

Biodiversity

Metropolitan Coal's biodiversity monitoring program has been developed to monitor impacts of the Project on aquatic and terrestrial flora and fauna, with a specific focus on swamps.

The biodiversity monitoring program includes monitoring of:

- upland swamp vegetation and groundwater;
- riparian vegetation;
- aquatic biota and their habitats; and
- amphibians.

The monitoring results are described below.

Upland Swamps Vegetation Monitoring

Eight upland swamps, namely Swamps 16, 17, 18, 20, 23, 24, 25 and 26 have been mapped above or immediately adjacent to Longwalls 20-22 (Figure 1). A swamp substrate characterisation study has also been conducted to contribute to Metropolitan Coal's understanding of the ecological, hydrological and geomorphic processes of swamps over Longwalls 20-22.

With the exception of in-valley Swamp 20, which supports tea tree thicket, all swamps over Longwalls 20-22 are small valley-side swamps and comprise restioid heath, with intergrades with banksia thicket. Transitions between restioid heath and banksia thicket are thought to be driven by fire frequency.

Three swamps (Swamps 16, 17 and 23), although showing seepage are more akin to sandstone heath woodland with low tree densities. The vegetation contains species found in upland swamps, mixed with a range of non-swamp species.

Swamps 101, 111a and 125 have been selected as control sites for monitoring of the restioid heath/banksia thicket valley-side swamps (Figure 1) and Swamps Woronora River 1, Woronora River South Arm and Dahlia Swamp have been selected as sites for monitoring of the tea tree thicket vegetation of Swamp 20 (Figure 2).

The upland swamp vegetation monitoring program includes visual monitoring, transect/quadrat monitoring and monitoring of indicator species, as described below.

Visual Inspections

Baseline visual inspections of the swamps overlying and immediately adjacent to Longwalls 20-22 and at the control swamps have been conducted in spring 2009 and autumn 2010 during the vegetation surveys.

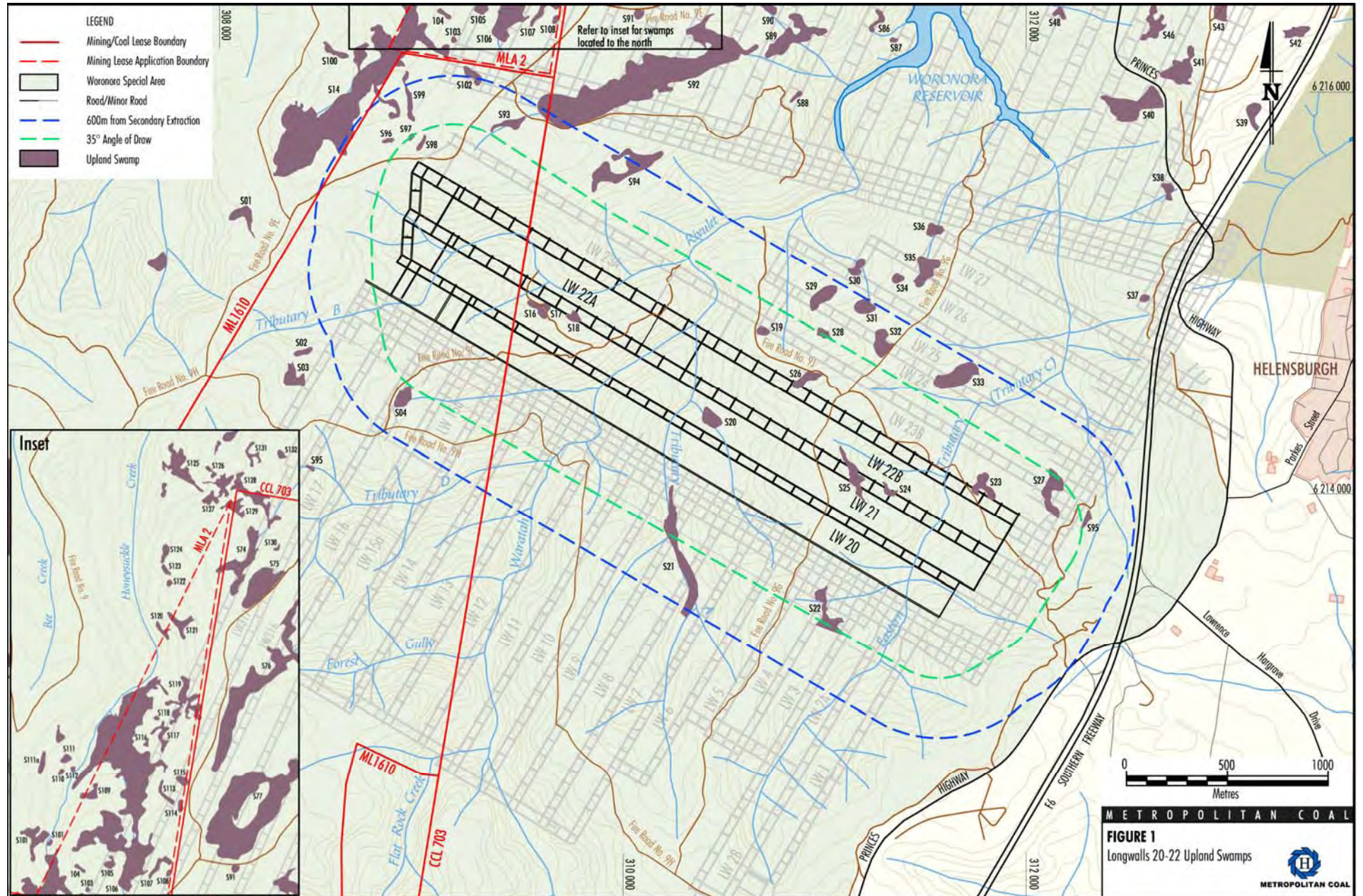
Traverses covering the majority of the extent of the swamp were conducted to record observations such as cracking of exposed bedrock areas and/or swamp sediments, areas of increased erosion, changes in water colour, changes in vegetation condition and the amount of seepage.

No major cracking of exposed bedrock areas or swamp sediments, areas of increased erosion, changes in water colour or vegetation condition were observed during the visual inspections. Minor surface cracking of exposed sandstone outcrops was observed in several swamps where vegetation has opportunistically grown, for example Swamps 17 and 23; and rock displacement has been recorded in the lower end of Swamp 24 within a drainage channel. Such features have been included in the photographic record.

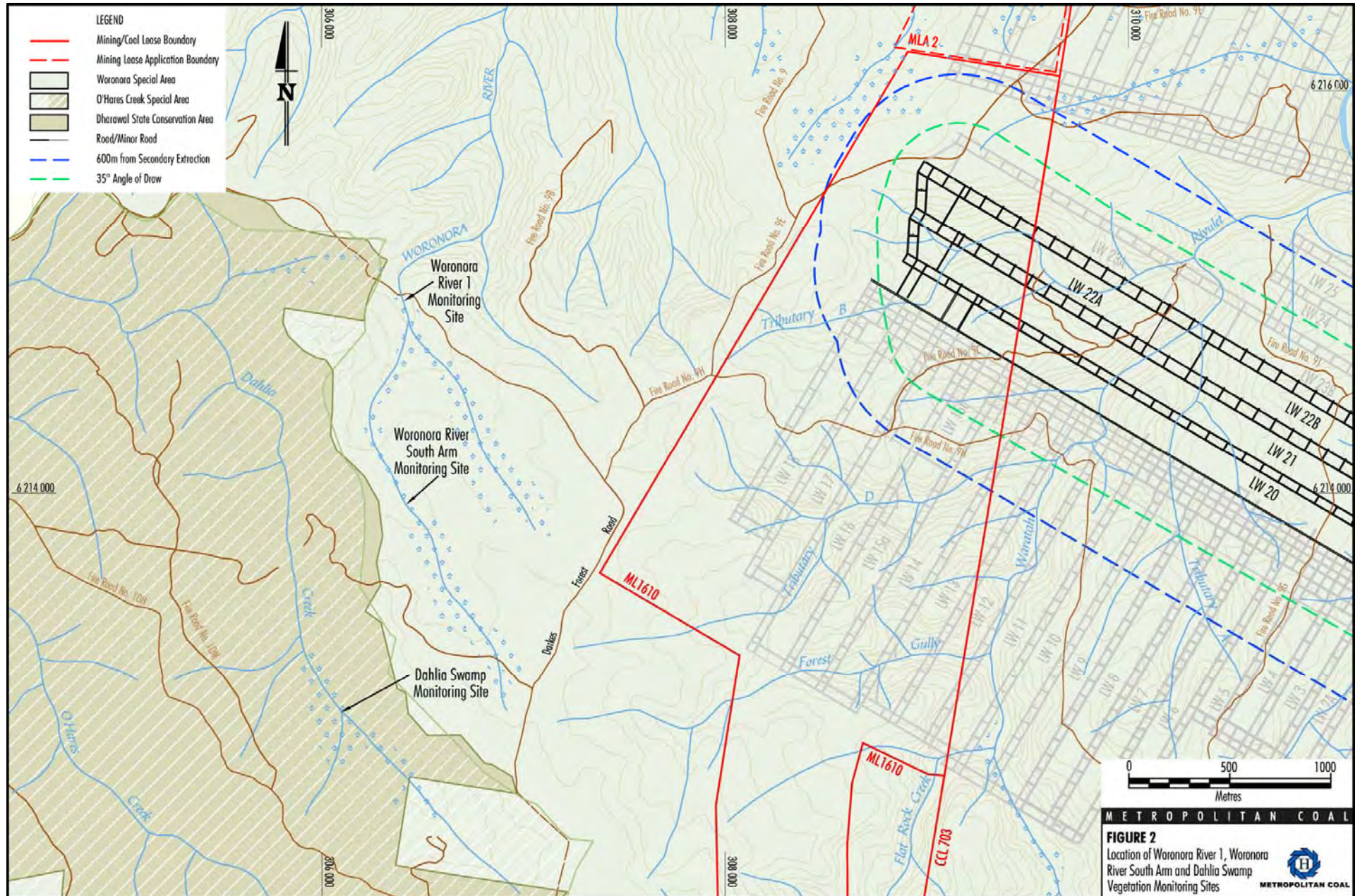
The baseline monitoring data provides a benchmark against which changes or trends can be measured during and after the mining of Longwalls 20-22.

Visual inspections will also be conducted monthly for the period of time that Longwall 20 is within 400 m of a swamp to record evidence of potential subsidence impacts.

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY



METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY



Transect/Quadrat Monitoring

Baseline transect and quadrat monitoring has been conducted in spring 2009 and autumn 2010 of:

- restioid heath vegetation – Swamps 18, 24 and 25 overlying Longwalls 20-22, and in control swamps 101, 111a and 125 (Figure 1); and
- tea tree thicket vegetation – Swamp 20 overlying Longwalls 20-22, and in control swamps Woronora River 1, Woronora River South Arm and Dahlia Swamp (Figures 1 and 2).

Swamps 16 and 17 (restioid heath/sandstone heath woodland) were also added to the vegetation monitoring program in autumn 2010 (Figure 1).

