

Ecological Monitoring Report

CSU Bathurst Campus – March 2020

CSU has allocated 20 per cent of land to biodiversity across each of its campuses, with a target to “Improve the biodiversity value of allocated land ‘year on year’ from 2015”. In order to provide a suitable metric for improvement of biodiversity, ecologist and CSU alumnus Mick Callan has established five photo point monitoring sites across the Ratified Biodiversity Zones on the Bathurst campus, as well as providing a baseline survey for avian richness. Both of these actions have been structured in such a way as to provide repeatable monitoring in order to effectively understand biodiversity changes across the site over time.

Bird Surveys

Introduction

Understanding the species richness (total number of species) of birds in any given area, be it a local reserve or on a national scale, is critical to implementing suitable management strategies. This understanding is also critical to managing environmental rehabilitation or restoration projects where long-term monitoring of bird data can demonstrate whether or not implemented management actions, such as feral animal control or revegetation, have been successful or not. It is important that any means of gathering this data is accurate, repeatable and as efficient as possible to ensure that all data collected is cost effective and of value to land managers and environmental professionals alike.

The Study Area

The study area was divided into three distinct zones for the purpose of the surveys, representing the two Ratified Biodiversity Zones of Hawthornden Creek, as well as its tributary Village Creek. The third area included was the dam and surrounds located on campus to the north of Village Creek, in order to provide a representation of the water fowl and waders present on campus.

Standardised Search

The three study areas were sampled twice daily during March 2020, between 7:30 am and 9:00 am, and in the afternoon between 3:45 pm and 5:15 pm. Each site was sampled on a rotating order, meaning that the first site sampled in the morning became the second site sampled in the afternoon, and subsequently the third site sampled the following morning. Additionally, the direction of travel during each survey was rotated meaning that if the morning survey ran east to west, the afternoon survey would be conducted in the opposite direction. A five-minute rest period was implemented between each survey to ensure that disruption to birds was minimised and that the site was ‘reset’.

Birds were identified to species level based on either visual or aural recognition, or a combination of both, with a familiarisation period not conducted prior to the commencement of the survey due to the familiarity with the site and the resident bird population. Binoculars that were utilised during the surveys were Nikon Monarch 7, 8 x 42. Where identification assistance was required The Australian Bird Guide[1] was utilised as a field guide.

The standardised search was conducted by moving freely throughout the creek corridor at each respective creek, and similarly moving freely around the dam, while recording all species of birds by visual or aural recognition. Where a bird was not immediately recognisable, it would be actively sought out to provide an accurate call or sighting. The survey period for each of the three study areas was allocated based on the size of the area and the complexity of habitat, with the time allocated to each survey being consistent:

- Hawthornden Creek: 45 minutes
- Village Creek: 10 minutes
- CSU Dam: 5 minutes

All species of birds were recorded as present only, with individual numbers of birds not recorded, nor were birds included which were outside of the university campus. Additionally, birds witnessed flying over the site, but not utilising the site, were not recorded. This methodology is consistent with the published works of CSU professor and ornithologist, Dr David M Watson [2, 3].

Stopping Rule

A results based, lenient stopping rule was utilised for the standardised search where sampling continued daily until the number of species recorded in a single sampling period only (singletons), was less than or equal to the number of species recorded in two sampling periods (doubletons), following a minimum of three searches [2]. This was completed for each individual survey area as well as a combined total for the campus. For all three sites, this was completed after the seventh survey.

