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3 April 2007

Ryde City Council
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ATTN: SAM CAPPELLI, MANAGER, THE ENVIRONMENT

Dear Mr Capelli

Stream health in the Lane Cove River and Middle Harbour Catchments

Thank you for the opportunity to analyse and report on the macroinvertebrate samples that you collected from the Lane Cove River and Middle Harbour catchments.

Please find enclosed my final report that details the trends of stream health at sites within the catchments, and their trends in water quality and stream health over time. As you can see, both spatial and temporal patterns in stream health are quite variable. At the conclusion of the report I have made some recommendations that I believe may improve your stream monitoring program, and the utility of the results you obtain from it. I would be happy to elaborate on these ideas and assist with your future programs.

Yours sincerely

Grant Hose

Final Report

Assessment of stream health using macroinvertebrates in the Lane Cove River and Middle Harbour Catchments

Spring 2006

Prepared for

Hunters Hill, Lane Cove, North Sydney,

Ryde and Willoughby Councils

By:

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February 2007

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Summary

Willoughby, North Sydney, Lane Cove, Hunters Hill and Ryde Councils participated in a biological monitoring program to assess environmental quality in the Middle Harbour and Lane Cove River Catchments in spring 2006.

The streams of the Lane Cove River and Middle Harbour catchments are small and steep. The dominant substrate is sandstone bedrock, and flow in the streams is largely dictated by storm events with a generally low base flow. Samples of the macroinvertebrate fauna in these streams were collected and analysed following the New South Wales Australian River Assessment System (AUSRIVAS) protocol. The University of Technology Sydney was engaged to identify macroinvertebrate samples, and analyse and report on those data.

The streams of the Lane Cove River and Middle Harbour catchments that were sampled in this study reflected varying degrees of impact consistent with the urbanisation of their catchments. Streams varied in the degree of impairment. Most streams were characterised as missing several commonly expected macroinvertebrate taxa, as indicated by AUSRIVAS O/E-Taxa values generally below 0.5. The macroinvertebrate taxa that were collected were predominantly those considered to be tolerant of disturbance, as indicated by SIGNAL2 scores below 4 for each site.

The inclusion of replicated sampling at each site in future sampling programs would improve the ability of the monitoring program to detect changes in stream health over time and space. Importantly, replicated sampling will enhance the capability of the monitoring program to highlight any improvements resulting from stream rehabilitation and remediation works implemented by the participating Councils.

Background

Willoughby, North Sydney, Lane Cove, Hunters Hill, Ryde, Ku-ring-gai and Hornsby Councils, with the assistance of consultants, have been conducting a biological monitoring program to assess the health of streams in the Middle Harbour and Lane Cove River catchments since 2001.

This monitoring program arose from a desire to establish a catchment-wide, long-term approach to better understand the health of local aquatic ecosystems. By monitoring the macroinvertebrate communities in aquatic ecosystems, the quality of water entering Sydney Harbour, and catchment influences, can be assessed and the value of management interventions measured.

Residential and industrial developments are the primary land uses throughout the Lane Cove and Middle Harbour Catchments. Most waterways in the upper catchments (first and second order streams) have been channelised or replaced by storm water pipes, which are fed by an extensive storm water drainage network. These drains generally flow into open creeks lower down in the catchment before entering the Lane Cove River or Middle Harbour.

As a result of the primary land uses, large areas of native vegetation have been removed and replaced with impervious surfaces such as roads, roofs and paved areas. This change has major impacts on the natural drainage and runoff of water during storm events, significantly altering the flow regime and water quality in the receiving streams.

Water quality issues in the Lane Cove and Middle Harbour Catchments are those typically associated with an urban catchment dominated by small first- and second-order streams. Storm water pollution sources are a key challenge and include:

- litter and other refuse
- influx of sediment and suspended solids from construction sites and poorly landscaped areas

- oils and surfactants from road based pollutants
- organic matter; leaves, twigs, etc carried by storm water
- nutrients from fertilisers, detergents and animal feaces
- toxic materials from accidental spills and deliberate dumping
- sewage overflows and sewerage leaks

The councils involved in the monitoring program acknowledge the influences of the highly modified urban landscape on aquatic ecosystem health and have combined resources to assess the health of the Lane Cove and Middle Harbour Catchments. By combining resources and sharing information, each council can compare sites with similar streams in neighbouring local government areas. This will provide insight into the merits and outcomes of the management strategies practiced by different councils, whilst sharing the responsibility of monitoring, maintaining and improving the aquatic ecosystem health for these two catchments.

This report presents the findings from sampling aquatic macroinvertebrates from 15 sites from the Middle Harbour and Lane Cove River Catchments in spring 2006.

Impacts of urban development on streams

Urban development is ultimately a process of replacing native vegetation with impervious surfaces such as roofs and roads (Barnes et al. 2000). The result is that the infiltration of rainwater is greatly reduced and runoff is greatly increased (Barnes et al. 2000). Runoff is often channelled into local streams where the increased volume and velocity of water received during rain events causes bank erosion, snag removal and changes to stream morphology (Arnold and Gibbons 1996). These physical impacts can degrade stream habitats, causing a change in the composition of stream biota (Arnold and Gibbons 1996). In addition to the altered hydrology, runoff from impervious urban surfaces can carry sediment that can smother biota and habitat, nutrients that cause eutrophication and nuisance plant growth, and/or pollutants that cause toxic effects and mortality to stream biota (Boulton and Brock 1999; Pizzuto et al. 2000; Malmqvist and Rundle 2002). As a result of these pressures, urban streams are often heavily polluted and generally have low diversity of aquatic fauna and poor ecosystem health (Walsh et al. 2001; Turak and Waddell 2002). To monitor and understand the effects of urban development on biodiversity and ecosystem health, a sensitive indicator is required.

