SOUTHLAND REGIONAL COUNCIL

SEPARATION

OF

MANAPOURI LAKE CONTROL

SPILL

INTO

MARAROA RIVER AND LAKE MANAPOURI

COMPONENTS

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November 1993

A report to the Southland Regional Council's Waiau River Working Party

Introduction

Spilling of water down the lower Waiau River is necessitated by one or other of 2 separate flood conditions. The first relates to a flood in Lake Manapouri and the second to a flood (flow greater than approximately 40 cumecs) in the Mararoa River. The Mararoa flood requirement is to prevent the flow of turbid (dirty) water into Lake Manapouri.

Where both flood rules may be applicable, such as when Lake Manapouri is above maximum control level (ie above 178.6m and in its flood range) and the Mararoa River is in flood, priority must be given to the rule which requires the larger gate opening.

Analyses

15 full years of record were available for analysis from 1977 to 1991 inclusive.

The Mararoa R flood rule did not come into operation until May 1978 (see Figure 2). So despite 2 large, and a few other smaller floods having occurred in the Mararoa R. in 1977 there was no spill as a result of these (Figure 1).

The approach taken to analyse the data was first of all to produce combined annual plots of MLC spill, Mararoa River flow and Lake Manapouri level (figures 1 to 15).

These plots were used to isolate the spill events which were then plotted at greater detail (not presented in this report). From these detailed plots in particular, but often from the annual plots, the controlling factor governing spill through the MLC structure was identifed.

In those instances where both the Lake and Mararoa R. were high it was assumed that spill was a requirement of the lake rule rather than the river rule. However in some instances spill was initially required as a result of flooding in the Mararoa but subsequently required because of high lake level. In such cases the initial portion of the spill was attributed to the Mararoa.

In each spill event the volume of water spilled was calculated. Volumes for all spill events in each year were summed and the mean flow for the year apportioned by the sum of Mararoa spill events to the sum of lake spill events.

Results

Table 1 summarises various mean flows for the years from 1978 to 1991. For completeness the annual mean inflows to Lake Manapouri and the annual mean flows of the Mararoa River are included.

MLC spill is the total mean flow of water spilled down the lower Waiau River. Lake spill is the lake component of this spill and likewise Mararoa spill is the Mararoa R component.

1989 was the only year in which no spill was required due to the lake rule. Mean inflow to lake Manapouri was lower in this year than in any of the other years from 1978 to 1991.

Over the 14 year period from 1978 to 1991 average spill flow through the Manapouri Lake Control structure was 72.2 m^3/s. 55.4 m^3/s or 76.7% was spilled as a requirement of the lake flood control rule and 16.7 m^3/s or 23.3% as a requirement of the Mararoa R flood rule.

Water spilled as a requirement of the Mararoa rule equates to 48% of the mean flow of the Mararoa River in the period 1978 to 1991.

YEAR	Manapouri Inflow m^3/s	Mararoa Flow m^3/s	MLC Spill m^3/s	Lake Spill Component Mean m^3/s	Lake Spill Component % of lake inflow	Mararoa Spill Comp Mean m^3/s	Mararoa Spill Comp % of Mararoa
1978	409.0	30.7	19.8	11.3	2.8%	8.5	27.7%
1979	461.0	36.7	70.8	49.7	10.8%	20.8	56.7%
1980	497.7	41.9	126.3	94.4	19.0%	31.9	76.1%
1981	384.2	25.0	17.2	3.9	1.0%	13.4	53.6%
1982	536.5	41.7	120.3	111.1	20.7%	9.2	22.1%
1983	532.6	44.8	98.4	87.2	16.4%	11.2	25.0%
1984	504.5	37.4	81.4	57.0	11.3%	24.4	65.2%
1985	373.5	24.3	52.0	40.8	10.9%	11.2	46.1%
1986	435.0	30.1	32.5	9.1	2.1%	23.4	77.7%
1987	497.2	43.4	86.8	66.5	13.4%	20.3	46.8%
1988	609.8	40.9	183.1	168.3	27.6%	14.8	36.2%
1989	343.7	22.6	12.4	0	0%	12.4	54.9%
1990	432.1	31.5	40.8	33.1	7.7%	7.7	24.4%
1991	457.3	39.4	68.4	43.3	9.5%	25.1	63.7%
MEANS	462.4	35.1	72.2	55.4	12.0%	16.7	47.6%

Table 1 Annual mean flows

The long term mean inflow to Lake Manapouri in the period since control (ie. from 1970 to 1991) inclusive is 434.6m^3/s.

In the period 1978 to 1991 the mean inflow was greater than this in 9 of the 14 years - in some years quite significantly - due to the occurrence of large flood events. These larger than normal mean annual flows have had the effect of boosting the overall mean spill flow for the period.

Table 2 gives the percentages of time spill has occurred in each year, along with the percent of time spill was required because of the Lake Manapouri flood rule (lake levels greater than 178.6m) and the percent of time spill was required due to the Mararoa R flood rule (by deduction from the lake control rule).

YEAR	% of time spill occurs	% of time spill due to Manapouri rule	% of time spill due to Mararoa rule
1978	13%	4%	9%
1979	33%	22%	11%
1980	51%	21%	30%
1981	15%	2%	13%
1982	41%	28%	13%
1983	50%	25%	25%
1984	41%	15%	16%
1985	29%	10%	19%
1986	31%	3%	28%
1987	55%	28%	27%
1988	54%	23%	31%
1989	19%	0%	19%
1990	27%	15%	12%
1991	33%	23%	10%
Means	35%	16%	19%

Table 2 Percentage of time spill is sourced from Lake Manapouri or Mararoa River

On average spilling of water occurred for 35% of the time in the 14 years from 1978 to 1991 inclusive. 16% of the time spill was due to the lake control flood rule and 19% of the time it was due to the Mararoa River flood rule.