Calculating Species Richness

The data was used to provide an estimate of species richness at the site, using the Chao estimator equation:

$$\hat{S}_{est} = S_{obs} + Q_1^2 / 2Q_2$$

Where:

\hat{S}_{est} = Estimate of species richness

S_{obs} = Observed species richness

Q_1 = Quantity of uniques (singletons)

Q_2 = Quantity of duplicates (doubletons)

Percentage of completeness of each survey method has been calculated utilising the following formula:

$$\% \text{ Completeness} = (S_{obs} / \hat{S}_{est}) \times 100$$

Incidence is the proportion of samples that each species was recorded in, calculated by dividing the number of recorded samples by the total number of samples (seven):

$$\text{Incidence} = R_{sam} / T_{sam}$$

Where:

R_{sam} = Recorded samples

T_{sam} = Total number of samples

Results

A total of seven standardised searches of each area were recorded across consecutive days, 18 to 21 March 2020. All birds recorded were identified to species level. A total species richness of 45 species (↓49) was recorded across the three survey areas, with each site having a species richness of:

Hawthornden Creek: 38 species (↓46)

Village Creek: 25 species (↑18)

CSU Dam: 17 species (↓19)

* brackets show the trend, up or down, indicated by an arrow, with the results from the Spring 2019 surveys

Table 1: Results for each survey area, as well as total results across all three survey areas. Species Observed shows the total number of species recorded across all surveys. Estimated Species Richness shows the calculated number of species estimated to be present on site during the survey period. % Completeness shows how complete the recorded species richness is based on calculated estimate of species richness.

SITE	SPECIES OBSERVED	ESTIMATED SPECIES RICHNESS	% COMPLETENESS
Hawthornden Creek	38	40.3	94.4
Village Creek	25	26.1	95.7
CSU Dam	17	17.7	96.2
Total Species	45	48.1	93.6

Additional Observations

While the purpose of the surveys was to provide baseline data relating to avian species richness, the following species were also recorded during the surveys:

Eastern Grey Kangaroo *Macropus giganteus*

Swamp Wallaby *Wallabia bicolor*

Cat *Felis catus*

Table 2: Complete inventory for standardised search, conducted across three zones, on consecutive days of 18 to 21 March 2020. Sampling period numbers 1-7 represents survey day. X denotes species recorded as present on a given day. - denotes species recorded as absent. Incidence is the proportion of samples that each species was recorded in, calculated by dividing the number of recorded samples by the total number of samples (seven).

* Introduced.

