Ltd), Flora and Fauna Management Plan.

29. The Pest and Weed Management Plan shall: a) identify potential terrestrial and aquatic pests and weeds that may be expected on and adjacent the site; b) describe the measures that would be implemented to prevent the occurrence of pests and weeds on and adjacent the site; c) include a program for monitoring the occurrence of pests and weeds on and adjacent the site, including the Greater Blue Mountains WHA and the Wollangambe River and its tributaries; d) include detailed procedures for the management and eradication of pests and weeds identified on and adjacent the site.	Section 5 S. 5.1 S. 5.2 S. 5.3 S. 5.4
30. The Flora and Fauna Monitoring Program shall include: a) detailed baseline data on the flora and fauna on the site and adjacent the site, including habitat present in the Greater Blue Mountains WHA and along the Wollangambe River and its tributaries; b) detailed flora and fauna impact assessment criteria; c) a program to monitor flora and fauna and habitat health on and adjacent the site, including within the Greater Blue Mountains WHA and along the Wollangambe River and its tributaries; and d) a protocol for the investigation, notification and mitigation of identified non-compliances with the flora and fauna impact assessment criteria.	Section 6

ATTACHMENTS

Credentials

Dr. Jane Aiken: Curriculum vitae

Qualifications & Professional Certification
Doctor of Philosophy, University of Western Sydney, (environmental, microbial biology &soil science)
Certified Professional Soil Scientist, CPSS (11 years)
Master of Sustainable Agriculture, Charles Sturt University, (in progress) (coal ash for agriculture)
Bachelor of Science, University of Western Sydney, (environmental science and microbiology)
Bachelor of Science (Honours 1), University of Western Sydney, (molecular and soil biology)

Professional experience:
Dr Jane Aiken has over 22 years of experience in land, site and environment management for agricultural wastewater, municipal and domestic wastewater, power station fly ash dry storage sites and small farms. Between 1993 and 2000 Jane worked with NSW Agriculture's irrigation officer to improve and implement dairy wastewater management systems along the east coast to Merimbula and Bega and Wagga Wagga, then studied attaining her research degree in a project to assess the microbial soil response to irrigation with secondary and tertiary municipal wastewater. She has managed water recycling projects, stormwater containments and wetlands at the University of Western Sydney Hawkesbury Campus.

In 2005 she began consulting projects as Soil Health Ecology. She worked on the rehabilitation works at the Penrith Lakes Scheme establishing baseline soil chemical properties data and has managed site works and revegetation projects in the Lithgow district. Continuing with business iterations Soil Health Ecology, Jane T. Aiken Consultancy and now Consulting &Environmental Services Pty Ltd, Jane provides specialist skills in environment management systems, planning and documentation, monitoring and reports. Her focus is rehabilitation and sustainability, through project tree planting and biodiversity offset, soil and sediment control, water balance and budget and biologically diverse soil management with reuse of waste soil materials, water and using coal ash for agriculture.

Jane has an environmental focus within Ecology & Sustainability, Environmental Ecology, Wastes and Recycling, Landscape Soils and Carbon Farming Initiatives. Her work scope covers Analysis & Investigation, Soils Training & Education, Site Rehabilitation and Revegetation, Supply Chain Investigation, Soft Systems Methodology, Rural Change Management, Systems and Linking Thinking and Climate Change Adaption & Mitigation. Jane has experience working within the coal fired power industry, agricultural and municipal wastewater, quarry rehabilitation, and with landholders to improve their soil management outcomes. She has environmental science degrees with experience covering soil biology, conservation biology, environmental biology, ecology, microbial ecology and numerical ecology.

Jane has published in *American Society of Soil Science* Journal, the journal *Water* (with Australian Water Association*, Advanced Materials Research, Australasian Plant Conservation, Desalination.* With conference papers and peer review articles since 2004 on topics of soil microbial ecology (DNA based community fingerprinting), water recycling projects, methods for mine site rehabilitation, the

utilisation of soils mapping knowledge and application of hydrogel polymers to sodic soil. She also has long-term and practical operational experience leading environmental teams.

Recent projects include:
Flora and fauna studies and statement of environmental effects with onsite wastewater design and planning, silt and sediment control plans, to support local council development applications.

Multivariate statistical methods, principle components, multivariate two way analysis of variance for soil carbon Action on the Ground project report for Tweed Valley, six land use classes and for assessment of compost to SOC stocks.

Revegetation for coal ash repository operations including planting trees, shrubs and grasses into caped site areas and with monitoring for biodiversity.

Jane is currently Vice President of Soil Science Australia and has served as Secretary, Vice President and President for the NSW Branch of Soil Science Australia since 2005, she currently serves with the Ash Development Association of Australia as part of the association's National Technical & Education Committee.

Dr. Aiken is currently managing director of Consulting & Environmental Services Pty Ltd, an environmental consultancy and management company - www.industrialsoils.com. She works in collaboration with Dr. Peter Bacon of Woodlots & Wetlands Pty Ltd.

Dr. Peter Bacon: Curriculum Vitae

Professional certification

- Certified Environmental Practitioner

Associations

- Environment Institute of Australia
- Institute of Foresters of Australia.

Experience

Dr Peter Bacon has over 35 years experience in investigating ecosystem management. In this time he has published over 300 articles, ranging from expert systems to reviews of major ecological processes. He currently guest lectures to post graduates on wetland design and management at the University of Technology, Sydney.

In 1990 he became Senior Research Scientist in State Forests of NSW. Between 1990 and 1993 he led a $600,000 study into ecological sustainable management of riparian vegetation communities along the Murray and Murrumbidgee Rivers. He investigated responses of native forests on the Newnes Plateau to various silvicultural treatments. He also studied the impacts of bushfire frequency on tree health.

He has been heavily involved on the use of vegetation to rehabilitate mine sites in the Lithgow and Hunter Regions of NSW.

In 1992 he was awarded a Churchill Fellowship to study in South Africa, Israel, Portugal and the USA. Specific aspects included impact of silvicultural treatments on tree growth.

In 1993 he co-ordinated and was senior author on the Land-use Issues Strategy for Wetlands in the Murray Darling Basin.

In 1995 he was engaged by ANCA to produce the NSW chapter of the second edition of '*A DIRECTORY OF IMPORTANT WETLANDS IN AUSTRALIA'.*

More recently he undertook assessment of landuse impacts on ecological health of the Macquarie Marshes. He also provided expert witness to an Environment Australia case involving degradation of the Gwydir River Wetlands.

Since 1995 he has undertaken literally hundreds of vegetation assessments in NSW alone.

Dr. Bacon is currently managing director of Woodlots & Wetlands Pty. Ltd., an environmental consultancy and management company.