In each of the years 1980, 1983, 1987 and 1988 water was spilled for more than 50% of the time.

Summary

From 1978 to 1991 inclusive:

1. Spill occurred for 35% of the time.

2. 16% of the time spill was because of the lake flood control rule.

3. 19% of the time spill was because of the Mararoa River flood rule.

4. Average spill flow in the period was $72m^3/s$.

5. 77% of the spill volume (average 55 m^3/s) was because of the lake flood control rule.

6. 23% of the spill volume (average 17 m^3/s) was because of the Mararoa River flood rule.

7. 12% of Lake Manapouri inflow (which includes Mararoa River flow) was spilled.

8. 48% of Mararoa River flow was spilled.

9. Spill flow exceeded $10m^3/s$ for 34% of the time; $20m^3/s$ for 33% of the time and $50m^3/s$ for 29% of the time.

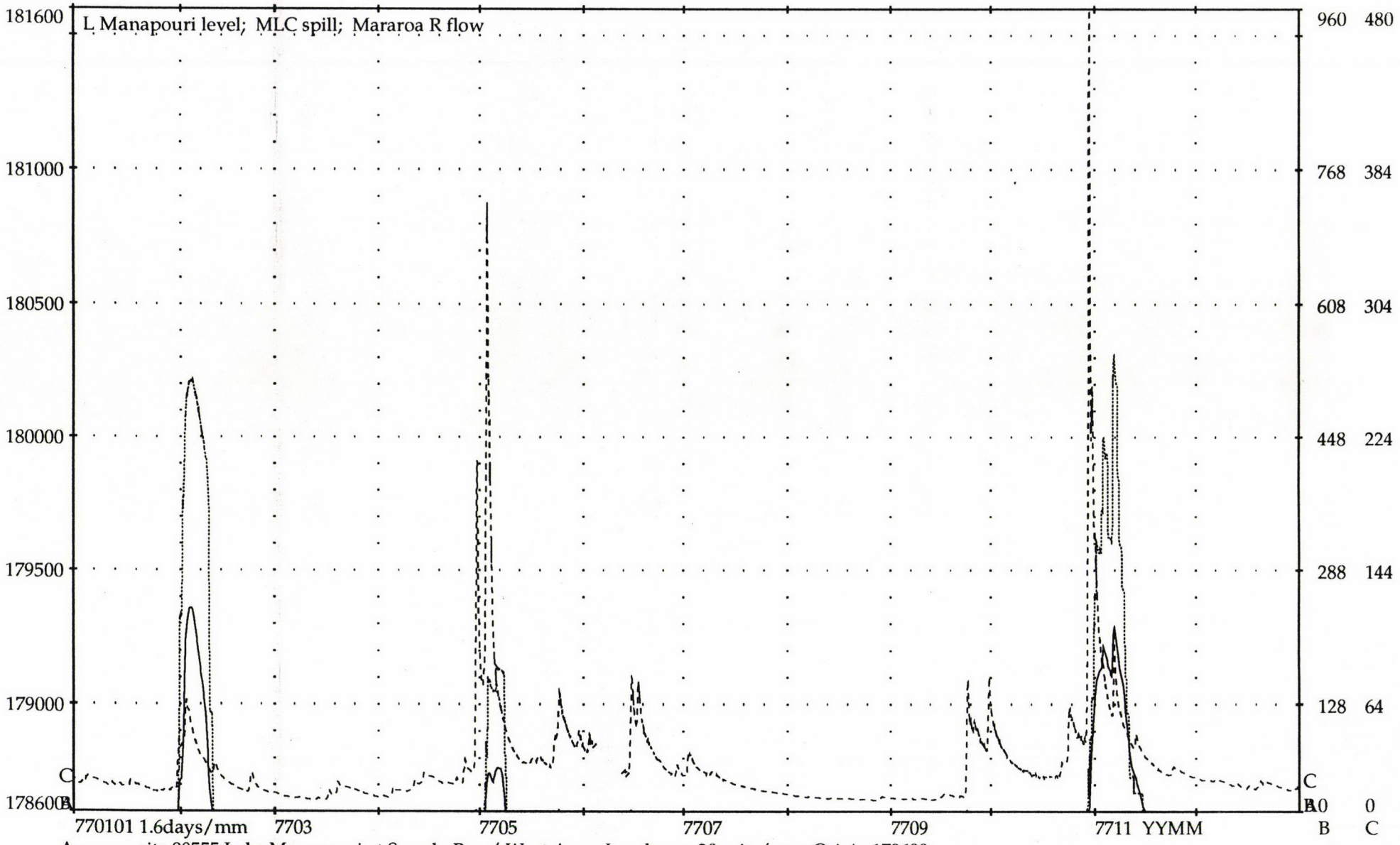

L Manapouri level; MLC spill; Mararoa R flow
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A —— site 89555 Lake Manapouri at Supply Bay / West Arm Level mm 20units/mm Origin 178600
B ..... site 9552 Lake Manapouri Spill at Mararoa Weir (Flow l/s)/1000 6.4units/mm
C - - - - site 79737 Mararoa at Cliffs (Flow l/s)/1000 3.2units/mm