Macroinvertebrates are widely used as biological indicators of water quality and stream ecosystem health. They play a major role in stream ecosystem function (Turak and Bickel 1994), and have diverse feeding habits and form key links in aquatic food webs (Chessman, 1995). Therefore their abundance and diversity are crucial in maintaining a balanced, functioning healthy ecosystem (Chessman, 1995). Macroinvertebrate species are variably sensitive to particular disturbances, including those associated with urban development. Because of this sensitivity, macroinvertebrate community composition is likely to change in response to most types of disturbances (Chessman, 1995). Macroinvertebrates are relatively sedentary organisms and have sufficient life spans that make them ideal for studies of spatial and temporal effects of disturbances (Rosenberg & Resh, 1993). Due to their size, macroinvertebrates are also convenient for field examination, storage and transport, and can be readily collected in large numbers with simple equipment (Chessman, 1995). As a result of these attributes, macroinvertebrates act as continuous monitors of the water they inhabit, which enables long term analysis of the environment (Rosenberg & Resh, 1993).

Methods

Sampling locations

Samples were collected from 15 sites spread across the Lane Cove River and Middle Harbour catchments. Sites spanned the Willoughby, North Sydney, Lane Cove, Hunters Hill, Ryde local government areas. Sites are listed below in Table 1.

Table 1. Sampling sites and their catchments, local government areas and latitude and longitudes.

Catchment	LGA	Site	Latitude	Longitude
Lane Cove	Hunters Hill	Brickmakers Ck	-33.824	151.141
Lane Cove	Hunters Hill	Tarban Ck	-33.836	151.136
Lane Cove	Hunters Hill	Tarban Ck Tributary	-33.836	151.136
Lane Cove	Lane Cove	Gore Ck	-33.827	151.179
Lane Cove	Lane Cove	Stringybark Ck	-33.807	151.160
Lane Cove	North Sydney	Berrys Ck	-33.831	151.191
Lane Cove	North Sydney	Quarry Creek (Tunks Pk)	-33.821	151.207
Lane Cove	Ryde	Buffalo Ck	-33.817	151.125
Lane Cove	Ryde	Porters Ck	-33.796	151.067
Lane Cove	Willoughby	Blue Gum Ck	-33.791	151.165
Lane Cove	Willoughby	Swaines Ck	-33.800	151.169
Middle Harbour	Willoughby	Flat Rock Ck	-33.815	151.208
Middle Harbour	Willoughby	Sailors Bay Ck	-33.806	151.215
Middle Harbour	Willoughby	Scotts Ck	-33.789	151.210
Middle Harbour	Willoughby	Sugarloaf Ck	-33.799	151.215

Sample collection

Samples were collected by officers of the participating councils with the exception of sites in the Hunters Hill LGA that were collected by Dr Grant Hose, UTS. Samples were collected in December 2006, on the shoulder of the spring AUSRIVAS sampling period.

Macroinvertebrates, and physical and chemical data were collected following the protocols for AUSRIVAS in New South Wales (Turak et al. 2004). Two distinct

Table 2. Water-quality and environmental data recorded at study sites and required for Australian River Assessment Scheme (AUSRIVAS) assessments.

Variable
Latitude (decimal degrees)
Longitude (decimal degrees)
Altitude (m asl)
Distance from Source (km)
Mode Width (m)
Slope[a]
Rainfall[b] (mm)
Alkalinity (mg $CaCO_3$/L)
Bedrock (% in substrate)
Boulder (% in substrate)
Cobble (% in substrate)

[a]Slope = change in elevation (m) 1 km upstream of site

[b]Rainfall = mean annual rainfall (ERIN 1996)

Data analysis

AUSRIVAS

Biological and environmental data collected from the study sites were analysed using the AUSRIVAS predictive models. Separate AUSRIVAS models have been developed for each Australian state and territory to account for heterogeneity of environmental conditions across Australia. In New South Wales, separate models have been developed for edge and riffle habitats and for autumn and spring. In addition, models have been developed for combined season data, where samples have been collected from the same site over consecutive autumn and spring seasons. Analyses conducted here used the New South Wales spring edge habitat models and the combined season model for edge habitats in eastern NSW. Detailed explanation of these AUSRIVAS models is provided by Simpson and Norris (2000) and is summarized here.

The AUSRIVAS software compares the site and habitat characteristics of a test site to data from a large number of reference sites to calculate the probability that macroinvertebrate families will occur at that test site. The site and habitat characteristics used are limited to those that are unlikely to be influenced by human disturbance. The variables used in the NSW spring and combined season edge models are listed in Table 2.

AUSRIVAS compiles a list of predicted taxa based on the environmental data. Predicted taxa are those that have ≥50% probability of occurrence (Simpson and Norris 2000). The probabilities of these taxa occurring (each ≥0.5) are summed to provide the number of expected taxa (Coysh et al. 2000). Probabilities (proportions) are summed, so the expected number of taxa is unlikely to be a whole number. O/E-Taxa values are derived by comparing the number of predicted taxa that have been observed (collected) at a site with the number expected and indicate the deviation of the number of observed taxa in that sample from the number expected under reference conditions.

