

Report Issued 2 July 2002

**RIVER*WATER QUALITY
IN THE PIONEER CATCHMENT
ON FEBRUARY 14 – 15, 2002**

**Water Quality Assessment and Protection
Natural Resource Sciences**

(*all samples tested were of raw river water and were not samples of treated water as reticulated for domestic supply in Mackay.)



Department of Natural Resources and Mines Queensland,
July 2002

Table of Contents

Summary.....	1
Introduction.....	1
Sampling sites.....	2
Sample analysis.....	3
Results and discussion.....	4
Pesticides.....	4
Nutrients and suspended sediment.....	6
Estimated export loads.....	7
Sampling at Dumbleton Weir on 28 th June 2002.....	10
Sampling program conducted by Mackay City Council.....	10
Conclusions and recommendations.....	10
Acknowledgement.....	11
References.....	11

For further information contact:

Bruce Simpson, Department of Natural Resources and Mines, 80 Meiers Road Indooroopilly Qld 4068
Tel. 07 38969486; <mailto:Bruce.Simpson@nrm.qld.com.au>

Summary

This report provides an assessment of water quality during a high-flow event in the Pioneer River on February 14-15, 2002. The flow records suggest that the event was not particularly unusual and was approximately a 1 in 2 years event.

Elevated concentrations of some pesticide residues in several samples of river water were found to exceed Australian water quality guideline values. It should be noted that all samples tested were of raw river water and were not samples of treated water as reticulated for domestic supply in Mackay.

Of particular concern was an estimated load of 470 kg of diuron, entering Dumbleton Weir during the event. The detection of diuron and four other herbicides commonly used in sugar production has management implications for the industry.

Nutrient and suspended sediment levels are also a concern, however more intensive monitoring would be required before the loads exported could be reliably attributed to particular land uses and management practices in the catchment.

A further sample of river water taken from Dumbleton Weir on the morning of 28th June 2002 contained no detectable pesticide residues. Routine sampling and testing of Mackay's drinking water consistently returns results that are within recommended Australian Drinking Water Guideline levels.

Introduction

The Pioneer catchment covers an area of 1,570 km². The Pioneer River is the main waterway in the catchment, draining eastward to Mackay through a narrow corridor; it has two main tributaries, Cattle Creek and Blacks Creek (Figure 1). The catchment is used extensively for sugarcane production, representing 19% of the catchment, predominantly on the river flats (GBRMPA, 2001). Much of the rest of the catchment is used for grazing cattle.

During a three-day rainfall event (13th to 15th February 2002), water samples were collected at four sites, coordinated by hydrographic staff of the Department of Natural Resources and Mines (NR&M), Mackay. The following is a record of the event by Ian White, a Senior Technical Officer with NR&M in Mackay.

“During the afternoon and early evening of the 13th February, there were minor runoff events in both Cattle Creek and the Pioneer River above Mirani Weir. Peak flow rates were approximately 290 and 220 cubic metres of water per second (cumecs) respectively and they peaked around 7 hours apart. This had the effect of deflating the rubber bags on both Mirani and Dumbleton Weirs and as a consequence the river system was flushed out to a large degree.

Early on the 14th another more significant rainfall event occurred with substantial rain falling on much of the land under agriculture. The spatial distribution of the rain which fell on the 13th and 14th was unusual as rainfall was generally heavier in the centre of the catchment instead of on the rim of the catchment as more typically occurs”.

Samples were taken manually at a number of points throughout the hydrograph. Although

sample numbers were limited and the sampling did not cover all of the hydrograph associated with the event, the data provide a reasonable basis for assessing water quality and estimating the loads of nutrients, sediments and pesticides exported during the event. One sampling site was located at Dumbleton Weir, the main source of water for the city of Mackay.

This report compares the observed concentrations of nutrients and pesticide residues with guideline values from the Australian Water Quality Guidelines (ANZECC and ARMCANZ 2000) and Australian Drinking Water Guidelines (NHMRC 1996). It should be noted that all samples tested were of raw river water and were not samples of treated water as reticulated for domestic supply in Mackay.