Common Name	Scientific Name	Sampling Period							Incidence
		1	2	3	4	5	6	7	
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	X	-	-	-	-	X	-	0.29
Galah	<i>Eolophus roseicapilla</i>	X	X	X	X	X	X	X	1.00
Rainbow Lorikeet	<i>Trichoglossus moluccanus</i>	X	X	-	X	-	X	-	0.57
Superb Fairywren	<i>Malurus cyaneus</i>	X	X	X	X	X	X	X	1.00
Noisy Miner	<i>Manorina melanocephala</i>	X	X	X	X	X	X	X	1.00
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	X	X	X	-	-	-	-	0.43
Striated Thornbill	<i>Acanthiza lineata</i>	X	-	-	-	X	-	-	0.29
Grey Butcherbird	<i>Cracticus torquatus</i>	X	X	X	X	-	X	X	0.86
Australian Magpie	<i>Cracticus tibicen</i>	X	X	X	X	X	X	X	1.00
Pied Currawong	<i>Strepera fuliginosa</i>	X	X	X	X	-	X	X	0.86
Willie Wagtail	<i>Rhipidura leucophrys</i>	X	X	X	X	X	X	X	1.00
Grey Fantail	<i>Rhipidura albiscapa</i>	X	X	-	X	-	X	X	0.71
Magpie-lark	<i>Grallina cyanoleuca</i>	X	X	X	X	X	X	X	1.00
Australian Raven	<i>Corvus coronoides</i>	X	X	-	X	-	X	X	0.71
Common Blackbird*	<i>Turdus merula</i>	X	-	-	X	-	X	X	0.57
Crested Pigeon	<i>Ocyphaps lophotes</i>	X	X	X	X	-	X	X	0.86
Welcome Swallow	<i>Hirundo neoxena</i>	X	X	-	X	-	-	-	0.43
Australian Wood Duck	<i>Chenonetta jubata</i>	X	-	X	X	X	-	X	0.71
Pacific Black Duck	<i>Anas superciliosa</i>	X	X	X	X	X	-	X	0.86
Masked Lapwing	<i>Vanellus miles</i>	X	X	X	X	X	X	X	1.00
Red-rumped Parrot	<i>Psephotus haematonotus</i>	X	X	X	X	X	-	X	0.86
Australian White Ibis	<i>Threskiornis molucca</i>		X	-	-	-	-	-	0.14
Australian King Parrot	<i>Alisterus scapularis</i>		X	-	-	-	X	X	0.43
Crimson Rosella	<i>Platyercus elegans</i>		X	X	X	X	-	X	0.71
Eastern Rosella	<i>Platyercus eximius</i>		X	X	X	-	X	-	0.57
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>		X	-	-	-	-	X	0.29
Red Wattlebird	<i>Anthochaera carunculata</i>		X	X	X	X	X	X	0.86
White-plumed Honeyeater	<i>Ptilotula penicillata</i>		X	-	X	-	X	X	0.57
Spotted Pardalote	<i>Pardalotus punctatus</i>		X	-	X	-	X	X	0.57
Common Starling*	<i>Sturnus vulgaris</i>		X	-	X	-	X	X	0.57
Double-barred Finch	<i>Taeniopygia bichenovii</i>		X	-	-	X	X	X	0.57
Noisy Friarbird	<i>Philemon corniculatus</i>		X	X	-	-	-	-	0.29
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>		X	-	-	-	-	-	0.14
White-browed Scrubwren	<i>Sericornis frontalis</i>		X	-	-	-	-	-	0.14
Chestnut Teal	<i>Anas castanea</i>		X	X	X	X	-	-	0.57
Rock Dove (Feral Pigeon)*	<i>Columbia livia</i>			X	X	X	X	X	0.71
Laughing Kookaburra	<i>Dacelo novaeguineae</i>			X	-	-	-	-	0.14
White-winged Chough	<i>Corcorax melanoramphos</i>			X	-	-	-	X	0.29
Fairy Martin	<i>Petrochelidon ariel</i>			X	-	X	-	-	0.29
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>				X	-	-	X	0.29
Yellow Thornbill	<i>Acanthiza nana</i>				X	X	X	-	0.43
Weebill	<i>Smicornis brevirostris</i>				X	-	-	X	0.29
Peregrine Falcon	<i>Falco peregrinus</i>						X	-	0.14
Diamond Firetail	<i>Stagonopleura guttata</i>						X	-	0.14
Silvereye	<i>Zosterops lateralis</i>							X	0.14

Table 3: Complete inventory for standardised search, conducted across the Hawthornden Creek Biodiversity Zone, on consecutive days of 18 to 21 March 2020. Sampling period numbers 1-7 represents survey day. X denotes species recorded as present on a given day. – denotes species recorded as absent. Incidence is the proportion of samples that each species was recorded in, calculated by dividing the number of recorded samples by the total number of samples (seven).
* Introduced.