AUSRIVAS uses numerical bands (ranges) of O/E-Taxa values to categorize biological quality or associated levels of ecological impairment. These bands are based on the distribution of O/E-Taxa values determined for a large number of reference sites. Upper and lower limits for Band A are defined by the 10th and 90th percentiles of O/E-Taxa values from all reference sites used in the model development (Turak et al. 2004). The interval of the 10th to 90th percentiles defines the width of the other AUSRIVAS bands. Band X (values >90th percentile) represents a richer invertebrate assemblage than reference. Band A is considered equivalent to reference; Band B (values <10th percentile) represents sites below reference condition. Values in this band indicate a mildly impaired site. Band C (values below Band B) represents sites that are moderately impaired and well below reference condition; and Band D (values below Band C) represents impoverished and severely degraded sites. Band D covers values between 0 and the lower limit of Band C.

SIGNAL2

In addition to AUSRIVAS O/E-Taxa values, taxon richness and SIGNAL2 scores were determined for each sample. The SIGNAL2 (Stream Invertebrate Grade Number-Average Level) score (Chessman, 2003) is a simple index that reflects the water quality of a stream. These scores are based on the tolerance of macroinvertebrates collected at that site to concentrations of nutrients (nitrogen and phosphorous), dissolved oxygen, salinity and turbidity. When combined with the number of taxa present, these scores provide a general indication of water quality. SIGNAL2 scores were calculated using only spring season samples.

High SIGNAL2 scores indicate a macroinvertebrate assemblage that contains a large proportion of sensitive taxa, and from this it can be inferred that the water quality at that site is good. SIGNAL scores are a relatively crude measure of water quality, yet provide important information on the tolerance of specific taxa that inhabit a stream. A low SIGNAL score generally indicates the macroinvertebrate assemblage at that site contains a large proportion of taxa that are tolerant to poor water quality and disturbance.

Temporal patterns

To explore changes in stream health overtime, past assessments were compiled from previous reports (Robyn Tuft & Associates 2002,2003, Biotrack 2005, Hose 2006) and raw data therein.

Results

Individual site assessments

AUSRIVAS models classified the 14 of the 15 sites into a single site group based on the environmental data (Table 3), which might be expected given the similar location, topography and geology of the catchments. An AUSRIVAS assessment was not possible for the Tarban Creek tributary because the available habitat did not meet AUSRIVAS definitions and sampling could not follow the AUSRIVAS protocol. Sampling in Tarban Ck Tributary focussed on assessing macroinvertebrate richness across all available habitats in the creek.

Combined season assessments could not be determined for Tarban Ck and Quarry Ck because these sites were not sampled in autumn 2006.

Table 3. AUSRIVAS site groups, O/E-Taxa scores and bands, SIGNAL2 scores and taxon richness and for sites within the Lane Cove River and Middle Harbour catchments.

		Spring Edge model				Combined Season	
Site	Taxon Richness	AUSRIVAS site Group*	O/E-Taxa value	AUSRIVAS Band	SIGNAL2 Score	O/E-Taxa value	AUSRIVAS Band
Brickmakers Ck	20	3 (0.99)	0.67	B	3.47	0.51	B
Tarban Ck	20	3 (1.00)	0.48	C	2.65	-	-
Tarban Ck tributary	9	-	-	-	2.89	-	-
Gore Ck	11	3 (0.99)	0.29	C	3.60	0.38	C
Stringybark Ck	7	3 (0.98)	0.19	D	2.57	0.32	C
Berrys Ck	11	3 (1.00)	0.38	C	3.00	0.38	C
Quarry Ck#	7	3 (1.00)	0.29	C	3.25	-	-
Buffalo Ck	15	3 (0.87)	0.31	C	3.50	0.43	C
Porters Ck	17	3 (1.00)	0.38	C	2.87	0.45	C
Blue Gum Ck	10	3 (0.55)	0.49	C	2.80	0.39	C
Swaines Ck	8	3 (1.00)	0.19	D	3.33	0.45	C
Flat Rock Ck	7	3 (0.99)	0.10	D	2.50	0.19	C
Sailors Bay Ck	12	3 (0.97)	0.48	C	3.08	0.32	C
Scotts Ck	11	3 (0.97)	0.10	D	3.55	0.06	D
Sugarloaf Ck	7	3 (0.90)	0.19	D	2.57	0.19	C

* Indicates the main group into which AUSRIVAS spring edge predictive model classified the site. Values in parentheses indicate the probability of the site group classification.

#This site has been referred to as Tunks Park in previous reports and should not be confused with Quarry Creek in the Ku-Ring-Gai LGA that has been sampled in some previous reports.

Study sites ranged in condition from moderately to severely disturbed, as indicated by O/E-Taxa values ranging from 0.67 to 0.10 (Table 3). Scotts and Flatrock Creeks were the most heavily impacted sites, suggesting a trend of Middle Harbour sites being generally more impacted than those in the Lane Cove catchment.

While the AUSRIVAS assessments indicate that numerous taxa that were expected at each site were not collected, the SIGNAL2 scores indicate that those taxa that were collected were largely dominated by taxa that are considered to be relatively tolerant to disturbance. SIGNAL2 scores ranged between 2.5 to 3.6 (Table 3).