The report discusses the magnitude of the flow and the loads of nutrients and pesticide residues transported during the event. The spatial distribution of rainfall and its relation to the timing of agrochemical applications in the catchment are also considered in order to evaluate the likelihood of similar or higher loads in the Pioneer River occurring in the future.

Sampling sites

Samples were collected at four stream gauging stations where water levels and flow rates are monitored continuously (Figure 1).

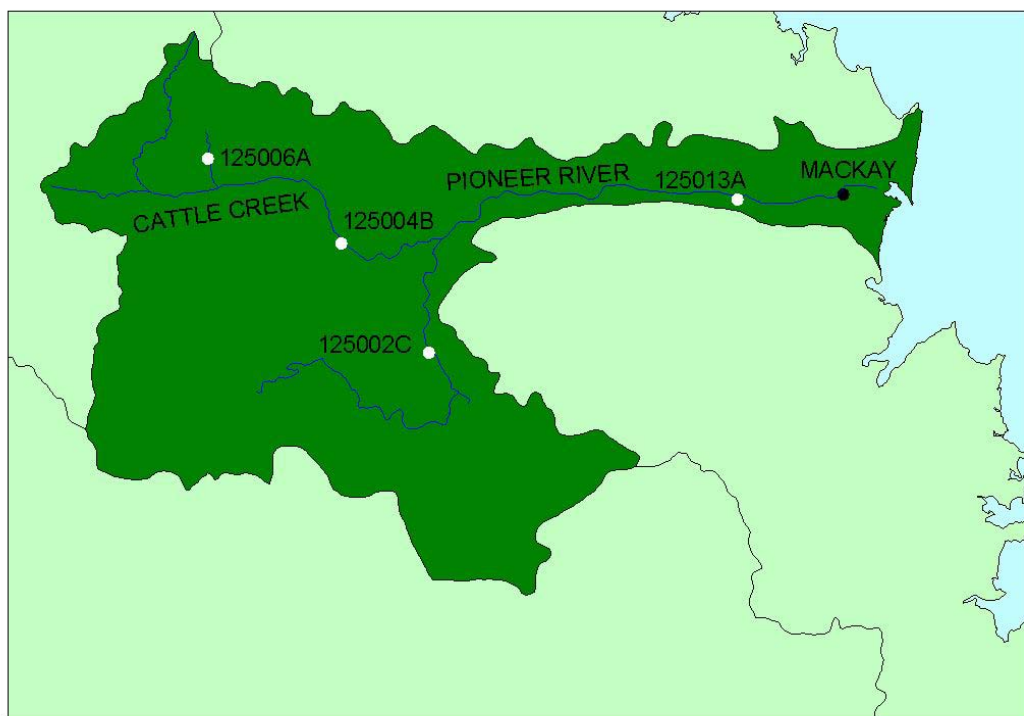


Figure 1 The Pioneer Catchment showing locations of the four sites (white circles) sampled on February 14-15, 2002.

In the Pioneer River, the gauging station (125013A) located at Dumbleton Pump Station (Dumbleton Weir) (AMTD 16.7 km), drains an area of 1,485 km². It has been in operation since 1988 and in that time has received a mean annual volume of 750,000 ML. This gauging station excludes only 85 km² of the total 1,570 km² catchment. Site 125006A, located at Finch Hatton Creek at the Dam Site (AMTD 3.2 km), drains an area of 36 km². Since its inception in 1976 it has received a mean annual volume of 48,900 ML. Site 125004B, Cattle Creek at Garget (AMTD 11 km), drains an area of 326 km². Since its inception in 1967 it has received a mean annual volume of 320,900 ML. Site 125002C, Pioneer River at Sarich's

(AMTD 57.7 km), drains an area of 757 km². Since its inception in 1958 it has received a mean annual volume of 293,100 ML.

Sample analysis

Samples were taken according to the standard procedures described in DPI Water Quality Sampling Manual (1995) and handled according to protocols described in DNR Water Sample Processing Procedure (1998). All samples were analysed at the NATA accredited Analytical Services Laboratory, Department of Natural Resources and Mines, Indooroopilly. Samples were analysed for a suite of pesticide residues and nutrients, except in two instances, when only nutrients were measured (Table 1). All samples were also analysed for suspended sediment and a standard suite of geochemical indicators.