FIGURE 1

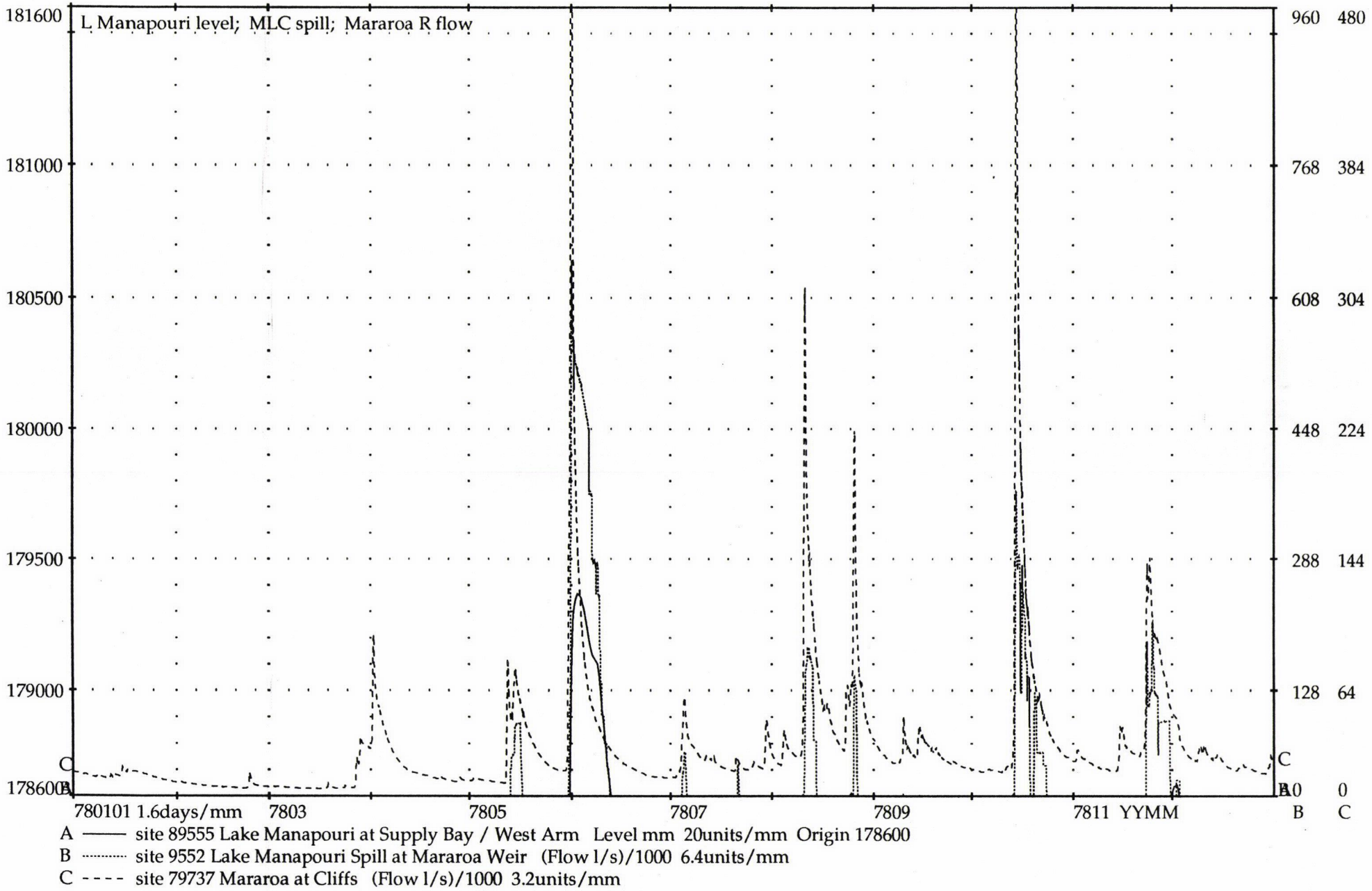

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FIGURE 2