Each swamp has been monitored with three transects, with the exception of the control swamps for Swamp 20 where only a single transect has been established owing to the much larger size of the control swamps.

The data collected for each quadrat includes:

- vegetation structure;
- dominant species;
- estimated cover and height for each stratum;
- full floristics;
- estimated cover abundance for each species using seven point Braun-Blanquet scale; and
- condition/health rating for each species in the quadrat.

Permanent photo points have been established along each transect.

In summary, the results of the baseline surveys indicate the following:

- Generally, vegetation at all sites was in a healthy condition throughout the survey period.
- Fluctuations in species cover and vegetation condition were recorded across all sites.
- Fluctuations in species richness were similar between longwall sites and control sites over the survey period.
- At several longwall and control sites there was a general trend in growth recorded over the survey period through increases in vegetation height and cover, particularly for species in the mid and/or lower stratum, for example *Banksia ericifolia* subsp. *ericifolia*, *Hakea teretifolia* and *Epacris obtusifolia*.
- Minor dieback (rating 4) to some dead branches (rating 3) was noted in random individuals at all longwall and control sites irrespective of survey season. Such species include *Banksia ericifolia* subsp. *ericifolia*, *Saropsis fastigiatus*, *Petrophile pulchella*, *Leptopsermum squarrosum* and *Xanthorrhoea resinosa*.
- Patches of senescent vegetation were also recorded in several swamps, for example at the end of Transect 3 in Swamp 25 (longwalls) where a patch of dead *Banksia ericifolia* subsp. *ericifolia* was observed, and between Transects 1 and 2 in Swamp 125 (control) where a patch of dead *Banksia ericifolia* subsp. *ericifolia* and *Banksia marginata* was found.
- A number of longwall and control sites recorded fluctuating cover values.
- No weeds were recorded within any of the sites.

The baseline monitoring data provides a benchmark against which changes or trends in vegetation structure, species composition and vegetation condition can be measured during and after the mining of Longwalls 20-22.

The changes in species composition, cover and condition reflect normal population variation and cycles in response to seasonal variations and plant growth.

Transect and quadrat monitoring will be conducted bi-annually in autumn and spring.

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

Indicator Species

Baseline population monitoring of indicator species has also been conducted in spring 2009 and autumn 2010.

Twenty tagged individuals of *Epacris obtusifolia*, *Sprengelia incarnata* and *Pultenaea aristata* have been monitored in each of the following valley side swamps:

- *Epacris obtusifolia* – Swamps 18, 24 and 25 above Longwalls 20-22 and at control sites 101, 111a and 125.
- *Sprengelia incarnata* – Swamp 24 above Longwalls 20-22 and at control sites 101 and 125.
- *Pultenaea aristata* – Swamps 18, 24 and 25 above Longwalls 20-22 and at control sites 101 and 111a. Note, survey of *Pultenaea aristata* in Swamp 24 commenced in autumn 2010.

Twenty tagged individuals of *Banksia robor*, *Callistemon citrinus* and *Leptospermum juniperinum* have also been monitored in Swamp 20 and at the associated control sites (Woronora River 1, Woronora River South Arm and Dahlia Swamp).

Population monitoring data collected includes a condition/health rating and a reproductive rating for each plant. The baseline monitoring data provides a benchmark against which the health and reproductive rating of the indicator species can be measured during and after the mining of Longwalls 20-22.

Monitoring of indicator species will be conducted bi-annually in autumn and spring.

Upland Swamps Groundwater Monitoring

Piezometers were installed in the following upland swamps in July 2010 to monitor groundwater levels (Figures 1 and 2):

- Valley side Swamps 16/17 overlying Longwalls 20-22 (sandstone piezometer to a depth of 10 m).
- Valley side Swamp 25 overlying Longwalls 20-22 (swamp substrate piezometer to a depth of 0.9 m and sandstone piezometer to a depth of 10 m).
- Valley side Swamp 101 (control - swamp substrate piezometer to a depth of 0.9 m and sandstone piezometer to a depth of 10 m).
- In-valley Swamp 20 overlying Longwalls 20-22 (swamp substrate piezometer to a depth of 0.9 m and sandstone piezometers to depths of 3 and 10 m).
- Headwater Swamp Woronora River 1 (WRSWAMP1) (control - swamp substrate piezometer to a depth of 0.9 m and sandstone piezometers to depths of 3 and 10 m).

The upland swamp groundwater monitoring results will be described in the 2011 Annual Review and subsequent Environmental Monitoring Summary update.

Riparian Vegetation Monitoring

The riparian vegetation monitoring program includes visual, quadrat, transect and indicator species monitoring of riparian vegetation on the Waratah Rivulet and Eastern Tributary, as described below.

Visual Inspections

Baseline visual inspections of riparian areas have been conducted in spring 2008, autumn 2009, spring 2009 and autumn 2010 in locations adjacent to riparian vegetation monitoring sites (sites MRIP01 to MRIP10, Figure 3), and areas traversed whilst accessing the monitoring sites.

The inspections recorded areas of new water ponding, any cracking or rock displacement and changes in vegetation condition, including areas of senescing vegetation that appear unusual.

No cracking or rock displacement or senescing vegetation that appears unusual were observed during the visual inspections.

Visual inspections of riparian vegetation will be conducted bi-annually in autumn and spring at the time of the vegetation surveys.

Quadrat/Transect Monitoring

Baseline quadrat and transect monitoring has been conducted in spring 2008, autumn 2009, spring 2009 and autumn 2010.

A permanent quadrat (20 m x 2 m) has been used to monitor riparian vegetation on the Waratah Rivulet and Eastern Tributary at sites MRIP01, MRIP02, MRIP05 and MRIP06 (overlying Longwalls 20-22) and at sites MRIP03, MRIP04, MRIP07 and MRIP08 (downstream of Longwalls 20-22) (Figure 3).

The data collected for each quadrat includes:

- vegetation structure;
- dominant species;
- estimated cover and height for each stratum;
- full floristics;
- estimated cover abundance for each species using seven point Braun-Blanquet scale; and
- condition/health rating for each species in the quadrat:

A permanent transect (50 m x 2 m, i.e. a 30 m extension of each quadrat) has also been used to monitor riparian vegetation at sites MRIP01 to MRIP08. The data collected along each transect includes the occurrence of weed species (species and location) and a condition/health rating for each plant along the transect.

Permanent photo points have been established for each quadrat and along each transect.

In summary, the results of the baseline surveys indicate the following:

- Generally, the vegetation at all sites was in a healthy condition throughout the survey period.
- Fluctuations in species cover and vegetation condition were recorded across all sites.
- Fluctuations in species richness were similar between longwall sites and control sites over the survey period.
- Minor dieback (rating 4) to some dead branches (rating 3) was noted in random individuals of species at all longwall and control sites irrespective of survey season.
- Long-senescent shrubs and stags were recorded within sites, in adjacent vegetation and across the streams, for example at sites MRIP01, MRIP02, and MRIP03.

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

- Areas of senescent vegetation were also recorded along the riparian areas most likely attributed to changes in water level over the summer period, and expressed in dieback of sedge species at the water line. Scattered shrub species were also noted to be senescing on the opposite bank to site MRIP02 as recorded at the time of initial survey. Such features are also included in the photographic record and notes made as part of visual observations of the area.
- A number of longwall and control sites recorded fluctuating cover values.
- Weeds were recorded in low abundance at the following sites:
 - MRIP01 – *Cyperus eragrostis* at the 20 m interval along the transect.
 - MRIP03 – *Cyperus eragrostis*, and *Conyza* sp. seedlings.
- Other weed species were observed infrequently along the banks of Waratah Rivulet downstream of Flat Rock Crossing and at site MRIP10 at the interface with the inundation zone of Woronora Reservoir. The occurrence of weed species along the riparian zones is likely due to the spread of weed propagules from the upper catchment by flooding events.
- No weeds were recorded at or adjacent to the monitoring sites along the Eastern Tributary.

The changes in species composition, cover and condition reflect normal population variation and cycles in response to seasonal variations and plant growth. The baseline monitoring data provides a benchmark against which changes or trends in vegetation structure, species composition and vegetation condition can be measured during and after the mining of Longwalls 20-22.

Quadrat and transect monitoring will be conducted bi-annually, in autumn and spring.

Indicator Species

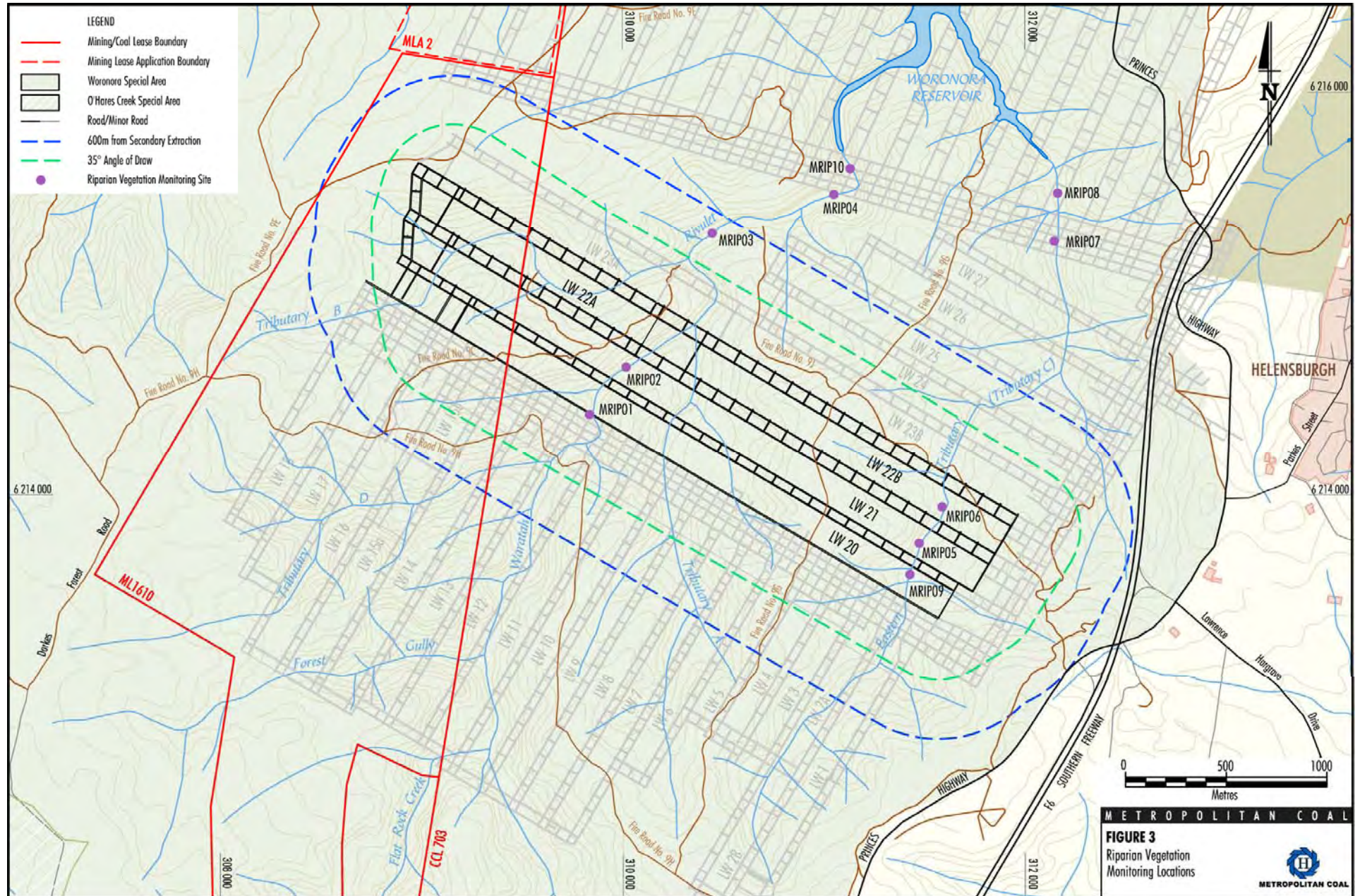
Baseline population monitoring of indicator species has been conducted in spring 2009 and autumn 2010.