Table 1 The time, date and location of sampling carried out in the Pioneer catchment

Sampling Time & Date	Location of sampling	Site Code ¹	Sample Code
0730, 14/02/2002	Finch Hatton Creek, Finch Hatton	12506A	FH1
0830, 14/02/2002 ²	Finch Hatton Creek, Finch Hatton	"	FH2
1030, 14/02/2002	Finch Hatton Creek, Finch Hatton	"	FH3
0815, 14/02/2002	Pioneer River at Dumbleton	125013A	D1
0900, 14/02/2002 ²	Pioneer River at Dumbleton	"	D2
1500, 14/02/2002	Pioneer River at Dumbleton	"	D3
2325, 14/02/2002	Pioneer River at Dumbleton	"	D4
0900, 15/02/2002	Pioneer River at Dumbleton	"	D5
1030, 14/02/2002	Pioneer River at Sarich's	125002C	S1
1055, 14/02/2002	Cattle Creek at Gargett	125004B	G1

¹ See Figure 1

² Pesticides were not measured on this occasion

Pesticides

Analysis for pesticide residues included organochlorines, organophosphates, triazines, phenylureas and phenoxy herbicides. A list of compounds tested and their limits of reporting (LOR) are shown in Table 2.

Table 2 Pesticides (and limits of reporting) included in analyses

Pesticide	LOR ¹	Pesticide	LOR	Pesticide	LOR
Chlorfenvinfos	1.0	Ametryn	0.05	β - BHC	0.05
Chlorpyrifos	0.05	Atrazine	0.05	Lindane(γ-BHC)	0.1
Chlorpyrifos methyl	1.0	Desethylatrazine	0.05	o,p- DDT	0.05
Diazinon	0.1	Deisopropylatrazine	0.20	p,p- DDT	0.05
Dimethoate	0.1	Propazine	0.1	o,p- DDE	0.1
Ethoprophos	0.1	Simazine	0.05	p,p- DDE	0.05
Fenamiphos	0.1	Hexazinone	0.05	o,p- TDE	0.05
Fenitrothion	1.0	Prometryn	0.05	p,p-TDE	0.1
Fenthion	1.0	Trifluralin	0.05	HCB	0.01
Malathion	0.05	Pendimethalin	0.2	Dieldrin	0.1
Methidathion	0.2	Procymidone	0.05	α- Chlordane	0.05
Parathion	1.0	Propiconazole	0.1	Diclofluanid	0.2
Parathion-methyl	1.0	α - Endosulfan	0.1	Diuron	0.3
Pirimiphos-methyl	1.0	β - Endosulfan	0.1	Heptachlor	0.05
Profenofos	1.0	ESS	0.05	α - BHC	0.1
Prothiofos	0.1	Hept.epox.	0.1	2,4-D	0.2
Sulprofos	1.0	Heptachlor	0.05	2,4,5-T	0.2
Tebuthiuron	0.05	α - BHC	0.1	MCPA	0.2

¹LOR = limit of reporting (µg/L)

Suspended sediment and nutrients

Samples were analysed for suspended sediment and the following nutrients: total nitrogen (N), total dissolved N, ammonium-N, oxides of N (nitrate-N plus nitrite-N), total phosphorus (P), total dissolved P, and soluble reactive P.

Other analyses

Samples were also analysed for: pH, electrical conductivity, total dissolved ions, total hardness as calcium carbonate (CaCO₃), total alkalinity as CaCO₃, sodium adsorption ratio, residual alkalinity, calcium, magnesium, sodium, potassium, hydroxide, carbonate, bicarbonate, sulphate, chloride and fluoride. Analysis was also carried out for the following metals; copper, iron, manganese and zinc. Note that results for all of these parameters were within relevant guideline levels and they are not discussed further in this report.

Results and discussion

Pesticides

Of the 53 pesticides included in the analyses, only five (ametryn, atrazine, hexazinone, diuron and 2,4-D) were detected at concentrations above the level of reporting. The five pesticides detected are all herbicides used in sugarcane production.