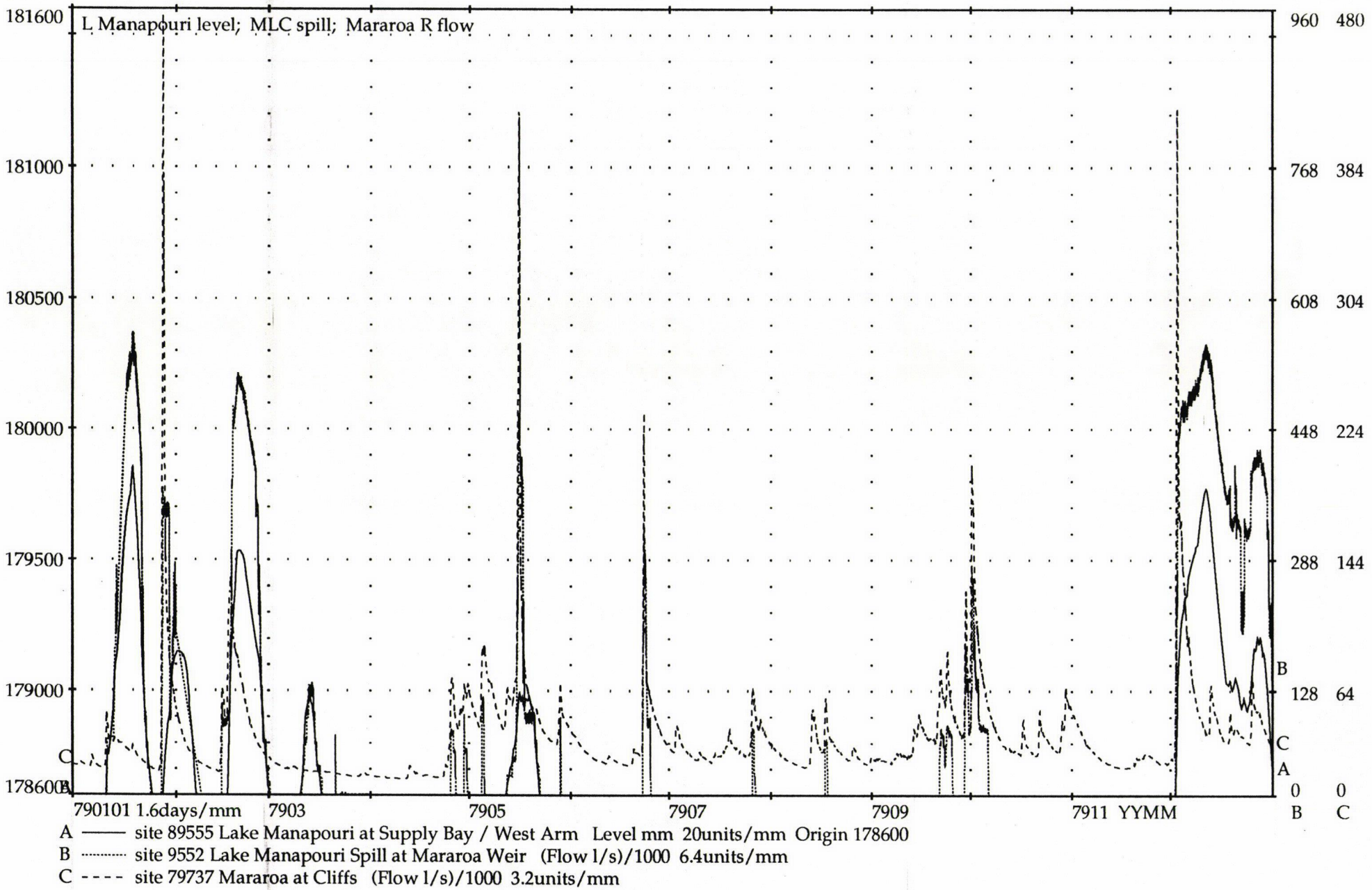

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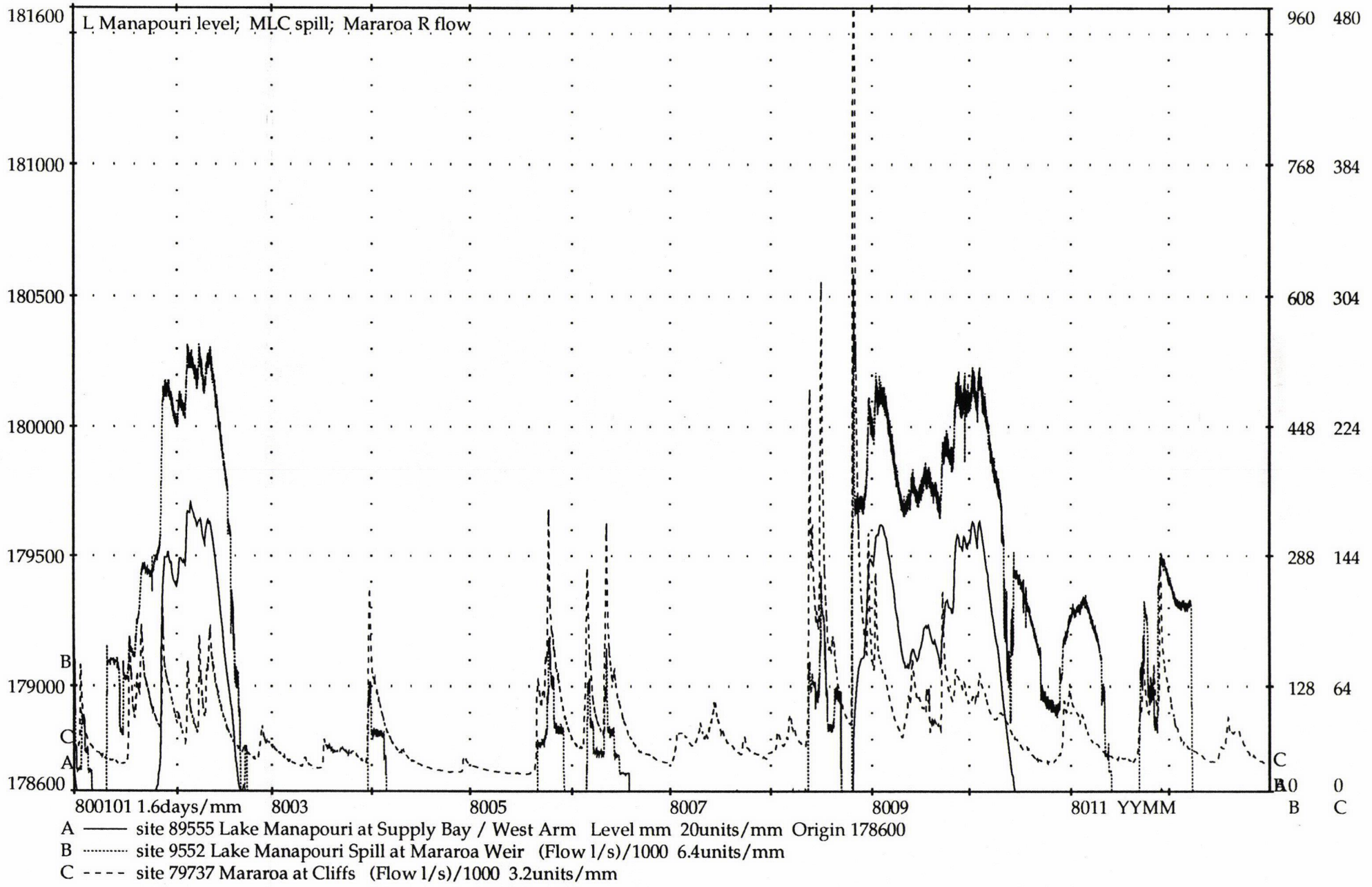