Twenty tagged individuals of *Prostanthera linearis*, *Schoenis melanostachys* and *Lomatia myricioides* have been monitored at sites MRIP01, MRIP02, MRIP05, MRIP06 and MRIP09 (overlying Longwalls 20-22) and at sites MRIP03, MRIP04, MRIP07, MRIP08 and MRIP10 (downstream of Longwalls 20-22) (Figure 3). Note, only ten individuals of *Prostanthera linearis* were available for tagging at site MRIP08.

Population monitoring data collected includes a condition/health rating and a reproductive rating for each plant. The baseline monitoring data provides a benchmark against which the health and reproductive rating of the indicator species can be measured during and after the mining of Longwalls 20-22.

Monitoring of indicator species will be conducted bi-annually in autumn and spring.

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY



Aquatic Biota and their Habitats

The aquatic ecology monitoring program for Longwalls 20-22 has been designed to:

- monitor subsidence-induced impacts on aquatic ecology (referred to as stream monitoring); and
- monitor the response of aquatic ecosystems to the implementation of stream remediation works (referred to as pool monitoring).

The design of the monitoring programs uses a “Beyond BACI” experimental design and focuses on representative sampling within streams and pools in the Longwalls 20-22 mining area and in suitable control streams and pools not subject to mine subsidence.

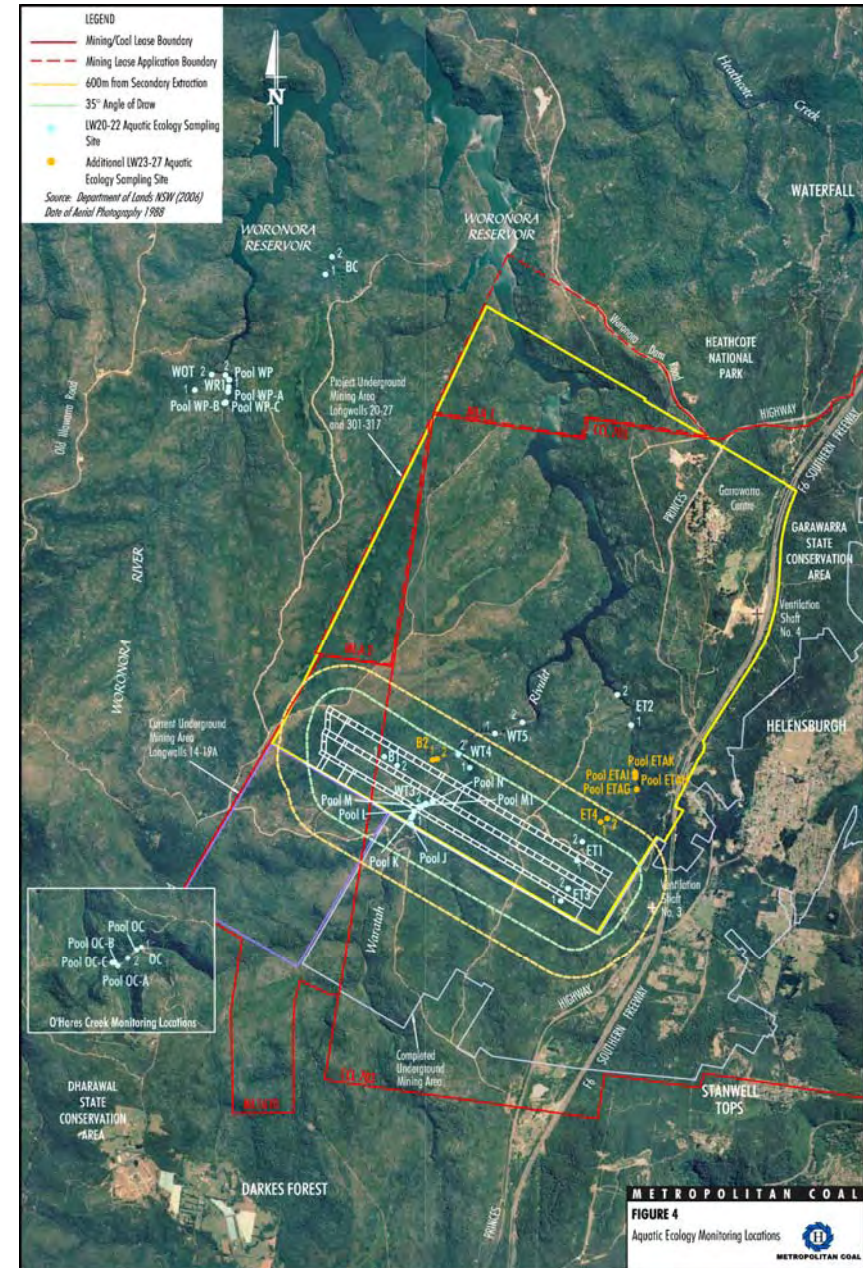
Stream Monitoring

The stream monitoring program includes the monitoring of aquatic habitat characteristics, water quality, aquatic macroinvertebrates and aquatic macrophytes. Baseline monitoring has been conducted in spring 2008, autumn 2009, spring 2009 and autumn 2010.

Monitoring has been conducted at two sampling sites (approximately 100 m long) at the following stream sampling locations:

- Locations WT3 on Waratah Rivulet, ET1 and ET3 on the Eastern Tributary and B1 on Tributary B, overlying Longwalls 20-22.
- Locations WT4 and WT5 on Waratah Rivulet and ET2 on the Eastern Tributary, downstream of Longwalls 20-22.
- Control locations: WR1 on Woronora River; OC on O'Hares Creek; BC on Bee Creek; and WOT on Woronora Tributary.

The approximate locations of the sampling sites are shown on Figure 4.



METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

The methods used to survey aquatic biota and their habitats at each site are:

- Stream characteristics are recorded in accordance with the Australian River Assessment System (AUSRIVAS) protocol (visual assessment of stream width and depth, riparian conditions, signs of disturbance, water quality and percentage cover of the substratum by algae).
- Water quality sampling is conducted for electrical conductivity, dissolved oxygen, pH, temperature, turbidity, oxygen reduction potential, alkalinity, total phosphorous and total nitrogen to provide information relevant to water quality at the time of sampling.
- Aquatic macroinvertebrate sampling is conducted using the AUSRIVAS protocol, as well as quantitative sampling where three replicate macroinvertebrate samples are collected within each site using timed sweeps.
- The distribution of submerged and emergent (occurring in-stream and in the riparian zone) aquatic macrophytes are estimated along each sampling location by assigning a cover class to each species. The cover classes are: (1) one plant or small patch (i.e. few), (2) not common, growing in a few places (i.e. scattered), and (3) widespread (i.e. common). In addition, an assessment of the in-stream (i.e. submerged and emergent) aquatic vegetation is made within each site by estimating the relative abundance (i.e. percentage cover) of aquatic macrophytes within five haphazardly placed 0.25 m² quadrats, using a stratified sampling technique.

Table 1 presents the AUSRIVAS Band results for each site prior to the commencement of Longwall 20.

Charts 1 to 4 present the mean abundance of macroinvertebrates, mean diversity of macroinvertebrates, mean percentage cover of macrophytes and mean diversity of macrophytes at each sampling location, respectively, using the quantitative sampling data. The baseline monitoring data provides a benchmark against which aquatic biota and their habitats can be measured during and after the mining of Longwalls 20-22.

Monitoring of the sampling sites will be conducted bi-annually, in autumn and spring.

Table 1
AUSRIVAS Band Results

Stream	Site	AUSRIVAS Band			
		Spring 2008	Autumn 2009	Spring 2009	Autumn 2010
Waratah Rivulet	WT3-1	B	B	B	B
	WT3-2	B	B	B	C
	WT4-1	D	C	C	C
	WT4-2	B	C	C	B
	WT5-1	B	C	C	C
	WT5-2	D	C	C	C
Eastern Tributary	ET1-1	D	C	B	B
	ET1-2	D	C	C	B
	ET2-1	D	B	B	C
	ET2-2	D	C	B	C
	ET3-1	#	#	B	C
	ET3-2	#	#	D	C
Tributary B	B1	B	C	C	C
	B2	C	B	C	B
Bee Creek	BC1	D	C	C	B
	BC2	C	B	D	B
Woronora Tributary	WOT1	C	B	-	B
	WOT2	C	C	D	C
Woronora River	WR1	D	B	C	B
	WR2	C	C	C	B
O'Hares Creek	OC1-1	B	B	B	A
	OC1-2	D	B	B	B

Survey of Sites ET3-1 and ET3-2 commenced in spring 2009 for Longwalls 23-27.

- Insufficient water habitat available to sample.