Common Name	Scientific Name	Sampling Period							Incidence
		1	2	3	4	5	6	7	
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	X	-	-	-	-	X	-	0.29
Galah	<i>Eolophus roseicapilla</i>	X	X	X	X	X	X	X	1
Rainbow Lorikeet	<i>Trichoglossus moluccanus</i>	X	X	-	X	-	X	-	0.57
Superb Fairywren	<i>Malurus cyaneus</i>	X	X	X	-	X	X	X	0.86
Noisy Miner	<i>Manorina melanocephala</i>	X	X	X	X	X	X	X	1.00
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	X	X	X	-	-	-	-	0.43
Striated Thornbill	<i>Acanthiza lineata</i>	X	-	-	-	X	-	-	0.29
Grey Butcherbird	<i>Cracticus torquatus</i>	X	X	X	X	-	X	-	0.71
Australian Magpie	<i>Cracticus tibicen</i>	X	X	X	X	X	X	X	1.00
Pied Currawong	<i>Strepera fuliginosa</i>	X	X	-	X	-	X	X	0.71
Willie Wagtail	<i>Rhipidura leucophrys</i>	X	X	X	X	X	X	X	1.00
Grey Fantail	<i>Rhipidura albiscapa</i>	X	X	-	X	-	X	X	0.71
Magpie-lark	<i>Grallina cyanoleuca</i>	X	X	X	X	-	-	X	0.71
Australian Raven	<i>Corvus coronoides</i>	X	X	-	X	-	X	X	0.71
Common Blackbird*	<i>Turdus merula</i>	X	-	-	-	-	-	X	0.29
Crested Pigeon	<i>Ocyphaps lophotes</i>		X	X	X	-	X	X	0.71
Australian White Ibis	<i>Threskiornis molucca</i>		X	-	-	-	-	-	0.14
Australian King Parrot	<i>Alisterus scapularis</i>		X	-	-	-	X	X	0.43
Crimson Rosella	<i>Platycercus elegans</i>		X	X	X	X	-	X	0.71
Eastern Rosella	<i>Platycercus eximius</i>		X	X	X	-	X	-	0.57
Red-rumped Parrot	<i>Psephotus haematonotus</i>		X	X	X	-	-	-	0.43
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>		X	-	-	-	-	X	0.29
Red Wattlebird	<i>Anthochaera carunculata</i>		X	X	X	-	X	X	0.71
White-plumed Honeyeater	<i>Ptilotula penicillata</i>		X	-	-	-	X	X	0.43
Spotted Pardalote	<i>Pardalotus punctatus</i>		X	-	X	-	X	X	0.57
Common Starling*	<i>Sturnus vulgaris</i>		X	-	X	-	X	X	0.57
Double-barred Finch	<i>Taeniopygia bichenovii</i>		X	-	-	-	X	X	0.43
Masked Lapwing	<i>Vanellus miles</i>			X	-	-	-	X	0.29
Laughing Kookaburra	<i>Dacelo novaeguineae</i>			X	-	-	-	-	0.14
White-winged Chough	<i>Corcorax melanoramphos</i>			X	-	-	-	X	0.29
Fairy Martin	<i>Petrochelidon ariel</i>			X	-	-	-	-	0.14
Rock Dove (Feral Pigeon)*	<i>Columbia livia</i>				X	X	X	X	0.57
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>				X	-	-	X	0.29
Yellow Thornbill	<i>Acanthiza nana</i>				X	X	X	-	0.43
Weebill	<i>Smicornis brevirostris</i>				X	-	-	X	0.29
Peregrine Falcon	<i>Falco peregrinus</i>						X	-	0.14
Diamond Firetail	<i>Stagonopleura guttata</i>						X	-	0.14
Silvereye	<i>Zosterops lateralis</i>							X	0.14

Table 4: Complete inventory for standardised search, conducted across the Village Creek Biodiversity Zone, on consecutive days of 18 to 22 March 2020. Sampling period numbers 1-7 represents survey day. X denotes species recorded as present on a given day. – denotes species recorded as absent. Incidence is the proportion of samples that each species was recorded in, calculated by dividing the number of recorded samples by the total number of samples (seven).

* Introduced.

Common Name	Scientific Name	Sampling Period							Incidence
		1	2	3	4	5	6	7	
Galah	<i>Eolophus roseicapilla</i>	X	X	X			X	X	0.5
Superb Fairywren	<i>Malurus cyaneus</i>	X	X	X	X	X	X	X	0.25
Noisy Miner	<i>Manorina melanocephala</i>	X	X	X	X	X	X	X	0.25
Australian Magpie	<i>Cracticus tibicen</i>	X	X	X	X	X	X	X	0.75
Pied Currawong	<i>Strepera fuliginosa</i>	X	X	X	X		X	X	1
Magpie-lark	<i>Grallina cyanoleuca</i>	X	X		X		X		1
Welcome Swallow	<i>Hirundo neoxena</i>	X			X				1
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>		X						0.5
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>		X						1
Red Wattlebird	<i>Anthochaera carunculata</i>		X	X	X		X		1
Noisy Friarbird	<i>Philemon corniculatus</i>		X	X					0.75
White-browed Scrubwren	<i>Sericornis frontalis</i>		X						0.5
Grey Butcherbird	<i>Cracticus torquatus</i>		X		X				0.75
Australian Raven	<i>Corvus coronoides</i>		X				X		0.25
Common Starling*	<i>Sturnus vulgaris</i>		X		X		X		0.5
Rock Dove (Feral Pigeon)*	<i>Columbia livia</i>				X			X	0.25
Crested Pigeon	<i>Ocyphaps lophotes</i>				X	X	X		0.5
Red-rumped Parrot	<i>Psephotus haematonotus</i>				X	X			0.25