Desethylatrazine, a breakdown product of the herbicide atrazine was also detected. Based on the ratio of the levels of desethylatrazine and the parent compound atrazine, the results would suggest that the levels of atrazine seen in the samples are from relatively recent applications of atrazine, rather than from applications months before. Depending on the range of planting and harvest times, atrazine application periods could extend over many months. Note that information on actual patterns of atrazine use by growers in the catchment could be provided by BSES staff in Mackay.

There were no residues detected in either of two samples taken at Finch Hatton (Table 3). At the Dumbleton Weir site, four samples were taken over a 24-hour period. Residues of a total of five pesticides were detected; ametryn, atrazine, (desethylatrazine), hexazinone, diuron and 2,4-dichlorophenoxyacetic acid (2,4-D). Residues of some of these pesticides were also found in samples from Cattle Creek at Gargett and in the Pioneer River at Sarich's.

At the Dumbleton Weir site, pesticides levels decreased during the event (Table 3). Higher levels at the early phases of a hydrograph are quite common, usually associated with an initial flush, higher sediment levels, and lower runoff volumes. At river scale, the source of the pesticide relative to the major source of initial runoff in the catchment will also influence the concentration pattern through the hydrograph. In this case, it would suggest that the initial runoff was from the area including the canelands, rather than from higher up in the catchment outside the cane-growing areas.

Pesticide residue concentrations measured during the event (Table 3) were compared to ANZECC and ARMCANZ (2000) Australian Water Quality Guidelines and the NHMRC (1996) Australian Drinking Water Guidelines (Table 4). This provides a general indication of stream water quality at the four sites during the sampling period. As previously noted, these comparisons apply to samples of raw river water, not treated water as reticulated to the residents of Mackay.

Table 3 Levels of pesticide residues ($\mu\text{g/L}$) found at the sampling sites, 14-15 February 2002¹

Pesticide residue	Sample ²							
	D1	D3	D4	D5	FH1	FH3	S1	G1
Ametryn	0.30	0.13	0.11	0.10	NDR	NDR	NDR	0.05
Atrazine	1.30	0.48	0.37	0.29	NDR	NDR	0.07	0.20
Desethylatrazine	0.10	0.05	NDR	NDR	NDR	NDR	NDR	NDR
Hexazinone	0.30	0.25	0.14	0.11	NDR	NDR	0.07	0.10
Diuron	8.50	2.50	1.10	0.90	NDR	NDR	0.40	1.00
2,4-D	0.40	NDR	0.20	NDR	NDR	NDR	NDR	NDR

¹ NDR = No detectable residue

² See Table 1 for details of site codes and sampling times for each sample

Drinking water protection guidelines (Table 4) indicate that the first sample taken from Dumbleton Weir contained atrazine residues at a concentration (Table 3) that exceeded the guideline value. However subsequent samples were within the guideline level. Residues of 2,4-D exceeded the drinking water guideline value in two of the samples from Dumbleton Weir. All other pesticide residues found were within Australian water quality guideline values (Table 4).

Table 4 Guideline values for pesticide residues ($\mu\text{g/L}$)

Pesticide	Guideline Categories			
	Drinking Water ¹	Aquatic Ecosystem Protection ^{2,3}	Primary Industries ²	Recreation ²
Ametryn	5	ND ⁴	N ⁵	ND
Atrazine	0.5	13 (45)	N	ND
Desethylatrazine	ND	ND	N	ND
Hexazinone	2	ND	N	600
Diuron	30 ⁶	0.2 ⁷	2 ⁷	40
2,4-D	0.1	280 (450)	N	100

¹ NHMRC (1996) – Note: these values apply at the point of use eg. at a tap

² ANZECC and ARMCANZ (2000)

³ Trigger value for toxicants for protection of 95% of species in slightly-moderately disturbed systems; figure in brackets shows trigger values for protection of 90% of species

⁴ ND = indicates guidelines are not available due to insufficient data

⁵ N = Guidelines are not available except for a general limit in irrigation waters of 10 $\mu\text{g/L}$ for all herbicides in New South Wales; for livestock drinking water, the human drinking water guidelines are recommended (NHMRC 1996)