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

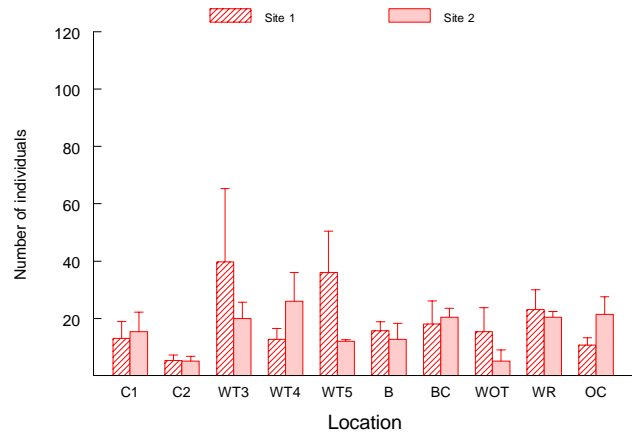


Chart 1a Mean (+SE) Macroinvertebrate Abundance, Stream Monitoring, Spring 2008

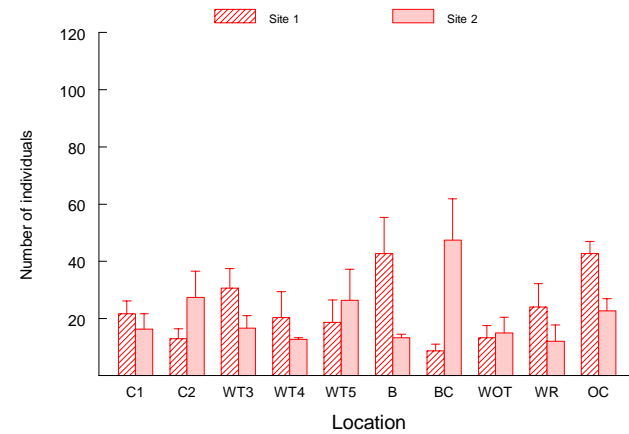


Chart 1b Mean (+SE) Macroinvertebrate Abundance, Stream Monitoring, Autumn 2009

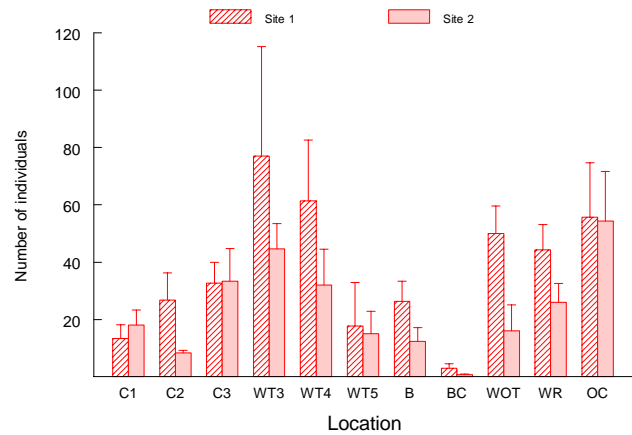


Chart 1c Mean (+SE) Macroinvertebrate Abundance, Stream Monitoring, Spring 2009

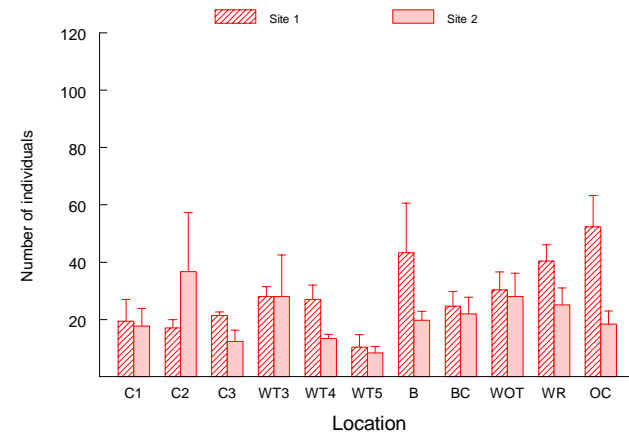


Chart 1d Mean (+SE) Macroinvertebrate Abundance, Stream Monitoring, Autumn 2010

Key: C – Tributary C/Eastern Tributary [C1 – Location 1 etc], WT – Waratah Rivulet [WT3 - Location 3 etc], B – Tributary B, BC – Bee Creek, WOT – Woronora Tributary, WR – Woronora River, OC – O'Hares Creek. (n = 3)

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

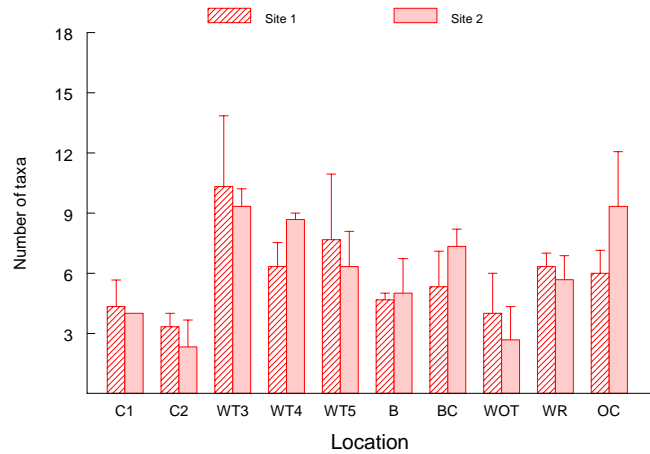


Chart 2a Mean (+SE) Macroinvertebrate Diversity, Stream Monitoring, Spring 2008

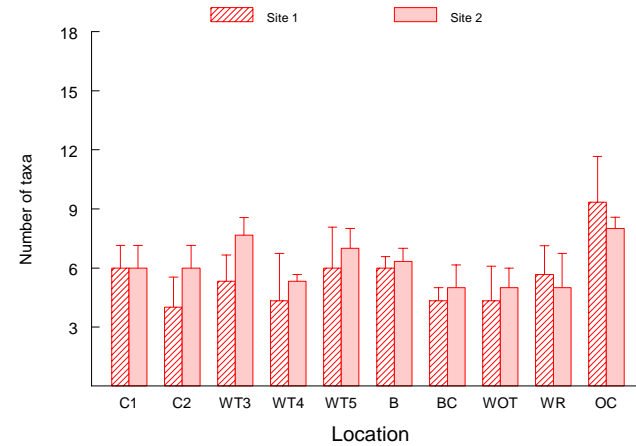


Chart 2b Mean (+SE) Macroinvertebrate Diversity, Stream Monitoring, Autumn 2009

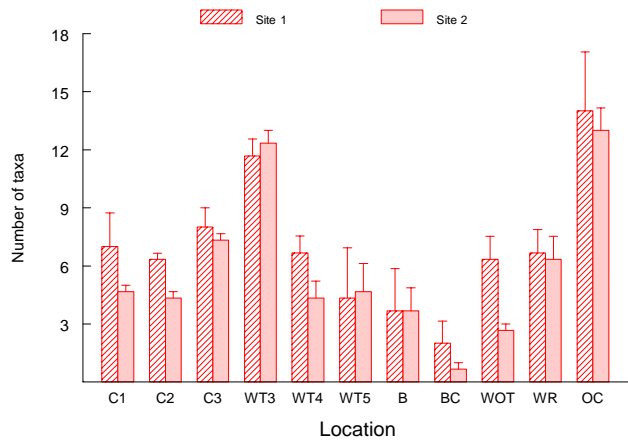


Chart 2c Mean (+SE) Macroinvertebrates Diversity, Stream Monitoring, Spring 2009

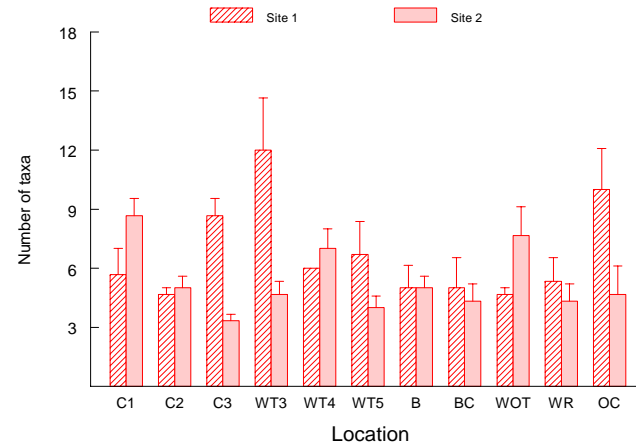


Chart 2d Mean (+SE) Macroinvertebrate Diversity, Stream Monitoring, Autumn 2010

Key: C – Tributary C/Eastern Tributary [C1 – Location 1 etc], WT – Waratah Rivulet [WT3 - Location 3 etc], B – Tributary B, BC – Bee Creek, WOT – Woronora Tributary, WR – Woronora River, OC – O'Hares Creek. (n=3)

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

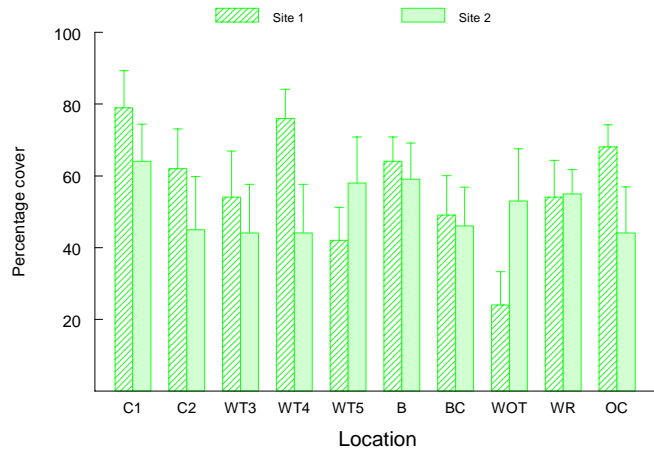


Chart 3a Mean (+SE) Macrophyte Percentage Cover, Stream Monitoring, Spring 2008

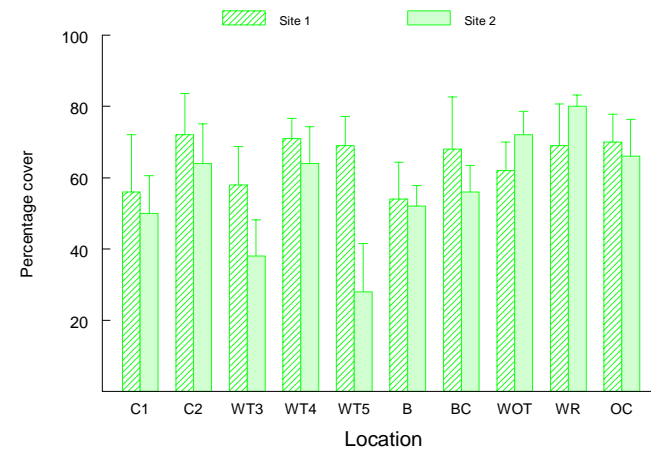


Chart 3b Mean (+SE) Macrophyte Percentage Cover, Stream Monitoring, Autumn 2009

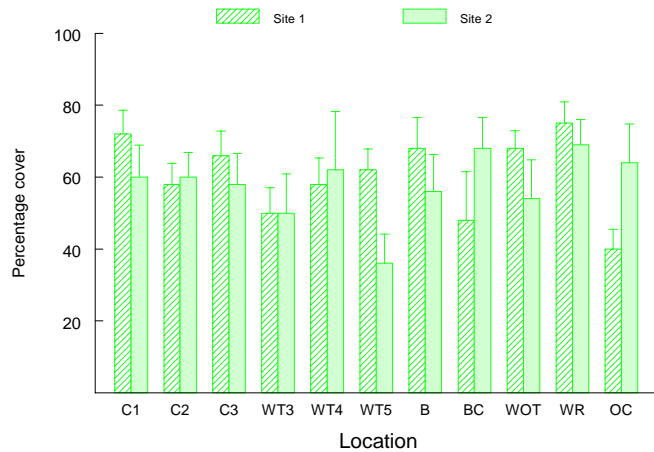


Chart 3c Mean (+SE) Macrophyte Percentage Cover, Steam Monitoring, Spring 2009

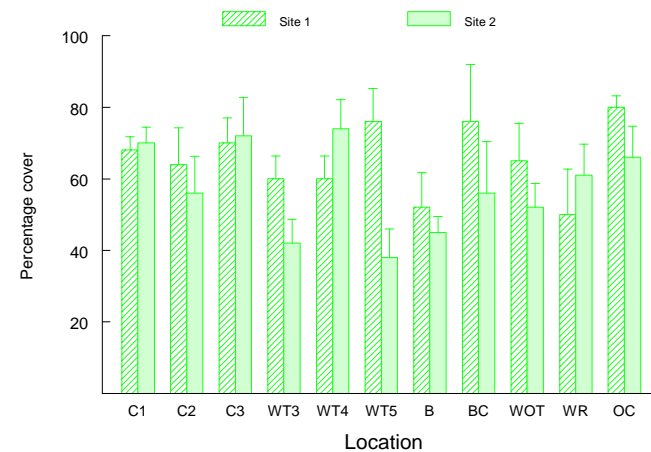


Chart 3d Mean (+SE) Macrophyte Percentage Cover, Stream Monitoring, Autumn 2010

Key: C – Tributary C/Eastern Tributary [C1 – Location 1 etc], WT – Waratah Rivulet [WT3 - Location 3 etc], B – Tributary B, BC – Bee Creek, WOT – Woronora Tributary, WR – Woronora River, OC – O'Hares Creek. (n=3)