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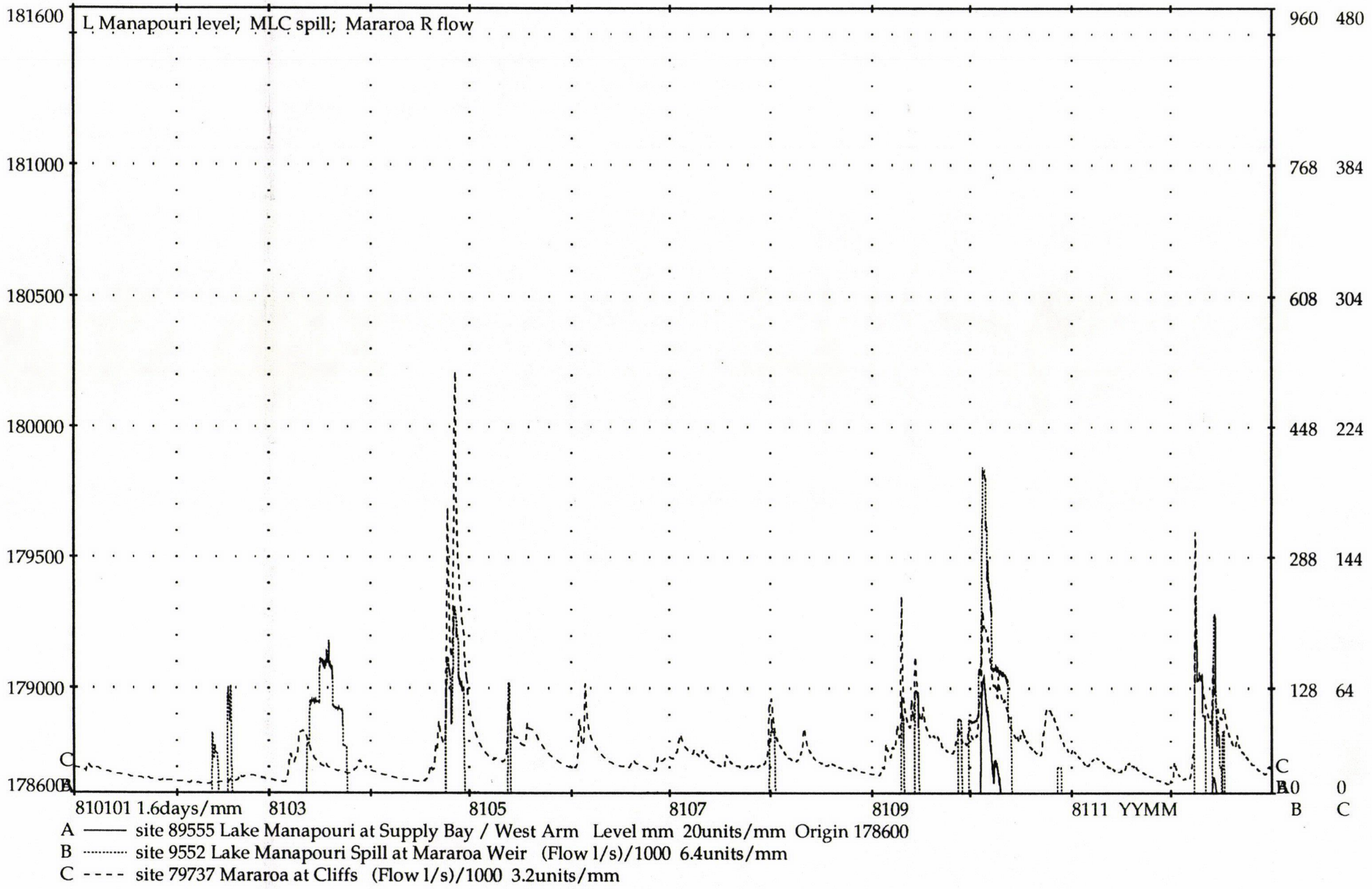

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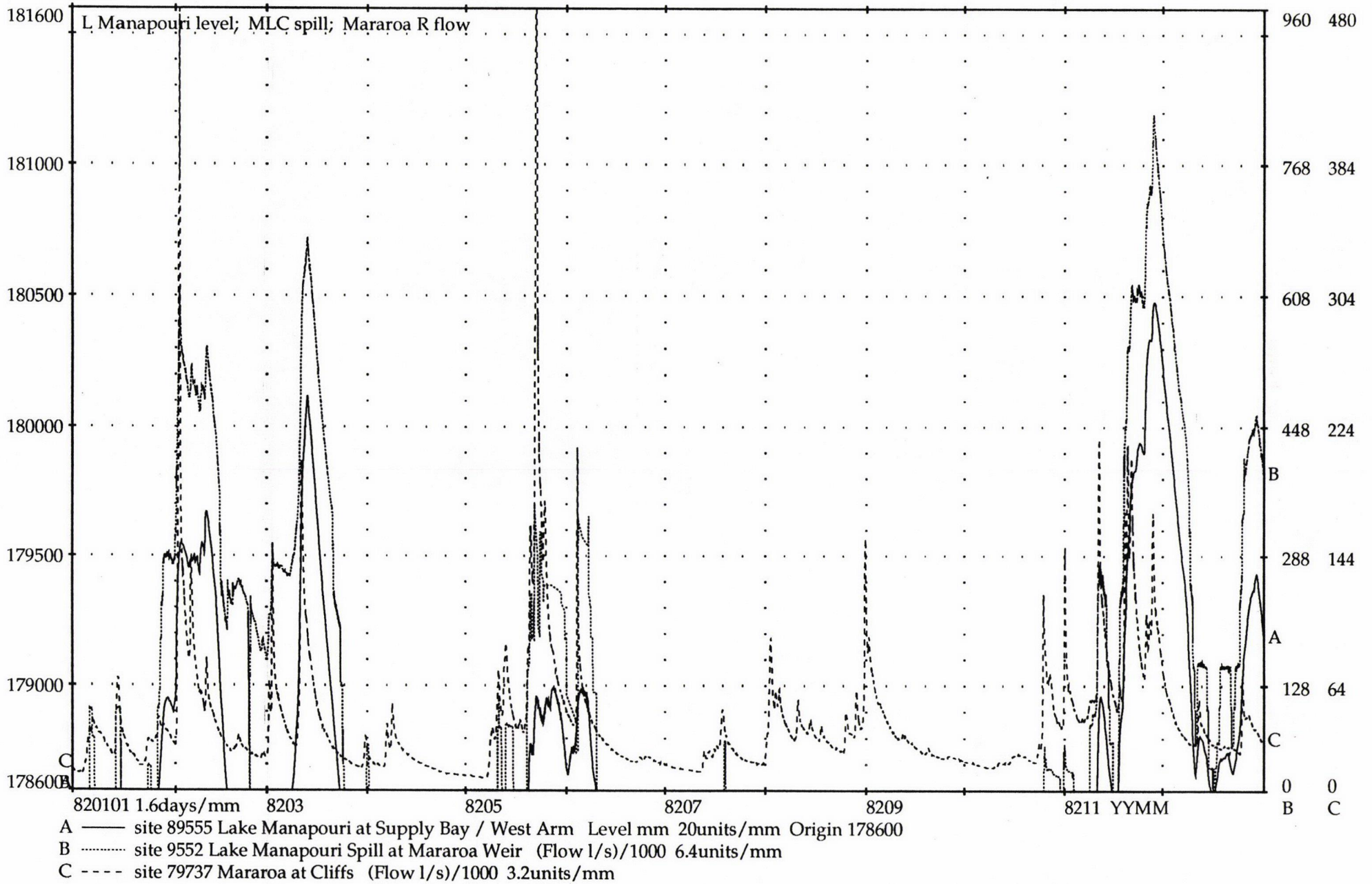