⁶ Health value based upon 10% of Acceptable Daily Intake

⁷ Indicative interim guideline only

Nutrients and suspended sediment

Nutrients are essential for aquatic ecosystem health. They typically occur naturally at very low concentrations and problems such as excessive growth of undesirable algal species may occur when nutrient levels become too high. Export of high nutrient loads can be of concern for ecosystem health, both within the river system itself and at sensitive downstream locations such as the Great Barrier Reef Marine Park. Similarly, problems may arise from elevated levels of suspended sediment. These potentially include not only problems due to the suspended material itself (e.g., reducing light penetration and smothering habitats) but also

those associated with nutrients, pesticides and other contaminants that may be attached to the suspended particles.

Nutrient concentrations measured in the Pioneer catchment during and after the February 2002 event (Table 5) were compared to Australian Water Quality Guidelines (ANZECC and ARMCANZ 2000) and the NHMRC (1996) Australian Drinking Water Guidelines (Table 6). They were also compared with the average concentrations previously measured under baseflow conditions on three sampling occasions in 2001.

Highest concentrations of total N, total P and suspended sediment were recorded in the Pioneer River at Dumbleton Weir at the peak of the hydrograph (sample D3, Table 5) during the event. At this time, 55% of the total N and 92% of total P transported were attached to the suspended sediment load. As would be expected, nutrient and suspended sediment concentrations during the event were elevated compared to mean concentrations measured in the previous year during baseflow conditions (Table 5).

Nutrient concentrations fluctuated over the 3-hour sampling period during the event at Finch Hatton. Nitrogen concentrations tended to be considerably lower at Finch Hatton than downstream at Dumbleton Weir (although this trend was less pronounced for oxides of N). Total P concentrations were similarly lower at Finch Hatton than at Dumbleton Weir, but there were no distinct differences in concentrations of filterable reactive P, which were relatively high at both sites.

Table 5 Concentrations of suspended sediment and nutrients (mg/L) found at the four sampling sites in February 2002; and average concentrations measured at Dumbleton Weir over three sampling occasions in 2001

	Sample Code										
	D1	D2	D3	D4	D5	DX ¹	FH1	FH2	FH3	S1	G1
Total N	1.87	1.69	2.66	1.55	1.09	0.42	0.58	1.02	1.14	1.74	1.18
Total P	0.32	0.29	0.50	0.31	0.16	0.03	0.20	0.09	0.12	0.42	0.26
Oxides of N	0.867	0.749	0.648	0.425	0.360	0.106	0.128	0.449	0.761	0.327	0.432
Ammonium-N	0.040	0.037	0.038	0.034	0.022	0.017	0.007	0.003	0.003	<	0.009
Filterable reactive P	0.094	0.099	0.023	0.065	0.086	0.006	0.120	0.070	0.091	0.104	0.079
Suspended sediment	190	NA ²	620	230	49	3	33	24	13	330	110

¹DX = the mean nutrient concentrations measured in the Pioneer River at Dumbleton Weir on the three previous three sampling occasions (19/04/2001, 14/06/2001 and 21/11/2001)

²NA = not analysed

Aquatic ecosystem protection guidelines (Table 6) indicate that total N, total P, oxides of N, and filterable reactive P at all sites exceeded guideline trigger values over the sampling periods in February 2002, while the trigger value for ammonium-N was exceeded only at Dumbleton Weir (Table 5). Note that the mean concentrations measured at Dumbleton Weir under baseflow conditions during 2001 also exceeded guideline trigger values, but to a much lesser extent. In future events it would be useful to continue monitoring for several days after the event to assess how quickly suspended sediment and nutrient levels return to typical baseflow concentrations.

Nitrate and nitrite are important water quality indicators for human and livestock drinking water, recreational water use and aquaculture production. Only the combined concentrations of these two indicators were measured (as oxides of N) in this event, so it is not possible to assess whether guideline levels for nitrate and nitrite were exceeded. However, stream waters were likely to have been well oxidised due to turbulence and under these conditions it is probable that nitrite concentrations were extremely low, with almost all of the N oxides present as nitrate. Concentrations of N oxides measured at all sites during the event were well below guideline values for nitrate-N for drinking water and other uses, which range from 10 to 90 mg/L as nitrate-N (NHMRC 1996, ANZECC and ARMCANZ 2000).