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

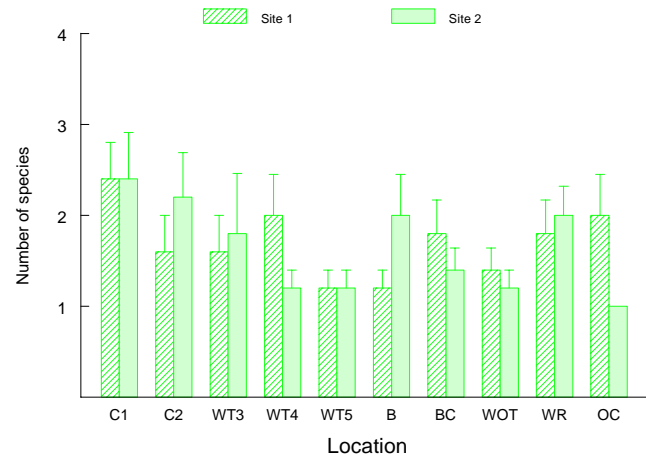


Chart 4a Mean (+SE) Macrophyte Diversity, Stream Monitoring, Spring 2008

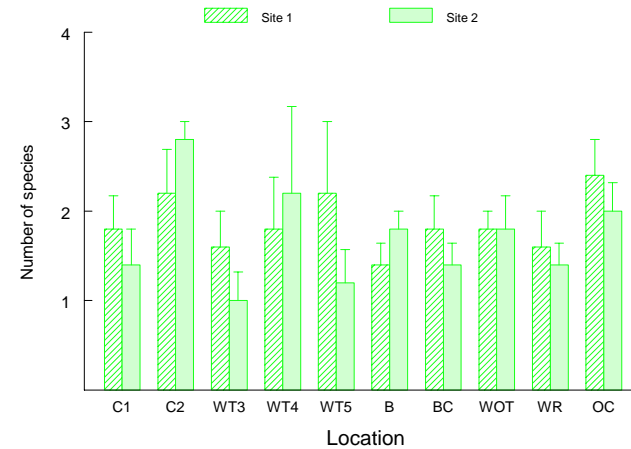


Chart 4b Mean (+SE) Macrophyte Diversity, Stream Monitoring, Autumn 2009

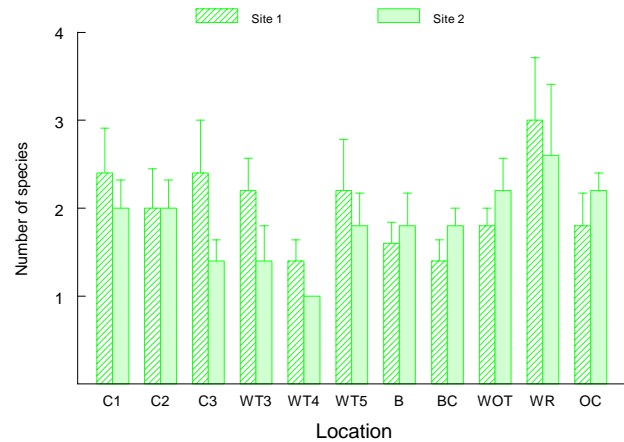


Chart 4c Mean (+SE) Macrophyte Diversity, Stream Monitoring, Spring 2009

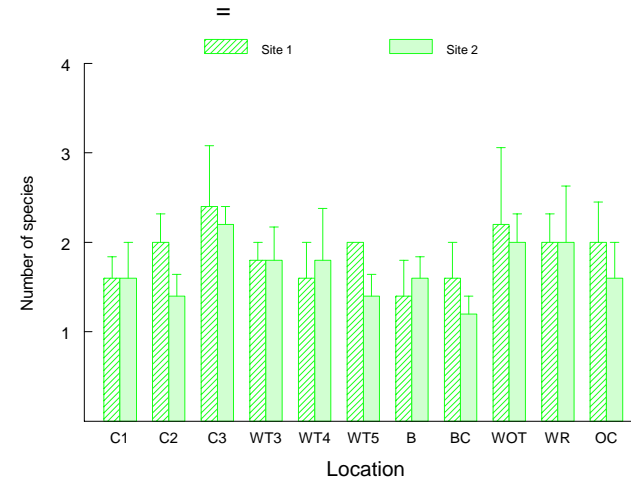


Chart 4d Mean (+SE) Macrophyte Diversity, Stream Monitoring, Autumn 2010

Key: C – Tributary C/Eastern Tributary [C1 – Location 1 etc], WT – Waratah Rivulet [WT3 - Location 3 etc], B – Tributary B, BC – Bee Creek, WOT – Woronora Tributary, WR – Woronora River, OC – O'Hares Creek. (n=3)

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

Pool Monitoring

Baseline monitoring of pools on Waratah Rivulet has been conducted since spring 2008 or spring 2009¹ to assess the response of aquatic ecosystems to the implementation of future stream remediation works, namely:

- Larger pools, J, M1 and N on Waratah Rivulet overlying Longwalls 20-22.
- Smaller pools K, L and M on Waratah Rivulet overlying Longwalls 20-22.
- One larger control pool on Woronora River (Pool WP) and one larger control pool on O'Hares Creek (Pool OC).
- Three smaller control pools on Woronora River (Pool WP-A, WP-B and WP-C) and three smaller control pools on O'Hares Creek (Pool OC-A, OC-B and OC-C).

The approximate locations of the sampling sites are shown on Figure 4.

Sampling is conducted at two random sites within the larger pools and at one site within the smaller pools.

Within each site in each pool, aquatic macroinvertebrates and macrophytes are sampled using the same quantitative techniques described for stream monitoring above. The AUSRIVAS sampling technique is not used for macroinvertebrate sampling in the pool monitoring.

Quantitative estimates of aquatic macrophytes (i.e. emergent, floating attached and/or submerged species of aquatic plants) are collected at one site at each small pool and at two sites at each large pool. In addition, the spatial distribution of floating attached and/or submerged macrophytes (e.g. *Myriophyllum pendunculatum* and *Triglochin procerum*) is also mapped in each pool, to provide a visual comparison of their distribution through time.

Charts 5 to 8 present the mean abundance of macroinvertebrates, mean diversity of macroinvertebrates, mean percentage cover of macrophytes and mean diversity of macrophytes at the larger pools, respectively, using the quantitative sampling data.

Charts 9 to 12 present the mean abundance of macroinvertebrates, mean diversity of macroinvertebrates, mean percentage cover of macrophytes and mean diversity of macrophytes at the smaller pools, respectively, using the quantitative sampling data.

The baseline monitoring data provides a benchmark against which aquatic biota and their habitats can be measured before and after stream remediation works.

Monitoring of the sampling sites will be conducted bi-annually, in autumn and spring.

¹ Pools monitored since spring 2008: larger pools - Pool N on Waratah Rivulet, Pool WP on Woronora River and Pool OC on O'Hares Creek.

Pools monitored since spring 2009: larger pools - Pools J and M1 on Waratah Rivulet; smaller pools: Pools K, L and M on Waratah Rivulet, Pools WP-A, WP-B, WP-C on Woronora River and Pools OC-A, OC-B, OC-C on O'Hares Creek.

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

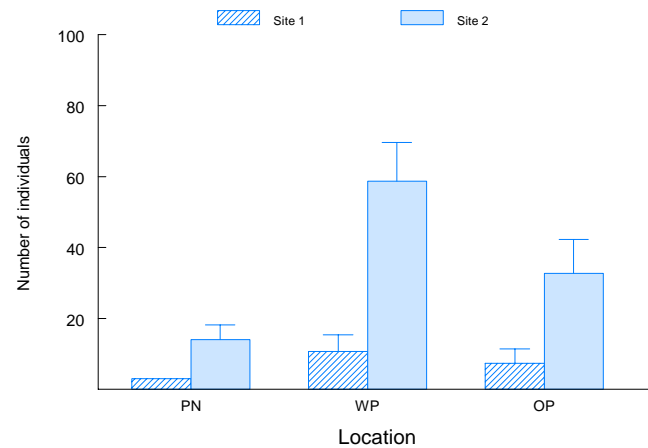


Chart 5a Mean (+SE) Macroinvertebrate Abundance, Larger Pools, Spring 2008

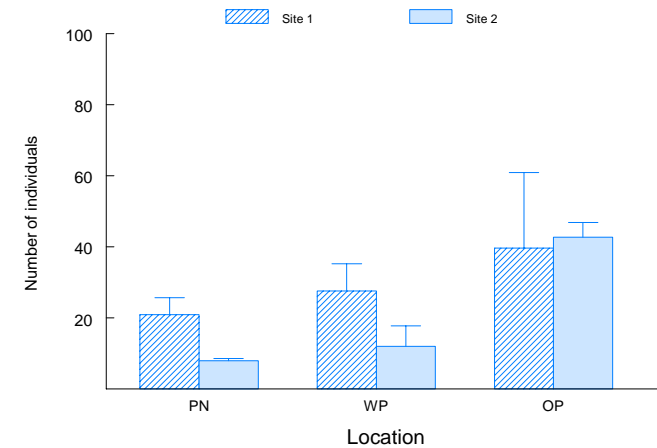


Chart 5b Mean (+SE) Macroinvertebrate Abundance, Larger Pools, Autumn 2009

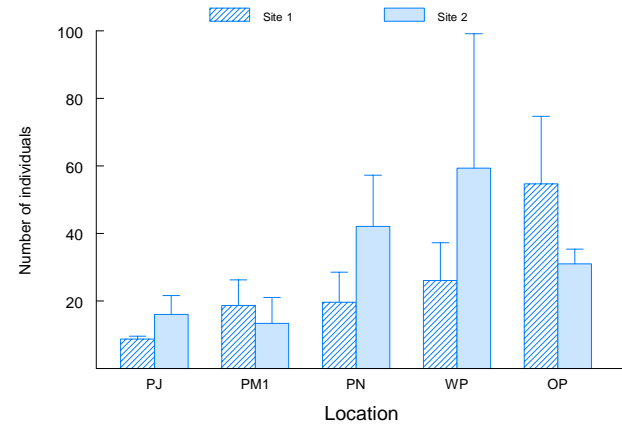


Chart 5c Mean (+SE) Macroinvertebrate Abundance, Larger Pools, Spring 2009

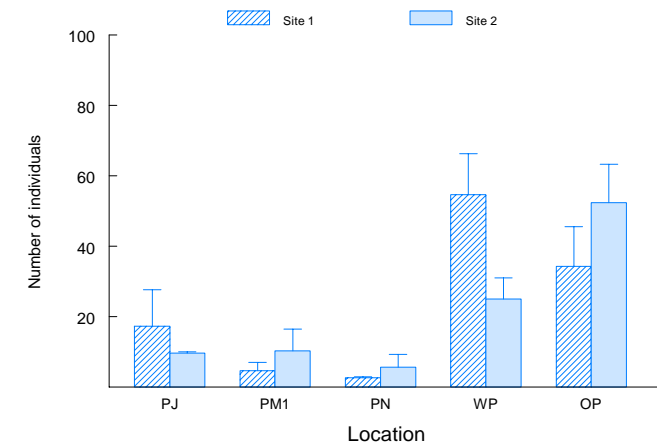


Chart 5d Mean (+SE) Macroinvertebrate Abundance, Larger Pools, Autumn 2010

Larger Pools Key: PJ – Pool J, PM1 – Pool M1, PN – Pool N, WP – Woronora Pool, OP - O'Hares Creek Pool (n = 3).