Combined season assessments generally provide a more robust assessment of stream health because they include a larger number of expected taxa to calculate the O/E-Taxa value. In this study, combined season assessments generally provided a similar or improved band allocation compared to the single season model.

Temporal Patterns

Lane Cove Catchment

Hunters Hill LGA

Stream health in Brickmakers Creek has varied considerably over time, as evidenced from Figure 1, but recent assessments suggest that it is a good quality urban stream. Despite the variability of assessments over time, the 2006 combined season assessment (Table 1) provides a realistic assessment of the health of this site.

Interestingly, the taxon richness recorded in Brickmakers Creek (20) greatly exceeds the richness recorded in previous assessments. This may reflect the experience of the operator on this sampling occasion, but nevertheless is surprising given that at the time of sampling, the creek was reduced to a series of pools with little flow between them.

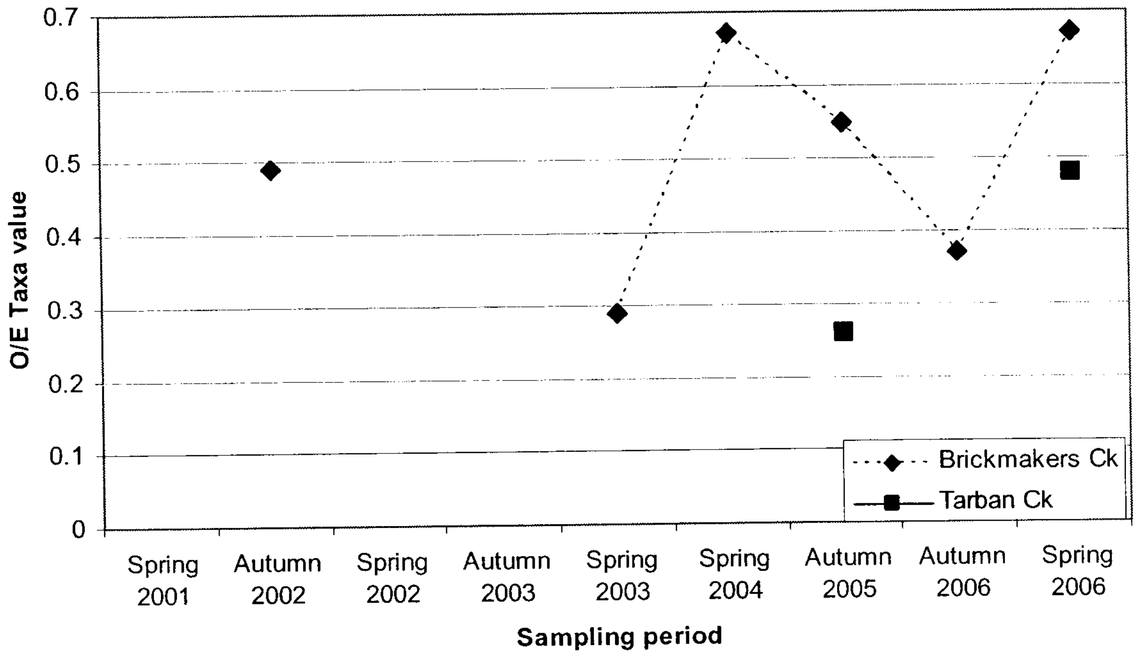

Figure 1. O/E-Taxa values for Brickmakers and Tarban Creeks, Hunters Hill LGA.

This was only the second time that the Tarban Creek site has been sampled as part of this monitoring program. The results from assessments in autumn 2005 and spring 2006 show little change in the health of the creek, and both indicate a considerably degraded site. Tarban Creek contained 20 taxa, making it and Brickmakers Ck the richest of all sites sampled at this time. However, most of the taxa were uncommon Diptera species, and most of these taxa are considered pollution tolerant species. For example, the dipteran Syrphidae ('rat-tailed maggots') are generally uncommon in macroinvertebrate samples, but when found often indicate organic enrichment or sewage contamination at a site. Because of this high number of uncommon but pollution tolerant taxa, the O/E-Taxa value and the SIGNAL2 score were lower than might otherwise be expected for a site of this richness.

While sampling in Tarban Creek, adult long-neck turtles (*Chelodina longicollis*) were observed and a juvenile turtle (shell diameter ~4 cm) was collected in the net.

A tributary of Tarban Creek was also sampled. The tributary has recently been rehabilitated, with much of the riparian vegetation removed and replaced with geo-textile material as the replanted vegetation takes hold. The stream channel also appears to have been modified with the geo-textile fabric and large sandstone boulders. Obtaining a valid AUSRIVAS sample was not possible at this site because of the small size of the stream, its structure and the absence of suitable habitat. Sampling in this stream aimed to sample all possible habitats to collate baseline data against which future improvements in stream health could be assessed.

Nine taxa were collected from the tributary. The macroinvertebrate assemblage was dominated by chironomid larvae. Most of the taxa collected were pollution tolerant species such as the chironomids, worms and air breathing taxa including Coleoptera (beetles) and Hemiptera (true bugs).

Lane Cove LGA

Sampling in Gore and Stringybark Creeks has yielded variable assessments of stream health since 2002. Stream health was at its worst, or close to, in autumn 2003 at both sites (Figure 2). The health of Stringybark Creek has declined considerably since Autumn 2006 although taxon richness has remained similar (7-8 taxa). The O/E-Taxa value for Gore Creek has also declined since the autumn 2006 sampling although both assessments, and the 2006 combined season assessment indicate a consistent allocation to Band C (Table 3). The decline in O/E-Taxa values relative to autumn 2006 may be due to the considerably reduced flow in both Gore and Stringybark Creeks in spring 2006.