Table 6 Guideline trigger values for nutrients for the protection of slightly disturbed aquatic ecosystems in lowland rivers of tropical Australia¹

	Trigger value (mg/L)
Total Nitrogen	0.2 - 0.3
Total Phosphorus	0.01
Oxides of Nitrogen	0.01
Ammonium-N	0.01
Filterable Reactive P	0.004

¹ ANZECC and ARMCANZ (2000)

Estimated export loads

Rainfall

The total rainfall for the 2 days averaged 233 mm over 16 rain gauges in the catchment, with a highest recording of 356 mm and a lowest of 127 mm (the latter close to Mackay). The highest rainfall totals were in the middle of the catchment, but rain was spread over the whole catchment. The average monthly rainfall for February is 384 mm at Finch Hatton, 348 mm at Gargett and 325 mm at Mackay. Clearly, the monthly averages show less spatial variation than the two-day totals for this particular event, but the February averages do show a tendency to also be higher in the middle and upper parts of the catchment.

Flow

Flow records for the site at Dumbleton Weir shows that the peak flow in the February 2002 event has been exceeded in at least 5 distinct events since January 1993. This indicates that it is unlikely to have been more than a 1 in 2 year event. Thus, the event was not atypical of events for this catchment and similar or bigger events are likely to occur in the future. The estimated total flow volume of the event was 125,900 ML at Dumbleton Weir and 985 ML at Finch Hatton.

Estimation of loads

Approximate estimates of the loads of suspended sediment and nutrients transported during the February 2002 event were calculated for the Dumbleton Weir and Finch Hatton sites using simple interpolation and integration techniques. Sufficient pesticide data were available only at the Dumbleton Weir site for estimating loads. (Load data were provided by Ian White of NR&M, Mackay).

Pesticides

Estimated export loads for atrazine and diuron were 75 kg and 470 kg, respectively, at Dumbleton Weir. It is stressed that these load calculations are based on a limited number of samples. However since samples were taken during the rising and falling stages of the hydrograph, and at peak flow (Figure 2), the estimates are considered to be indicative of what was exported. For finer detail, it would be necessary to have more intense sampling covering both event data as well as base flow conditions.

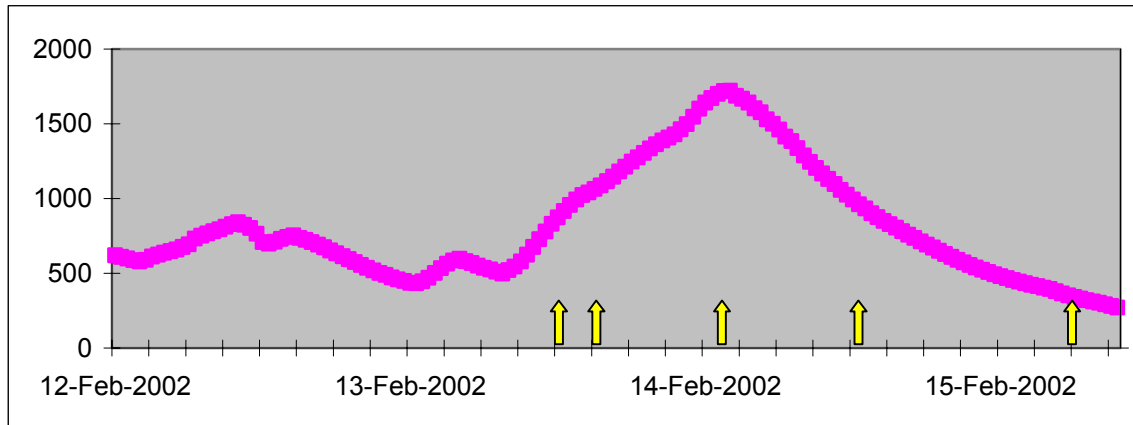


Figure 2 The hydrograph at Dumbleton Weir on the Pioneer River showing sampling times. Note that pesticides were not measured in the second sample taken.