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

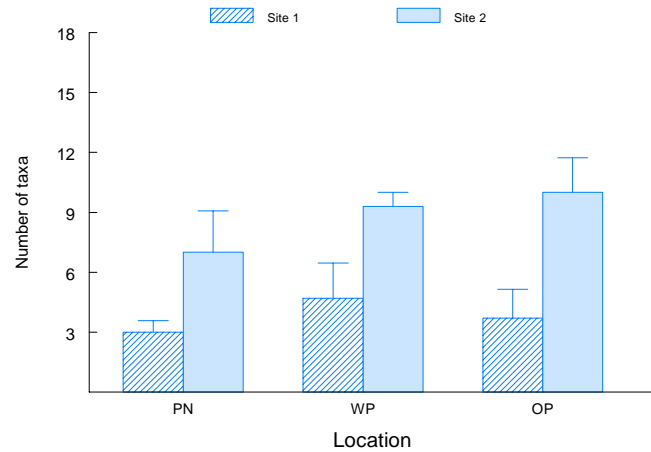


Chart 6a Mean (+SE) Macroinvertebrate Diversity, Larger Pools, Spring 2008

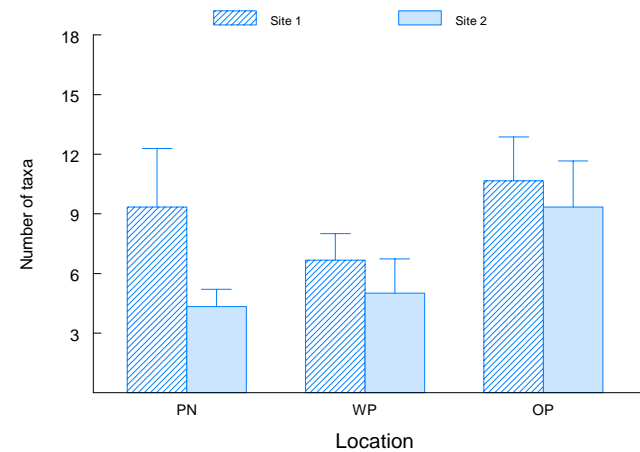


Chart 6b Mean (+SE) Macroinvertebrate Diversity, Larger Pools, Autumn 2009

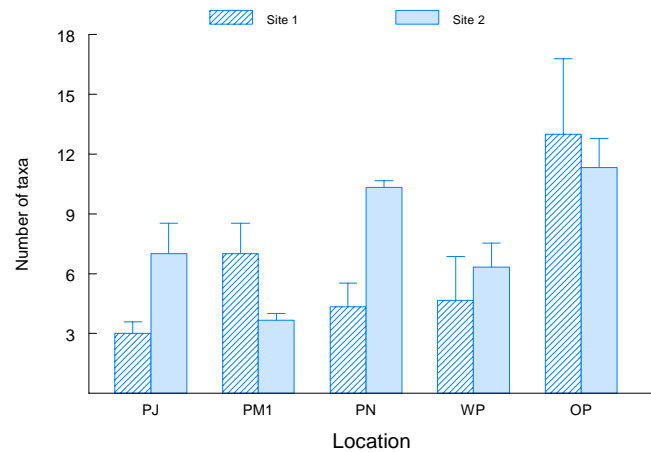


Chart 6c Mean (+SE) Macroinvertebrate Diversity, Larger Pools, Spring 2009

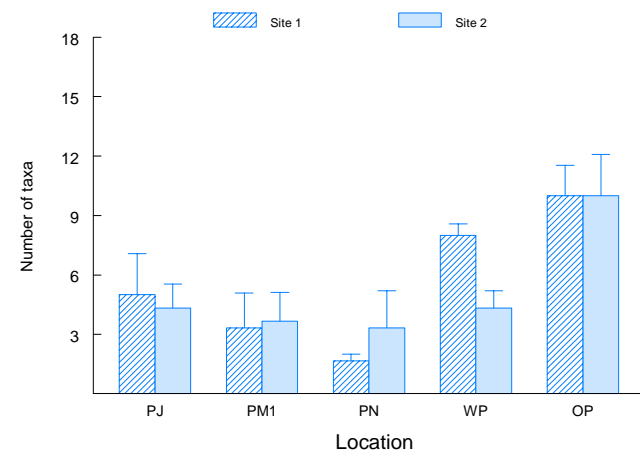


Chart 6d Mean (+SE) Macroinvertebrate Diversity, Larger Pools, Autumn 2010

Larger Pools Key: PJ – Pool J, PM1 – Pool M1, PN – Pool N, WP – Woronora Pool, OP - O'Hares Creek Pool (n = 3).

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

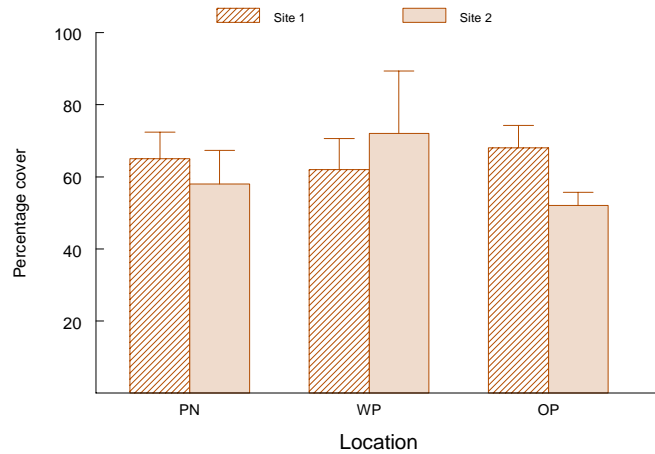


Chart 7a Mean (+SE) Macrophyte Percentage Cover, Larger Pools, Spring 2008

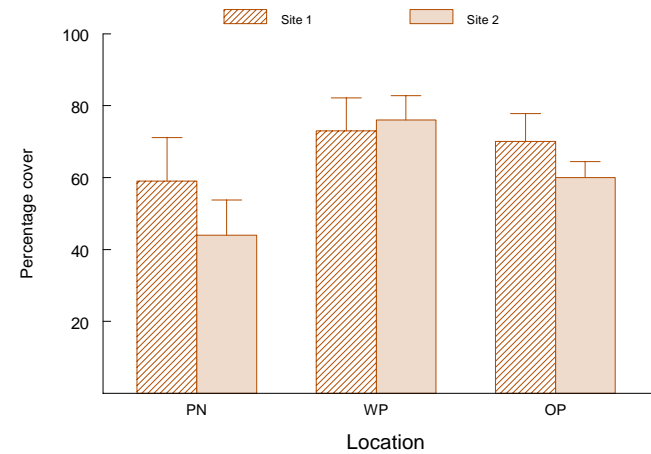


Chart 7b Mean (+SE) Macrophyte Percentage Cover, Larger Pools, Autumn 2009

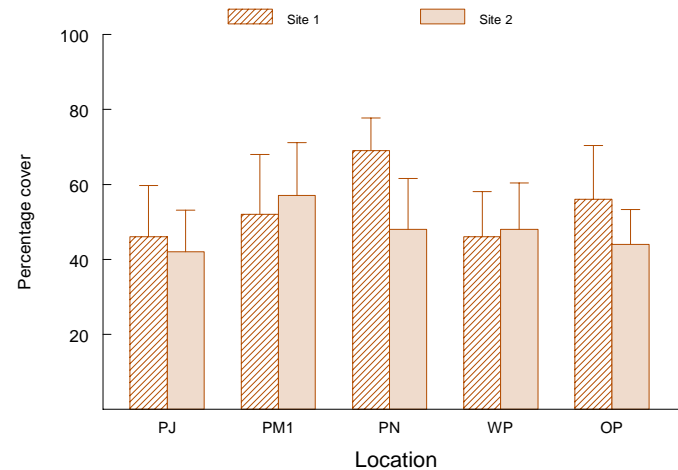


Chart 7c Mean (+SE) Macrophyte Percentage Cover, Larger Pools, Spring 2009

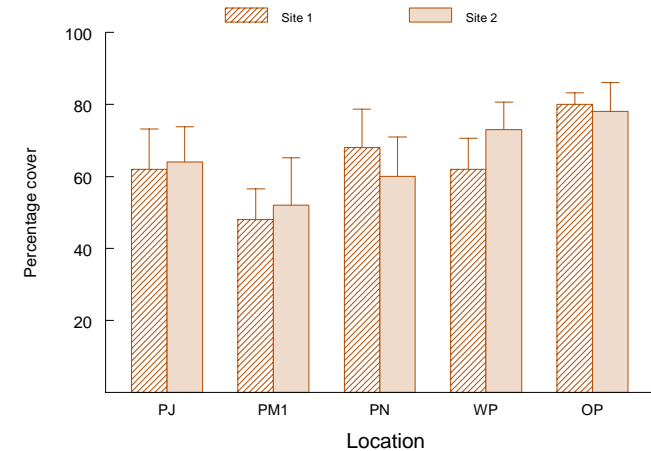


Chart 7d Mean (+SE) Macrophytes Percentage Cover, Larger Pools, Autumn 2010

Larger Pools Key: PJ – Pool J, PM1 – Pool M1, PN – Pool N, WP – Woronora Pool, OP - O'Hares Creek Pool (n = 5)