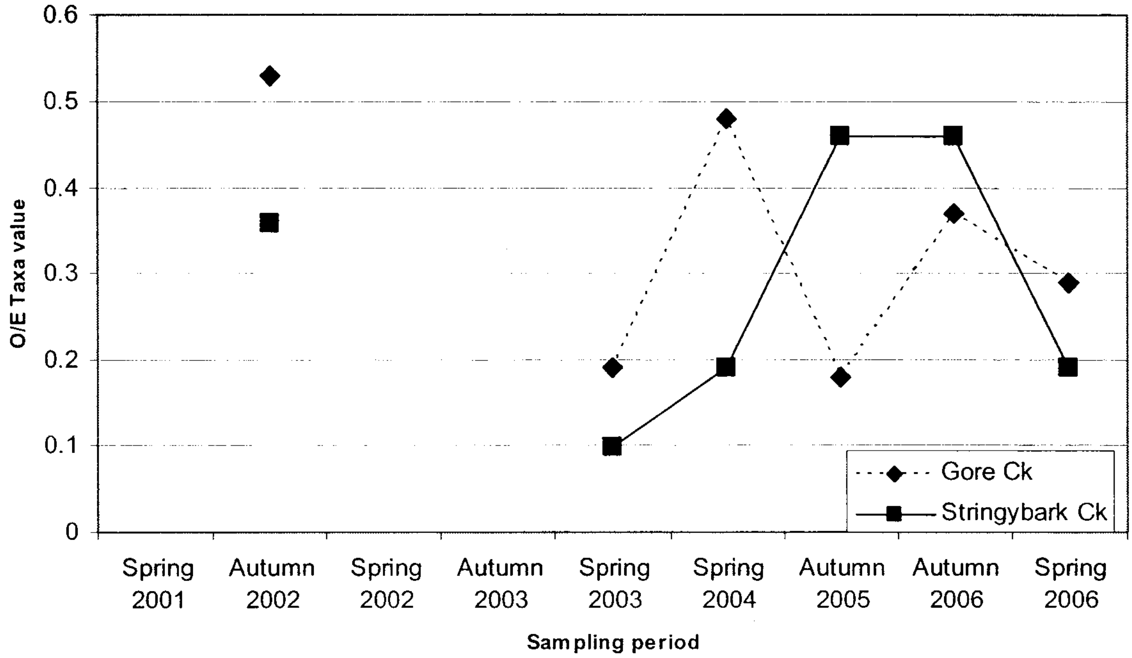

Figure 2. O/E-Taxa values for Gore and Stringybark Creeks in the Lane Cove LGA.

North Sydney LGA

Assessments in North Sydney LGA have consistently indicated significant impairment to the macroinvertebrate assemblages in both Berry's and Quarry Creeks (Figure 3). Berry's Creek has shown a sharp increase in O/E50 value since autumn 2006 with both the spring 2006 assessment, and the 2006 combined season assessment giving an O/E50 value of 0.38 and allocating the site to Band C. Council officers reported seeing an eel at the Berry's Creek site.

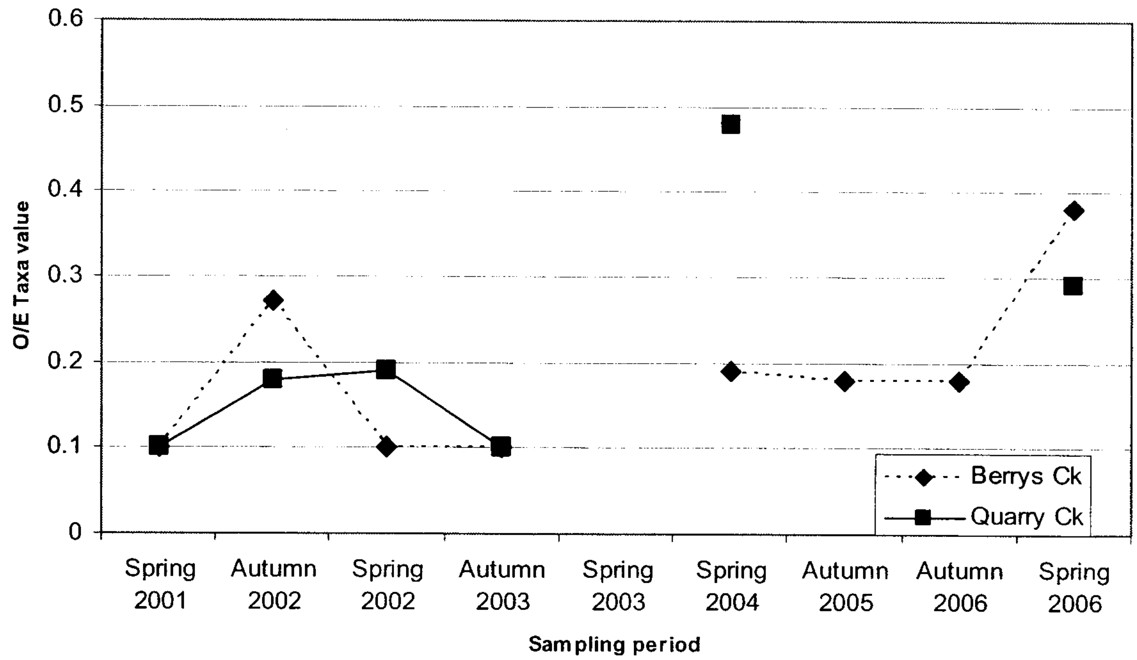

Figure 3. O/E-Taxa values for Berrys and Quarry Creeks in the North Sydney LGA.