Table 5: Complete inventory for standardised search, conducted across the CSU Dam site, on consecutive days of 18 to 22 March 2020. Sampling period numbers 1-7 represents survey day. X denotes species recorded as present on a given day. – denotes species recorded as absent. Incidence is the proportion of samples that each species was recorded in, calculated by dividing the number of recorded samples by the total number of samples (seven).

* Introduced.

Common Name	Scientific Name	Sampling Period							Incidence
		1	2	3	4	5	6	7	
Galah	<i>Eolophus roseicapilla</i>	X	X	X			X	X	0.71
Superb Fairywren	<i>Malurus cyaneus</i>	X	X	X	X	X	X	X	1.00
Noisy Miner	<i>Manorina melanocephala</i>	X	X	X	X	X	X	X	1.00
Australian Magpie	<i>Cracticus tibicen</i>	X	X	X	X	X	X	X	1.00
Pied Currawong	<i>Strepera fuliginosa</i>	X	X	X	X		X	X	0.86
Magpie-lark	<i>Grallina cyanoleuca</i>	X	X		X		X		0.57
Welcome Swallow	<i>Hirundo neoxena</i>	X			X				0.29
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>		X						0.14
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>		X						0.14
Red Wattlebird	<i>Anthochaera carunculata</i>		X	X	X		X		0.57
Noisy Friarbird	<i>Philemon corniculatus</i>		X	X					0.29
White-browed Scrubwren	<i>Sericornis frontalis</i>		X						0.14
Grey Butcherbird	<i>Cracticus torquatus</i>		X		X				0.29
Australian Raven	<i>Corvus coronoides</i>		X				X		0.29
Common Starling*	<i>Sturnus vulgaris</i>		X		X		X		0.43
Rock Dove (Feral Pigeon)*	<i>Columbia livia</i>				X			X	0.29
Crested Pigeon	<i>Ocyphaps lophotes</i>				X	X	X		0.43
Red-rumped Parrot	<i>Psephotus haematonotus</i>				X	X			0.29
Eastern Rosella	<i>Platycercus eximius</i>					X	X		0.29
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>					X			0.14
White-plumed Honeyeater	<i>Ptilotula penicillata</i>					X		X	0.29
Common Blackbird*	<i>Turdus merula</i>					X	X		0.29
Double-barred Finch	<i>Taeniopygia bichenovii</i>						X	X	0.29
Australian King Parrot	<i>Alisterus scapularis</i>						X		0.14
Willie Wagtail	<i>Rhipidura leucophrys</i>						X	X	0.29

Photo Point Monitoring

Photo point monitoring provides a system of photographic monitoring in order to record changes at a site over time in much the same manner as time lapse photography. In order to ensure consistent images at each photo point, it is important to ensure that photographs are taken at the same precise location, facing the same aspect, and preferably with the same photographic equipment.

Bathurst Regional Council (BRC) established a series of photo monitoring points in May 2011, across the Hawthornden Creek Biodiversity Zone, prior to the significant creek rehabilitation works implemented in that year. The system of photo point monitoring established varied somewhat from the CSU guidelines. However, where it was most appropriate these points have been incorporated into the new monitoring sites to provide some history and context.