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

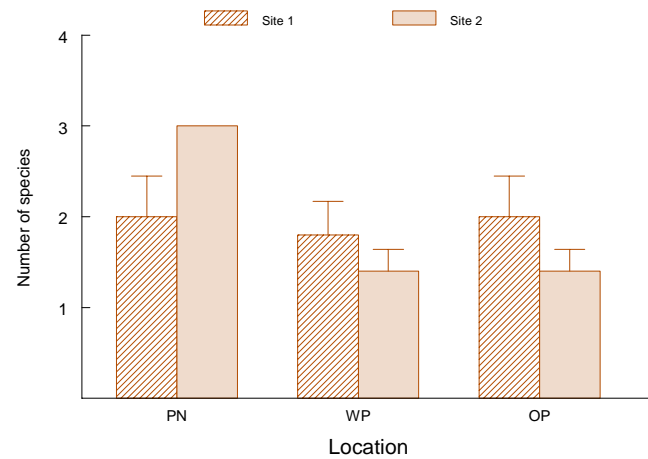


Chart 8a Mean (+SE) Macrophyte Diversity, Larger Pools, Spring 2008

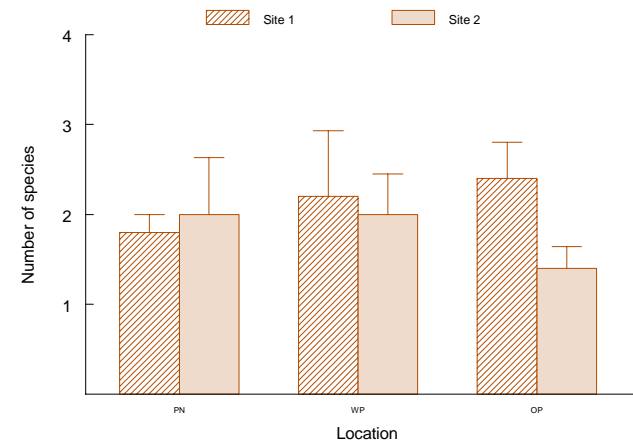


Chart 8b Mean (+SE) Macrophyte Diversity, Larger Pools, Autumn 2009

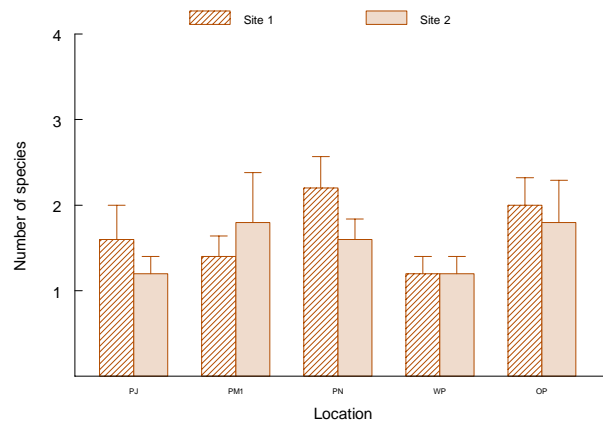


Chart 8c Mean (+SE) Macrophyte Diversity, Larger Pools, Spring 2009

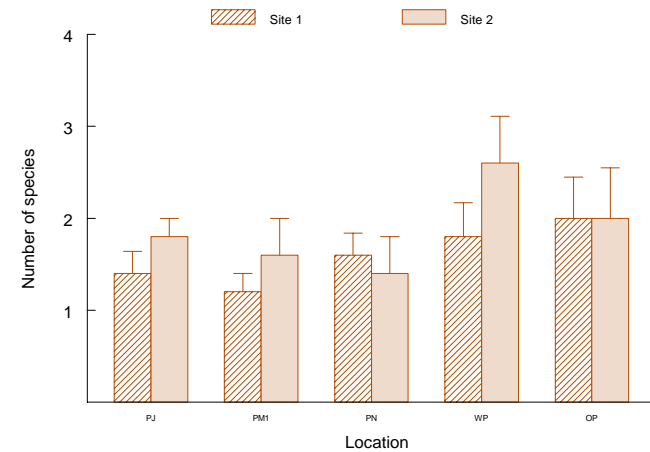


Chart 8d Mean (+SE) Macrophyte Diversity, Larger Pools, Autumn 2010

Larger Pools Key: PJ – Pool J, PM1 – Pool M1, PN – Pool N, WP – Woronora Pool, OP - O'Hares Creek Pool ($n = 5$)

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

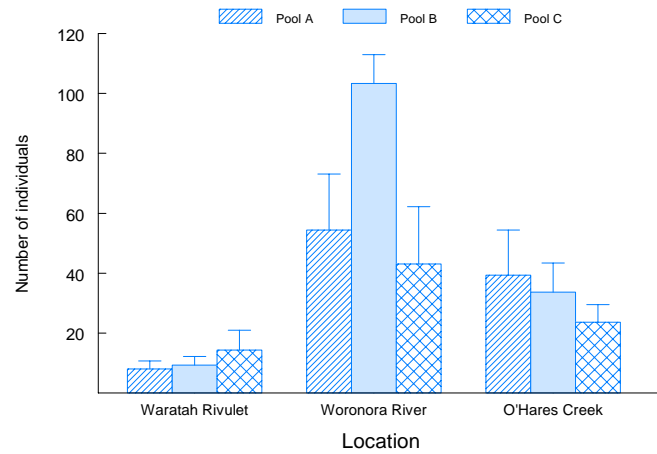


Chart 9a Mean (+SE) Macroinvertebrate Abundance, Smaller Pools, Spring 2009

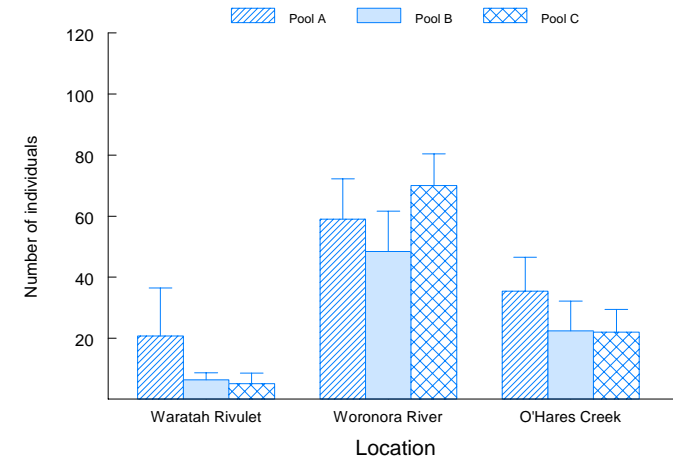


Chart 9b Mean (+SE) Macroinvertebrate Abundance, Smaller Pools, Autumn 2010

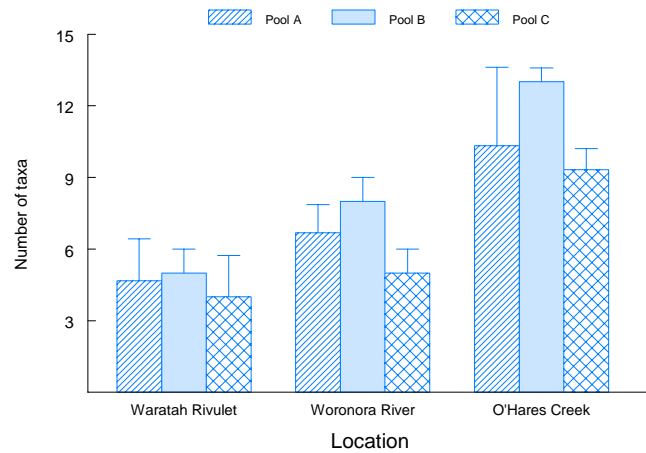


Chart 10a Mean (+SE) Macroinvertebrate Diversity, Smaller Pools, Spring 2009

Note: Pools A, B and C on Waratah Rivulet represent Pools K, L and M, respectively (n = 3).

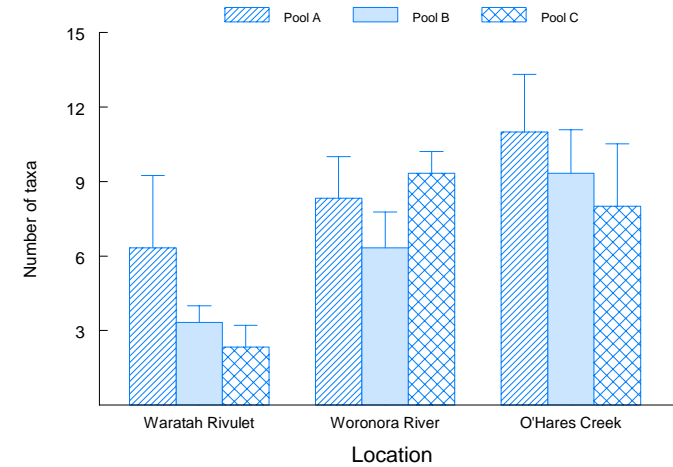


Chart 10b Mean (+SE) Macroinvertebrate Diversity, Smaller Pools, Autumn 2010

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

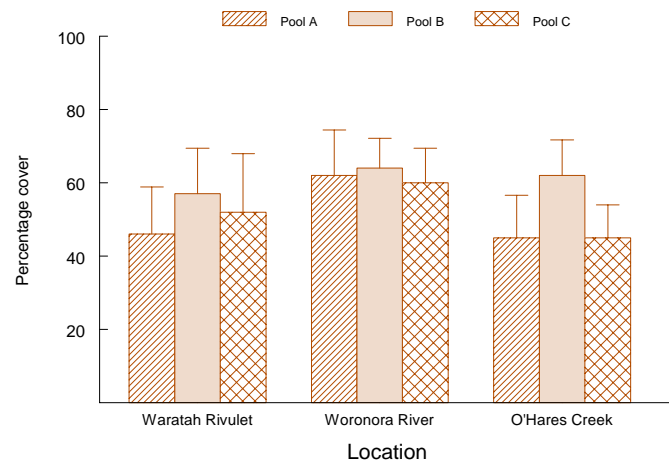


Chart 11a Mean (+SE) Macrophyte Percentage Cover, Smaller Pools, Spring 2009

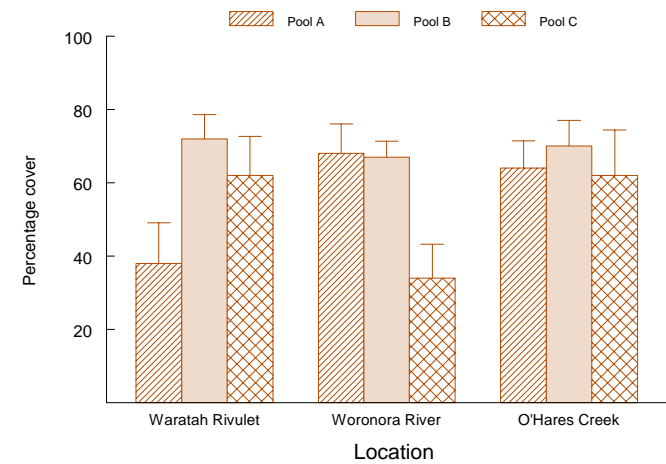


Chart 11b Mean (+SE) Macrophyte Percentage Cover, Smaller Pools, Autumn 2010

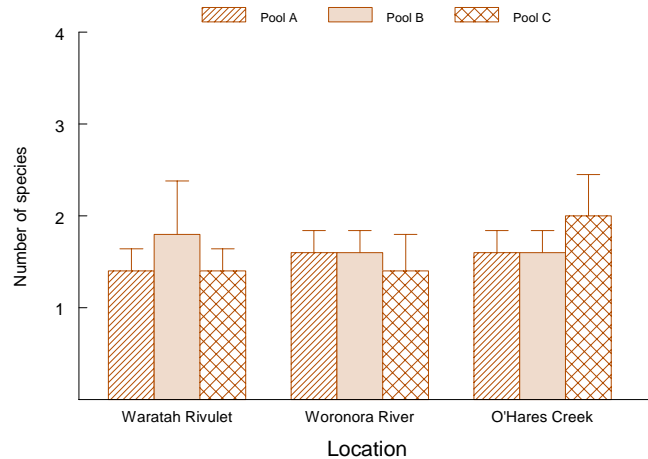


Chart 12a Mean (+SE) Macrophyte Diversity, Smaller Pools, Spring 2009

Note: Pools A, B and C on Waratah Rivulet represent Pools K, L and M, respectively (n = 3).