The health of Quarry Ck was similar (Band C) in spring 2006 compared to Spring 2004 when it was last sampled. However, richness in 2006 was slightly less. The macroinvertebrate assemblage consisted of taxa that are common in degraded urban creeks, with the exception the dipteran Syrphidae ('rat-tailed maggots') which are generally uncommon. When found, Syrphidae usually indicates organic enrichment or sewage contamination at the site.

Ryde LGA

Stream health at both Buffalo and Porters Creek sites declined from 2002 to 2003 (Figure 4), which is a pattern consistent with several other sites within the catchment. Stream health has remained consistent but relatively poor at Buffalo Creek since this time. In contrast, O/E-Taxa values from Porters Ck have been quite variable. Assessments for both Porters and Buffalo Creeks were consistently in level C in both 2006 single season and combined season assessments (Table 3).

The high assessment in autumn 2005 reflects the collection of an unusually high number of taxa (19) on that occasion. In spring 2006, both Porters and Buffalo Creeks again had quite high taxon richness (Table 3). Interestingly, Buffalo Creek contained a high richness of dragonfly taxa (5 families).

Water quality at both sites was turbid at the time of sampling, and the water level was low in Porters Creek.

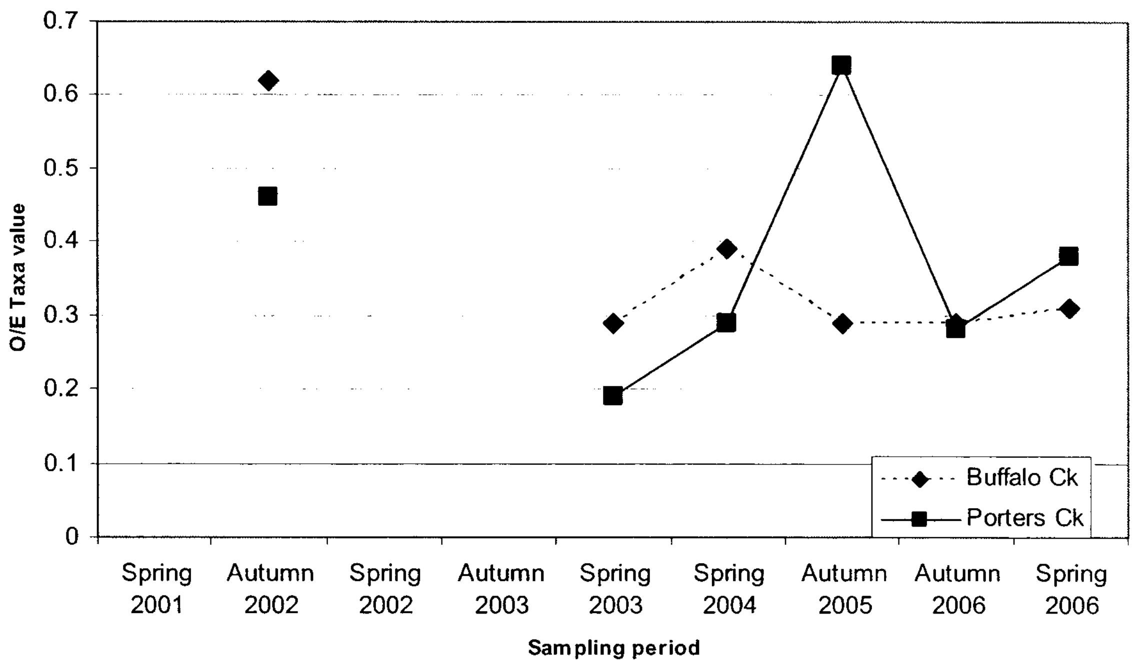

Figure 4. O/E-Taxa values for Buffalo and Porters Creeks in the Ryde LGA.

Willoughby LGA

Lane Cove Catchment

Stream health at the Blue Gum Creek site has been reasonably consistent over time, but assessments have been indicative of considerable impairment (Figure 5). In contrast, health at the Swaines Creek site has shown steady improvement from a low O/E-Taxa value of 0.19 in autumn 2003 to 0.55 in autumn 2006. However in spring 2006, Swaines Ck declined in health with an O/E-Taxa value of 0.19. Council officers reported a sewage odour at the site at the time of sampling.