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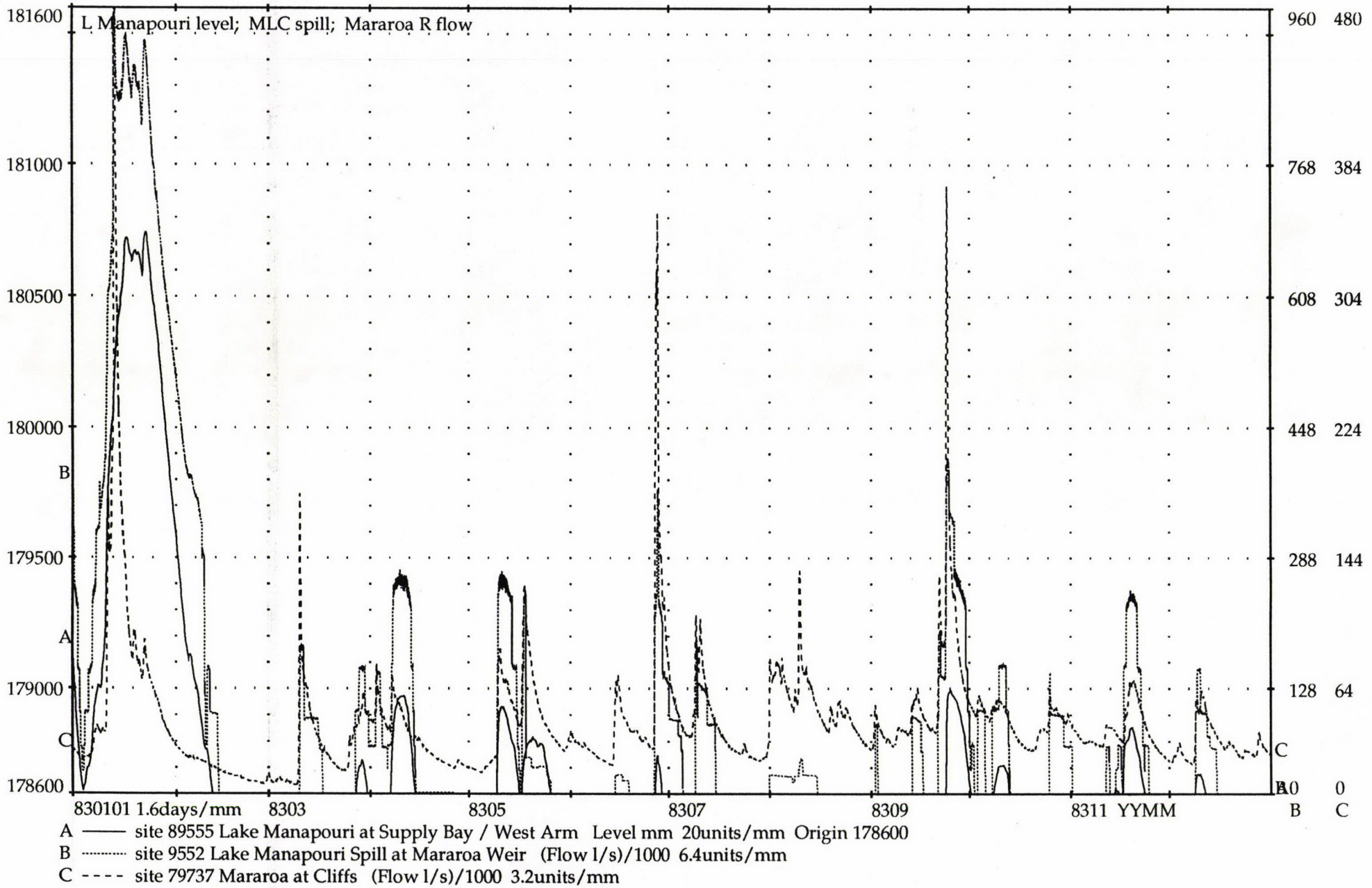