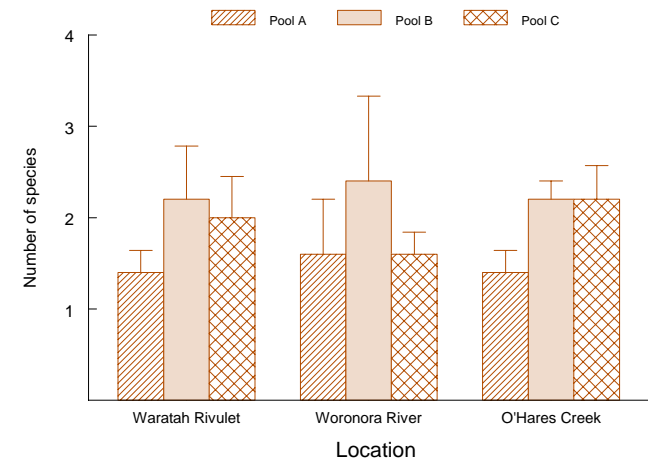


Chart 12b Mean (+SE) Macrophyte Diversity, Smaller Pools, Autumn 2010

METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

Amphibian Surveys

A monitoring program has been developed for Longwalls 20-22 to monitor amphibian species, with a focus on the habitats of the Giant Burrowing Frog (*Heleioporus australiacus*) and Red-crowned Toadlet (*Pseudophryne australis*) associated with tributaries. Baseline monitoring has been conducted in spring/summer 2009.

Six sites overlying Longwalls 20-22 and six control sites will be surveyed annually in spring/summer (i.e. October to February) during suitable weather conditions. The approximate locations of the sampling sites are shown on Figure 5. Each site is surveyed once during a standard one hour general area day search (early morning and late afternoon) supplemented by an evening 60 minute search/playback session using hand held spotlights and head lamps.

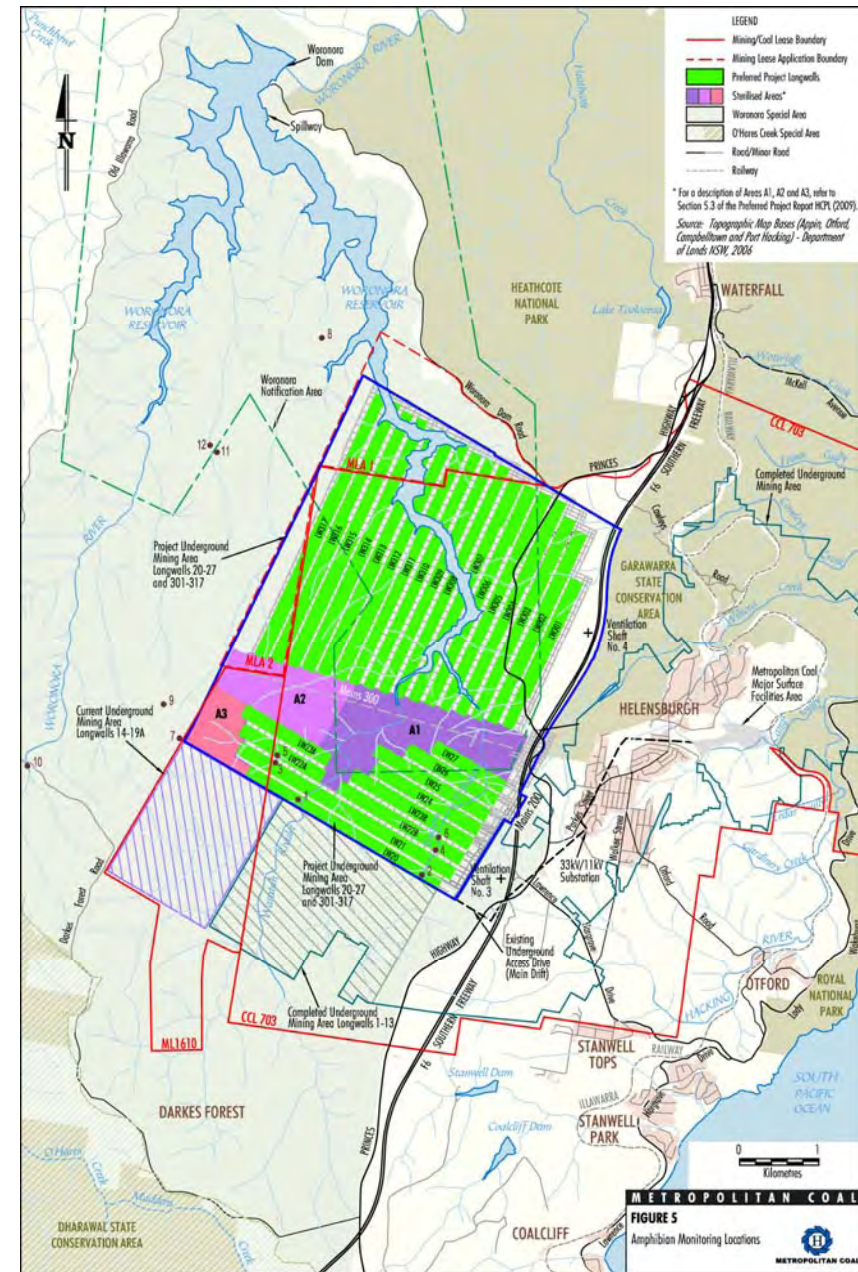
Species are assigned to the following relative abundance categories for tadpole and adult stages:

- 0 = no sightings;
- 1 = one sighting of adult or tadpole stage;
- UC = uncommon (i.e. 2 to 10 individuals), adult or tadpole stage;
- MC = moderately common (i.e. 11 to 20 individuals), adult or tadpole stage;
- C = common (i.e. 21 to 40 individuals), adult or tadpole stage; and
- A = abundant (>40 individuals), adult or tadpole stage.

The results of the survey are presented in Table 2. In summary, the results of the baseline surveys indicate:

- A total of eleven species were recorded, nine in sites above Longwalls 20-22 and eight in control sites, being representatives from the two families Myobatrachidae and Hylidae.
- Species diversity varied across sites from 0 to 7. No amphibians were recorded at control Sites 8, 11 and 12. The most species diverse site was Site 10 (control) with seven species, followed by Sites 4 and 5 (Longwalls 20-22), with six species each.
- Two threatened species, the Giant Burrowing Frog and Red-crowned Toadlet were recorded during the survey.
- There was no significant difference between amphibian species diversity in the Longwalls 20-22 sites and control sites.

The baseline monitoring data provides a benchmark against which amphibians can be monitored during and after the mining of Longwalls 20-22. Monitoring of the survey sites will be conducted annually in spring/summer.



METROPOLITAN COAL - ENVIRONMENTAL MONITORING SUMMARY

Table 2
Amphibian Species Diversity and Abundance, Spring/Summer 2009

Scientific Name	Common Name	Sites Above Longwalls 20-22						Control Sites						Total		Relative Abundance ²	
		1	2	3	4	5	6	7	8	9	10	11	12	Test	Control	Test	Control
Myobatrachidae																	
<i>Crinia signifera</i>	Common Eastern Froglet	1 ¹ 0	1 0	1 0	>10 0	2 0	1 0	1 0	0 0	0 0	5 >10	0 0	0 0	>16 0	6 >10	MC	MC
<i>Heleioporus australiacus</i>	Giant Burrowing Frog ^{V, V}	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 1	0 0	0 0	0 0	0 1	0	1
<i>Limnodynastes peronii</i>	Brown-striped Frog	0 0	0 0	0 0	1 0	1 0	1 0	0 0	0 0	0 0	2 0	0 0	0 0	3 0	2 0	UC	UC
<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog	0 0	0 0	0 0	0 0	0 0	0 0	1 0	0 0	0 0	0 0	0 0	0 0	0 0	1 0	0	1
<i>Pseudophryne australis</i>	Red-crowned Toadlet ^V	0 0	1 0	2 0	2 0	0 0	0 0	1 0	0 0	1 0	1 0	0 0	0 0	5 0	3 0	UC	UC
<i>Uperoleia laevisgata</i>	Smooth Toadlet	0 0	0 0	0 0	1 0	0 0	0 0	0 0	0 0	0 0	1 0	0 0	0 0	1 0	1 0	1	1
Hylidae																	
<i>Litoria citropa</i>	Blue Mountains Tree Frog	0 0	1 0	0 0	1 0	0 0	1 0	0 0	0 0	0 0	0 0	0 0	0 0	3 0	0 0	UC	0
<i>Litoria freycineti</i>	Southern Rocket Frog	0 0	0 0	0 0	0 0	5 0	1 0	0 0	0 0	0 0	2 0	0 0	0 0	6 0	2 0	UC	UC
<i>Litoria wilcoxii</i>	Stony Creek Frog	0 0	10 0	0 0	0 0	3 0	0 0	0 0	0 0	0 0	4 2	0 0	0 0	13 0	4 2	MC	UC
<i>Litoria peronii</i>	Peron's Tree Frog	0 0	1 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 0	0 0	1	0
<i>Litoria phyllochroa</i>	Leaf-green Tree Frog	0 0	0 0	0 0	2 0	1 0	>5 0	0 0	0 0	0 0	0 0	0 0	0 0	>8 0	0 0	UC	0
	Number of Species	1	5	2	6	5	5	3	0	1	7	0	0	9	8	-	-

¹ First line of data refers to the presence or absence of adults, while the second line of data refers to absence or presence of tadpoles.

² Relative Abundance: 0 – no sightings, 1 – One sighting of adult or tadpole stage, UC – Uncommon, 2 to 10 individuals (adult or tadpole stage), MC – Moderately common, 11 to 20 individuals (adult or tadpole stage), C – Common, 21 to 40 individuals (adult or tadpole stage), A – Abundant, >40 individuals (adult or tadpole stage).

^{v, v} Listed as vulnerable under the NSW *Threatened Species Conservation Act, 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*.

^v Listed as vulnerable under the NSW *Threatened Species Conservation Act, 1995*.