The total annual applications of atrazine and diuron for sugarcane production in the catchment are approximately 25,000 kg and 23,500 kg, respectively (Hamilton and Haydon, 1996). Comparison of the exports of atrazine and diuron from the cane areas above Dumbleton during the two-day event, with the above annual applications provides an estimate of the proportion exported. For atrazine the comparison is between 75kg and 25,000 kg, so the export during the event was approximately 0.3% of the annual application. (If the total application figure were reduced to allow for the relatively small area of caneland below Dumbleton, the ratio would be slightly higher). For diuron, the load exported during the event represented approximately 2% of the annual application (470 kg of the estimated annual application of 23,500 kg).

Considering that the calculations are based on only one event and it is likely that earlier applications of diuron would have undergone significant in-field breakdown, the ratio of 2% for diuron is quite significant. For a more detailed assessment, information would be needed on the spatial and temporal applications of diuron for the season, particularly in the two months preceding the rainfall event. Annual exports will vary depending on the timing and frequency of rainfall events, however the amount of diuron exported in this single event would suggest annual exports are higher than desirable.

Diuron is relatively persistent (variable depending on soil type and conditions). Simpson *et al.* (2001) have shown that field half-lives (DT50) can vary from 13 days to >250 days in canelands. Diuron is initially moderately bound to soil particles (Kd approximately 30) however this binding to soil/sediments can increase significantly over the 1-2 weeks following application (Simpson *et al.* 2002). Knowledge of the pesticide properties and of the key transport processes provides sound scientific basis for practical management options for reduced pesticide losses.

More detailed knowledge of the persistence and soil adsorption properties of diuron (and other pesticides) on the key soil types in the Mackay region would help to provide increased confidence in developing improved management strategies for the region.

Suspended sediment and nutrients

Comparisons can be made between suspended sediment and nutrient loads exported from both the Dumbleton Weir and Finch Hatton sites during the February event (Table 7), although the three samples taken at Finch Hatton were less representative of the complete hydrograph for the event than those taken at Dumbleton Weir.

Table 7 Comparison of sediment and nutrient loads and export rates for the Finch Hatton and Dumbleton Weir sites during the February 2002 event

	Dumbleton Weir		Finch Hatton	
	Load (tonnes)	Export rate ¹ (kg/ha)	Load (tonnes)	Export rate ² (kg/ha)
Sediment	41540	265	29.5	8.2
Total N	243	1.5	0.68	0.19
Total P	44	0.3	0.18	0.05

¹ Based on catchment area of 1,570 km² for Dumbleton Weir

² Based on catchment area 36 km² for Finch Hatton

Although the sub-catchment area at Finch Hatton represents 2.3% of the total catchment area at Dumbleton Weir, the suspended sediment load exported from Finch Hatton (29.5 tonnes) accounted for <0.1% of the load measured downstream at Dumbleton Weir (41,540 tonnes). This suggests that for this event the Finch Hatton sub-catchment contributed disproportionately less suspended sediment to the Dumbleton Weir than other sub-catchments. Thus, export rates (kg/ha) were much lower for the Finch Hatton sub-catchment than for the whole catchment upstream of Dumbleton Weir (Table 7). Furthermore, there were large differences in loads of suspended sediment per unit volume of runoff (330 kg/ML at Dumbleton Weir, in contrast to 30 kg/ML at Finch Hatton).

Similarly, exports of N and P from Finch Hatton were 0.3% and 0.4% of respective loads at Dumbleton Weir, again suggesting that the Finch Hatton sub-catchment contributed relatively less to the loads at Dumbleton Weir than other sub-catchments during this event. It should be noted that these are only approximate estimates of the loads of sediment and nutrients transported but the comparisons give some idea of their relative magnitudes at the two sites in this event.