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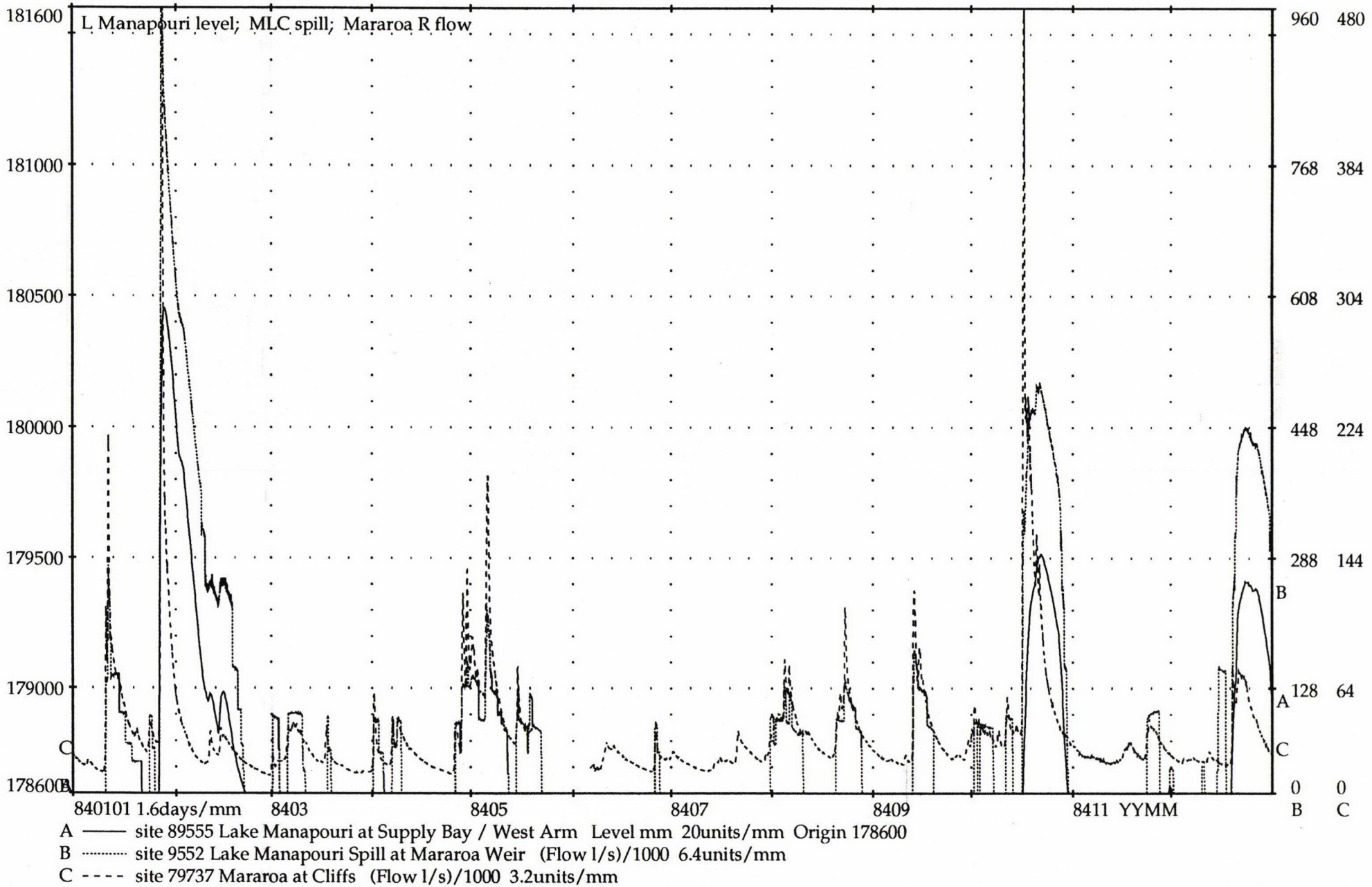

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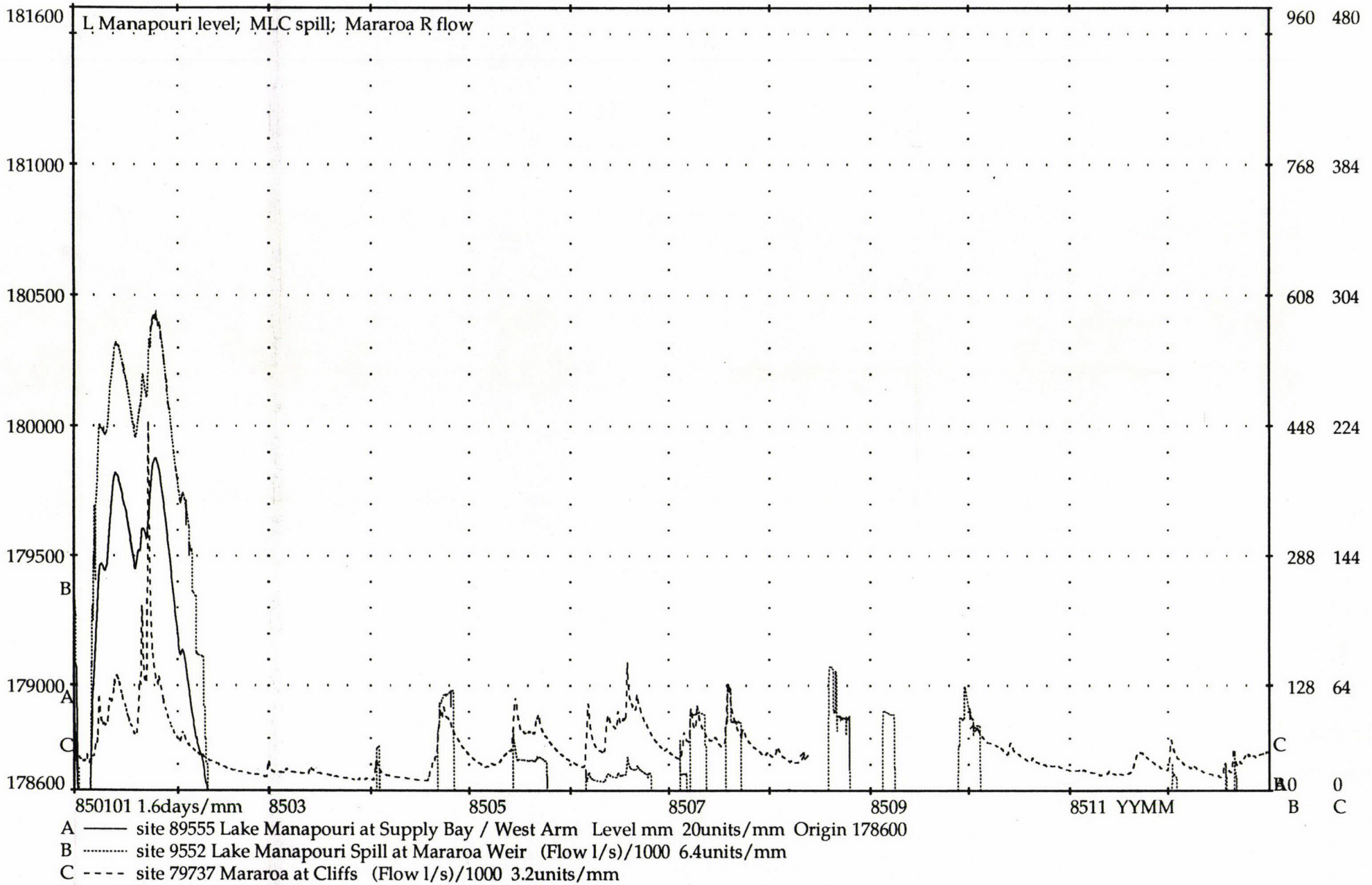