A total of five new photo monitoring points were established on 30 May 2019, with three of these sites incorporating previous BRC monitoring. Four sites were established on the Hawthornden Creek Biodiversity Zone, and one on the Village Creek Biodiversity Zone. Due to the variations in monitoring techniques, and camera equipment, these photo points don't match exactly, but general features in the landscape are recognisable in order to make them practical for comparing images over time. Additionally, the full range of photo points provide by BRC have been replicated across the site. Images were taken using the camera on a Samsung Galaxy S9 phone.

SITE	LATITUDE	LONGITUDE	ELEVATION
PP1	-33.435	149.56178	694 m
PP2	-33.43501	149.55948	709 m
PP3	-33.43425	149.55863	707 m
PP4	-33.43516	149.55824	703 m
PP5	-33.43557	149.55726	702 m

Photo Point Monitoring Map - May 2019



Photo Point 1 – Downstream



Figure 1: Photo Point 1 – Downstream – 25 May 2011



Figure 2: Photo Point 1 – Downstream – 30 May 2019



Figure 3: Photo Point 1 - Downstream - 7 November 2019



Figure 4: Photo Point 1 - Downstream - 23 March 2020

Photo Point 1 – Upstream



Figure 5: Photo Point 1 - Upstream - 25 May 2011



Figure 6: Photo Point 1 - Upstream - 30 May 2019



Figure 7: Photo Point 1 - Upstream - 7 November 2019



Figure 8: Photo Point 1 - Upstream - 23 March 2020

Photo Point 2 - Downstream



Figure 9: Photo Point 2 - Downstream 25 May 2011



Figure 10: Photo Point 2 - Downstream - 30 May 2019



Figure 11: Photo Point 2 - Downstream - 7 November 2019



Figure 12: Photo Point 2 - Downstream - 23 March 2020

Photo Point 2 - Upstream



Figure 13: Photo Point 2 - Upstream - 25 May 2011



Figure 14: Photo Point 2 - Upstream - 30 May 2019



Figure 15: Photo Point 2 - Upstream - 7 November 2019



Figure 16: Photo Point 2 - Upstream - 23 March 2020

Photo Point 3 - Downstream



Figure 17: Photo Point 3 - Downstream - 30 May 2019



Figure 18: Photo Point 3 - Downstream - 7 November 2019



Figure 19: Photo Point 3 - Downstream - 23 March 2020

Photo Point 3 - Upstream



Figure 20: Photo Point 3 - Upstream - 30 May 2019



Figure 21: Photo Point 3 - Upstream - 7 November 2019



Figure 22: Photo Point 3 - Upstream - 23 March 2020

Photo Point 4 - Downstream



Figure 23: Photo Point 4 - Downstream - 25 May 2011



Figure 24: Photo Point 4 - Downstream - 30 May 2019



Figure 25: Photo Point 4 - Downstream - 7 November 2019



Figure 26: Photo Point 4 - Downstream - 23 March 2020

Photo Point 4 - Upstream



Figure 27: Photo Point 4 - Upstream - 25 May 2011



Figure 28: Photo Point 4 - Upstream - 30 May 2019



Figure 29: Photo Point 4 - Upstream - 7 November 2019



Figure 30: Photo Point 4 - Upstream - 23 March 2020

Photo Point 5 - Downstream



Figure 31: Photo Point 5 - Downstream - 30 May 2019



Figure 32: Photo Point 5 - Downstream - 7 November 2019



Figure 33: Photo Point 5 - Downstream - 23 March 2020

Photo Point 5 - Upstream



Figure 34: Photo Point 5 - Upstream - 30 May 2019



Figure 35: Photo Point 5 - Upstream - 7 November 2019



Figure 36: Photo Point 5 - Upstream - 23 March 2020