Many factors may have contributed to the apparent differences in export rates of suspended sediment and nutrients from these two sites, including differences in rainfall and runoff generated in different parts of the catchment. Much more information would be required to identify the specific sub-catchments, land uses and management practices contributing to these loads and to assess their relative significance in terms of likely downstream impacts on water quality and ecosystem health. More detailed sampling of events at key stages of the hydrograph would help refine loads for these sites and similar monitoring would be required for other sub-catchments.

Sampling at Dumbleton Weir on 28 June 2002

A further sample of river water was taken from the Dumbleton Weir on the morning of 28th June 2002, by an officer of the Department of Natural Resources & Mines. The sample was analysed for the presence of the same 53 pesticides included in the analysis of the February samples (see Table 2). The sample was analysed at NR&M's NATA accredited Analytical Services Laboratory, at Natural Resource Sciences, Indooroopilly, which also analysed the samples taken in February 2002.

No pesticides were detected in the most recent sample.

Sampling program conducted by Mackay City Council

The incident investigated by this report relates to *raw* water in the Pioneer River. The Mackay City Council advises that while this remains the main source of Mackay's urban water supply, it undergoes a complex system of treatment before being released for general distribution through the City's reticulation system. As a result, treated town water is a commodity quite different from raw river water.

Two levels of testing are undertaken to guarantee the cleanliness and safety of Mackay's drinking water. Mackay Water conducts a routine operational water sampling program which tests for microbiological contaminants. Additionally, Mackay City Council's Environmental Health Services undertakes an independent sampling and testing program, with analysis by the Queensland Health laboratories in Brisbane.

These sampling and testing regimes consistently return results that are within the levels set by the Australian Water Quality Guidelines and Australian Drinking Water Guidelines.

Conclusions and recommendations

The timing of catchment runoff such as the February event relative to the application of pesticides and fertilisers in the catchment, will influence concentrations and export loads in the Pioneer River. However, the data available for this assessment suggest that the event was not atypical for the catchment at that time of year and it thus raises a number of issues that require further attention.

Based on the land use in the catchment, it is clear that the pesticides detected in the sampling program were from sugarcane production. The relatively high export of diuron during this single event suggests that management practices need to be improved.

A more detailed sampling program covering both event and baseflow conditions would help to identify temporal changes in concentrations, provide the necessary data for calculation of annual exports and provide additional direction for improved management. Some additional information on the properties of key pesticides (persistence and soil adsorption) would help to quantify the impact of management options for the region.

There may be a need to reduce the loads of suspended sediment and nutrients exported from some parts of the catchment. More comprehensive monitoring of events at a number of sites over a range of seasonal conditions would be needed to evaluate the sources of these contaminants, and to identify links to specific land use and land management practices requiring remedial action.

The absence of pesticide residues in the sample taken on 28 June 2002 supports the view that if pesticides are detected in the Pioneer River, their presence should be limited to the pesticide application period.

Acknowledgement

We thank Ian White, Supervising Hydrographer, Department of Natural Resources and Mines, Mackay, for supplying the technical data and information on which this report is based. We also acknowledge the information supplied by the Mackay City Council.

References

- ANZECC and ARMCANZ (2000). "Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, The guidelines", Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, Canberra.
- DNR (1998). "Water Sample Processing Procedure", Department of Natural Resources, Brisbane.
- DPI (1995). "Water Quality Sampling Manual", Department of Primary Industries, Brisbane.
- GBRMPA (2001). "Great Barrier Reef Water Quality Action Plan", Great Barrier Reef Marine Park Authority, Townsville, September 2001.
- Hamilton, D. and Haydon, G. (1996). "Pesticides and Fertilizers in the Queensland Sugar Industry", Department of Primary Industries, Brisbane.
- NHMRC (1996). "Australian Drinking Water Guidelines", National Health and Medical Research Council, Agricultural and Resource Management Council of Australia and New Zealand, Canberra.
- Simpson, B.W., Ruddle, L.J., Packett, R. and Fraser G. (2001). Minimising the risk of pesticide runoff – What are the options? Proceedings of Australian Society of Sugar Cane Technologists, ASSCT 23: 64-69
- Simpson, B.W., Ruddle, L.J. and Noble A. (2002). Persistence and mobility of herbicides in three Australian soils. Manuscript in preparation for submission to Journal of Environmental Quality