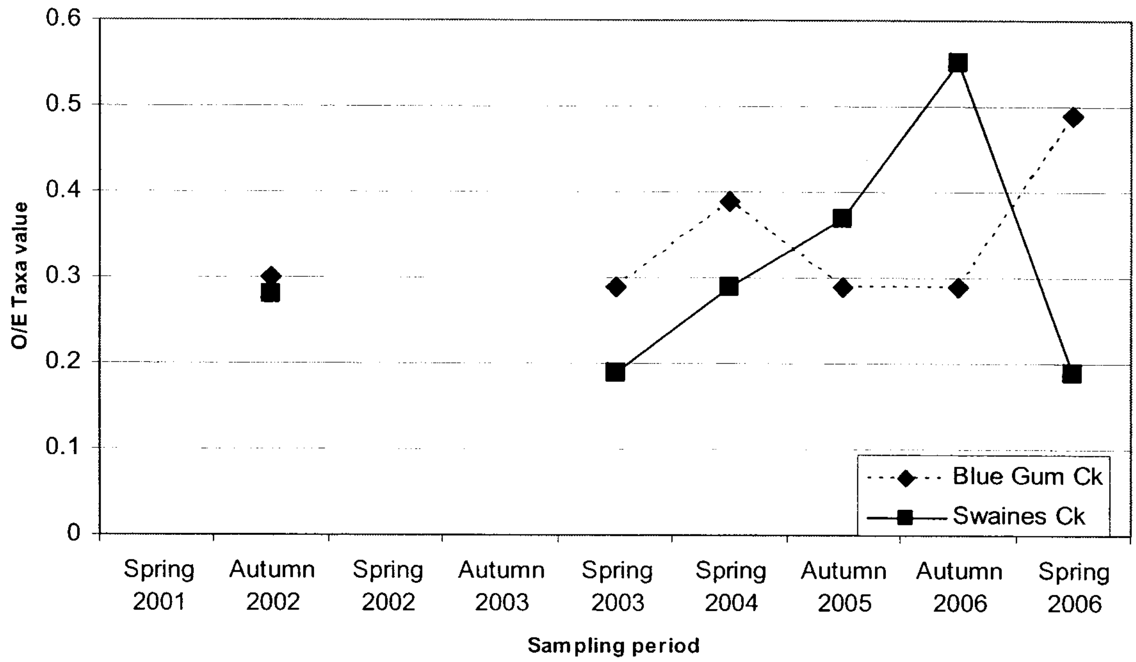

Figure 5. O/E-Taxa values for Blue Gum and Swaines Creeks in the Willoughby LGA.

The assessment for Blue Gum Creek suggests an improvement in health relative to the autumn 2006 assessment (Figure 5), despite their being low flow conditions at the time of spring sampling. The low flow conditions may explain the large abundance of Culicidae (mosquito) larvae collected at this site compared to previous occasions. Culicidae larvae prefer to inhabit still or stagnant water.

Middle Harbour Catchment

Assessments for Scotts and Sugarloaf Creeks have been highly variable over time (Figure 6). This trend is exacerbated by the O/E-Taxa value of 0 for Sugarloaf Creek in 2005. This assessment arose because none of the taxa that were

On all sampling occasions, including spring 2006, O/E-Taxa values for Flat Rock Creek have indicated a severely degraded creek (Figure 7), with 90% of the expected taxa being absent. Macroinvertebrate samples were dominated by pollution tolerant taxa, particularly worms, snails and chironomids.

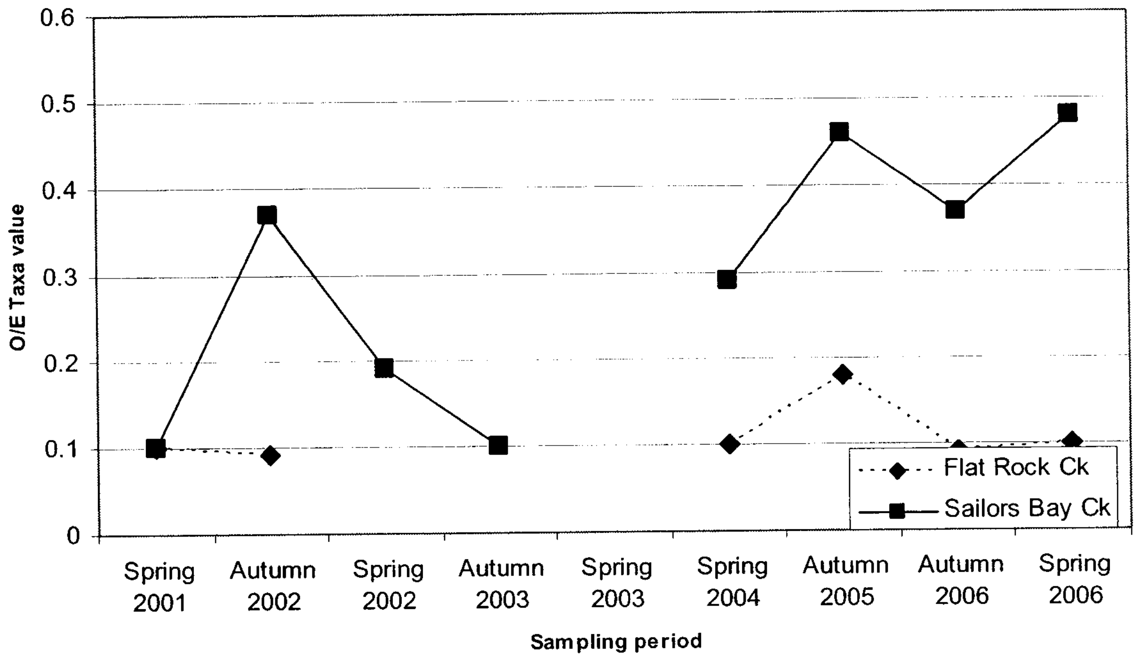

Figure 7. O/E-Taxa values for Flat Rock Creek and Sailors Bay Creek in the Willoughby LGA

Key findings

The streams of the Lane Cove River and Middle Harbour catchments that were sampled in this study reflected varying degrees of impact, consistent with the urbanisation of their catchments. The macroinvertebrate assemblages at each site contained a suite of pollution tolerant taxa that would be expected in small urban-impacted streams. However, most sites were characterised as missing several macroinvertebrate taxa that would be expected to be found at those sites in the absence of any disturbance.