BRC PP1 - No. 1



Figure 37: BRC PP1 - No. 1 - 25 May 2011



Figure 38: BRC PP1 - No. 1 - 30 May 2019



Figure 39: BRC PP1 - No.1 - 7 November 2019



Figure 40: BRC PP1 - No.1 - 23 March 2020

BRC PP1 - No. 2



Figure 41: BRC PP1 - No. 2 - 25 May 2011



Figure 42: BRC PP1 - No. 2 - 30 May 2019



Figure 43: BRC PP1 - No.2 - 7 November 2019



Figure 44: BRC PP1 - No.2 - 23 March 2020

BRC PP1 - No. 3



Figure 45: BRC PP1 - No. 3 - 25 May 2011



Figure 46: BRC PP1 - No. 3 - 30 May 2019



Figure 47: BRC PP1 - No.3 - 7 November 2019



Figure 48: BRC PP1 - No.3 - 23 March 2020

BRC PP2 - Upstream Tributary (CSU PP 1)



Figure 49: BRC PP2 - Upstream Tributary - 25 May 2011



Figure 50: BRC PP2 - Upstream Tributary - 30 May 2019



Figure 51: BRC PP2 - Upstream Tributary - 7 November 2019



Figure 52: BRC PP2 - Upstream Tributary - 23 March 2020

BRC PP3 – Upstream Tributary (CSU PP 2)



Figure 53: BRC PP3 - Upstream Tributary - 25 May 2011



Figure 54: BRC PP3 - Upstream Tributary - 30 May 2019



Figure 55: BRC PP3 - Upstream Tributary - 7 November 2019



Figure 56: BRC PP3 - Upstream Tributary - 23 March 2020

BRC PP3 – Across Creek to North (CSU PP 2)



Figure 57: BRC PP3 - Across Creek to North - 25 May 2011



Figure 58: BRC PP3 - Across Creek to North - 30 May 2019



Figure 59: BRC PP3 - Across Creek to North - 7 November 2019



Figure 60: BRC PP3 - Across Creek to North - 23 March 2020

BRC PP4 – Across Creek to North (CSU PP 4)



Figure 61: BRC PP4 - Across Creek to North - 25 May 2011



Figure 62: BRC PP4 - Across Creek to North - 30 May 2019



Figure 63: BRC PP4 - Across Creek to North - 7 November 2019



Figure 64: BRC PP4 - Across Creek to North - 23 March 2020

BRC PP4 – South to Mount Panorama (CSU PP 4)



Figure 65: BRC PP4 - South to Mount Panorama - 25 May 2011



Figure 66: BRC PP4 - South to Mount Panorama - 30 May 2019



Figure 67: BRC PP4 - South to Mount Panorama - 7 November 2019



Figure 68: BRC PP4 - South to Mount Panorama - 23 March 2020

BRC PP5 - Downstream



Figure 69: BRC PP5 - Downstream - 25 May 2011



Figure 70: BRC PP5 - Downstream - 30 May 2019



Figure 71: BRC PP5 - Downstream - 7 November 2019



Figure 72: BRC PP5 - Downstream - 23 March 2020

BRC PP6 - North Across Creek



Figure 73: BRC PP6 - North Across Creek - 25 May 2011



Figure 74: BRC PP6 - North Across Creek - 30 May 2019



Figure 75: BRC PP6 - North Across Creek - 7 November 2019



Figure 76: BRC PP6 - North Across Creek - 23 March 2020

BRC PP7 - Downstream



Figure 77: BRC PP7 - Downstream - 25 May 2011



Figure 78: BRC PP7 - Downstream - 30 May 2019



Figure 79: BRC PP7 - Downstream - 7 November 2019



Figure 80: BRC PP7 - Downstream - 23 March 2020

BRC PP8 – Upstream



Figure 81: BRC PP8 - Upstream - 25 May 2011



Figure 82: BRC PP8 - Upstream - 30 May 2019



Figure 83: BRC PP8 - Upstream - 7 November 2019



Figure 84: BRC PP8 - Upstream - 23 March 2020

Observations and Recommendations

While conducting the monitoring and survey work several observations were made regarding potential future environmental works on the CSU Bathurst campus.

CSU Dam

The Dam on campus at CSU provides habitat and refugia for a range of bird species that have not been recorded in other areas of the campus. It is noted that the dam level has been quite low several months which exposed mud flats and increased the number of mud-probing feeding species. Additionally, a large number of eucalypts have germinated around the edge of the dam. Recent rains have resulted in the dam level increasing, which is likely to change the composition of species using the site. While the habitat values at present are reasonable, this area could benefit from the following actions:

- **Removal of small willow tree adjacent to dam**

This tree is still relatively small and could be treated with the 'cut and paint' method of herbicide application cheaply and efficiently at present. If left untreated this invasive species has the potential to quickly colonise the dam area through seeding and establishment of broken branches etc.

- **Importation of timber for habitat**

Where removal of trees on campus is required, particularly any native eucalypt species, they could potentially be placed on the edge of the dam, extending into the water, as habitat features. This would provide additional perching opportunities for a range of bird species and may even save on disposal costs relating to the tree removal works.

- **Retention of macrophytes**

The dam is colonised by a range of macrophytes – reeds and rushes – around the waters edge that provide important habitat for water fowl, as well as the invertebrates that they feed on. It is important these plants are retained as habitat.

Hawthornden Creek

While extensive erosion control and stabilisation works have been undertaken within the bed and banks of Hawthornden Creek in recent years, there is still several points within the creek bed where active head cuts are eroding. This is lowering the bed level through incision and has the potential to move upstream very quickly during major flooding events, with the potential to impact on the existing bed control structures. The following actions are recommended:

- **Implement small scale erosion control works**

The active head cuts in the creek are still relatively minor and could be managed through small scale intervention in the short term. Should these head cuts continue unabated, they will almost certainly impact on the previous mitigation works and will likely result in significant expenditure to remediate these structures.

- **Targeted revegetation within the creek bed**

Revegetation works within the creek bed should be targeted and carried out in coordination with small scale erosion control works. While plantings will not be able to contain the current erosion control issues in their own right, in combination with erosion control works, the combined benefits will result in a stable and resilient system into the future.

- **Implement feral animal control**

A feral cat was recorded in Hawthornden Creek on two occasions during the Autumn 2019 survey period and in the Autumn 2020 period. A Red Fox and active den were recorded in the creek during the Spring 2019 surveys. Both Feral cats and Red Foxes are efficient predators and can have devastating impacts on local wildlife. It is recommended that a professional be engaged to trap and humanely dispose of the ferals present,

or if possible, to shoot them under relevant licences and permits. Additionally, the small number of sightings of Common Mynas suggest that a trapping or culling process carried out at present may be effective in halting their spread into the campus. These are an aggressive feral species that outcompete native birds for nesting hollows, and actively drive native birds from their home territories.

- **Woody weed control**

There exists at present a large number of small exotic tree species becoming established in the creek bed. At present these trees would be able to be effectively controlled using the 'cut and paint' herbicide application method. If left untreated, they will grow into large trees that then become very costly to manage. It is recommended that any control of these woody weeds should be done in conjunction with revegetation with native riparian species.

Village Creek

Village Creek is a small creek that originates within the Boundary Road Reserve site. It has undergone some extensive revegetation works, yet still lacks any form of complex habitat which is shown through the reduced species richness in comparison to Hawthornden Creek.

- **High density of exotic grasses and forbs**

Village Creek has a high density of instream vegetation that is largely dominated by exotic grasses and forbs. It is recommended that works should commence at the top of the system to control sections of weeds approximately 20 metres in length, and revegetate these strips with native grasses, forbs and macrophytes. This would allow a gradual and staged process that would not result in creek bed erosion or great expense.

References

1. Menkhorst, P., et al., The Australian bird guide. 2017, Clayton South: CSIRO Publishing.
2. Watson, D.M., Comparative evaluation of new approaches to survey birds. *Wildlife Research*, 2004. **31**(1): p. 1-11.
3. Watson, D.M., The 'standardized search': An improved way to conduct bird surveys. *Austral Ecology*, 2003. **28**(5): p. 515-525.