The results of spring 2006 sampling are generally consistent with those of previous sampling periods. Importantly, this monitoring program is building a very useful database on stream health within the region. However, the temporal patterns of stream health have been quite variable, with some sites showing an increase in O/E-Taxa values over time, some a decline, and others little temporal variability.

Many of the sites were noted to have low flow conditions at the time of sampling. It is encouraging that sites such as Brickmakers, Gore and Stringybark Creeks maintained a relatively rich macroinvertebrate fauna despite these conditions.

Recommendations

The AUSRIVAS protocol can be sensitive to operator variability so it is recommended, where possible, that Council officers undertake formal AUSRIVAS training.

To better understand the spatial and temporal patterns of stream health at these sites, it is recommended that AUSRIVAS assessments be replicated (at least duplicated) at each site. This will allow for more reliable assessments of stream health at each site, and greater ability to detect changes in stream health in space and time.

Given the possible estuarine influence occurring at the new Scotts Creek sampling site, we recommend that the sampling site be relocated further upstream.

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Appendix 1. Raw biological data – Spring 2006

	Taxa Code	Brickmakers Ck	Gore Ck	Stringybark Ck	Berrys Ck	Buffalo Ck	Porters Ck	Blue Gum Ck	Swaines Ck	Sailors Bay Ck	Scotts Ck	Sugarloaf Ck	Quarry Ck	Tarban Ck	Tarban Tributary	Flat Rock Ck
Dugesiidae	IF619999	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda	II999999	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0
Hydrobiidae	KG029999	0	2	1	0	4	20	12	4	18	0	7	0	4	0	1
Ancylidae	KG069999	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physidae	KG089999	9	1	2	2	34	6	7	7	1	0	6	6	1	8	13
Corbiculiidae	KP029999	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Glossiphoniidae	LH019999	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Richardsonianidae	LH039999	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eropdellidae	LH059999	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Oligochaeta	LO999999	22	2	5	3	0	3	11	18	5	1	6	5	16	5	15
Polychaeta	LP999999	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Acarina	MM999999	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Cladocera	OG999999	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Paramelitidae	OP069999	0	0	0	0	0	0	0	3	0	11	0	0	1	0	0
Cirolanidae	OR129999	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeromatidae	OR139999	1	0	0	0	0	0	0	0	0	16	0	0	0	0	0
Atyidae	OT019999	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Collembola	QA999999	0	0	0	3	0	1	0	0	0	0	1	0	2	0	0
Dytiscidae	QC099999	1	0	0	0	0	1	4	0	0	0	0	0	1	2	0
Hydrophilidae	QC119999	0	0	0	1	0	0	0	0	1	0	0	0	3	0	0
Staphylinidae	QC189999	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0
Scirtidae	QC209999	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Elmidae	QC349999	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psephenidae	QC379999	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Curculionidae	QCAN9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tipulidae	QD019999	0	0	0	0	0	0	0	0	0	1	0	0	2	5	0
Dixidae	QD069999	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Culicidae	QD079999	1	4	8	1	0	0	38	0	0	0	0	0	12	0	0
Psychodidae	QD129999	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Stratiomyidae	QD249999	0	0	0	0	0	1	1	0	0	0	0	0	3	0	0
Dolichopodidae	QD369999	0	0	0	0	0	0	0	3	0	1	0	0	2	0	0
Syrphidae	QD439999	0	0	0	0	0	0	0	0	0	0	0	5	3	0	0
Sciomyzidae	QD459999	0	0	0	0	0	0	0	0	0	0	0	0	9	1	0
Tanypodinae	QDAE9999	2	0	0	2	0	0	2	0	1	0	0	4	2	4	0
Orthocladiinae	QDAF9999	0	0	0	0	8	5	0	0	0	0	0	0	0	0	1
Chironominae	QDAJ9999	16	2	1	11	29	24	9	2	20	1	10	6	17	98	7
Veliidae	QH569999	1	4	1	0	0	0	2	4	1	0	0	0	0	0	0
Gelastocoridae	QH6499999	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Corixidae	QH659999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Notonectidae	QH679999	0	0	0	0	2	7	0	0	3	0	2	0	0	1	0
Pyralidae	QL019999	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Coenagrionidae	QO029999	1	0	0	0	0	5	0	0	1	0	0	0	0	0	0
Isostictidae	QO039999	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Protoneuridae	QO049999	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Megapodagrionidae	QO079999	0	0	0	0	2	1	0	3	0	0	2	0	0	0	0
Synlestidae	QO089999	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0
Aeshnidae	QO129999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Gomphidae	QO139999	0	0	0	2	0	0	1	0	2	0	0	1	0	0	0
Corduliidae	QO169999	3	2	0	1	26	3	0	0	2	1	0	0	0	0	0
Leptoceridae	QT259999	5	0	0	5	0	1	0	0	0	0	0	0	0	1	0
Crab		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Hydra		0	0	0	0	1	1	0	0	0	0	0	0	0	0	0