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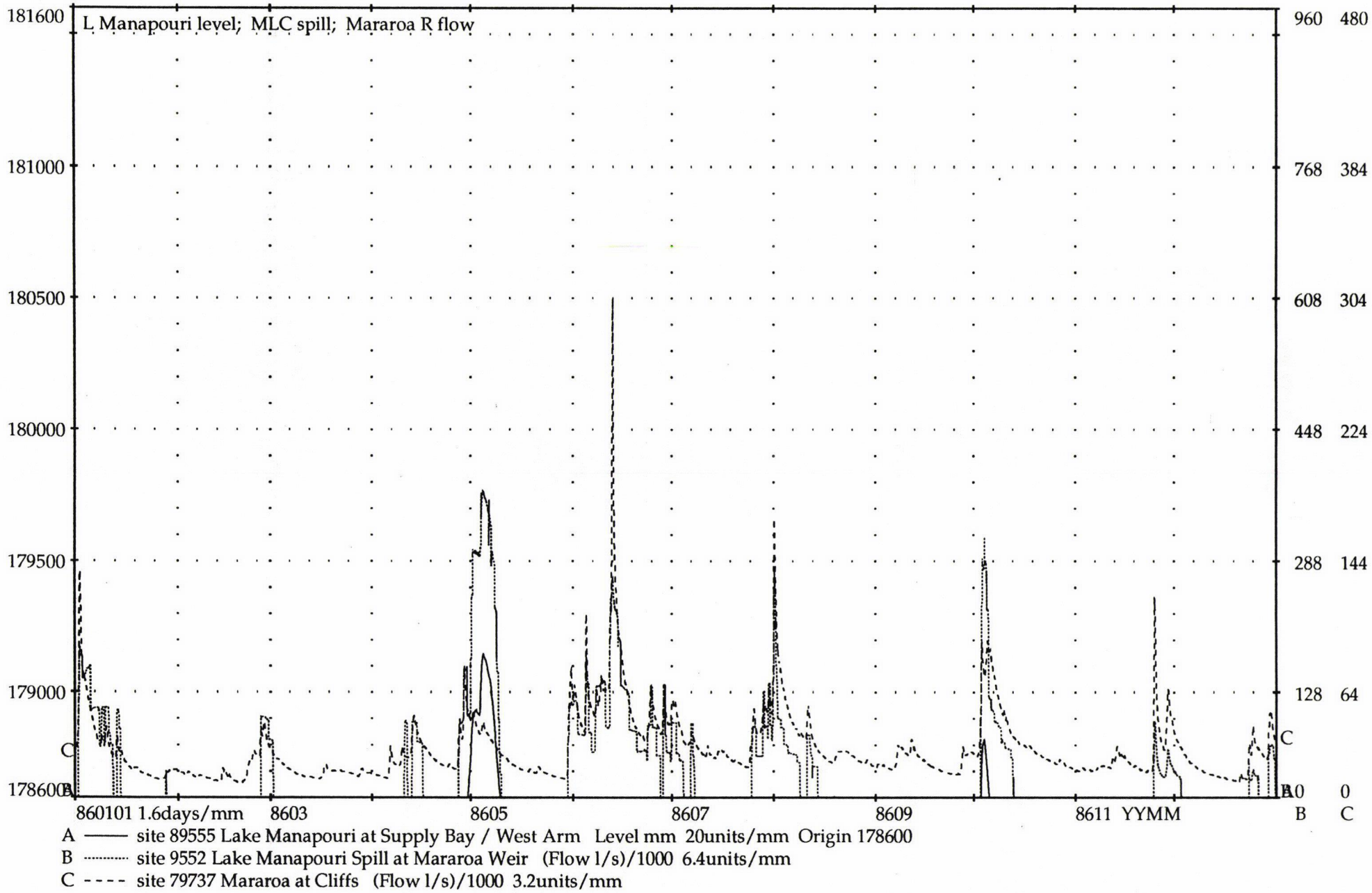

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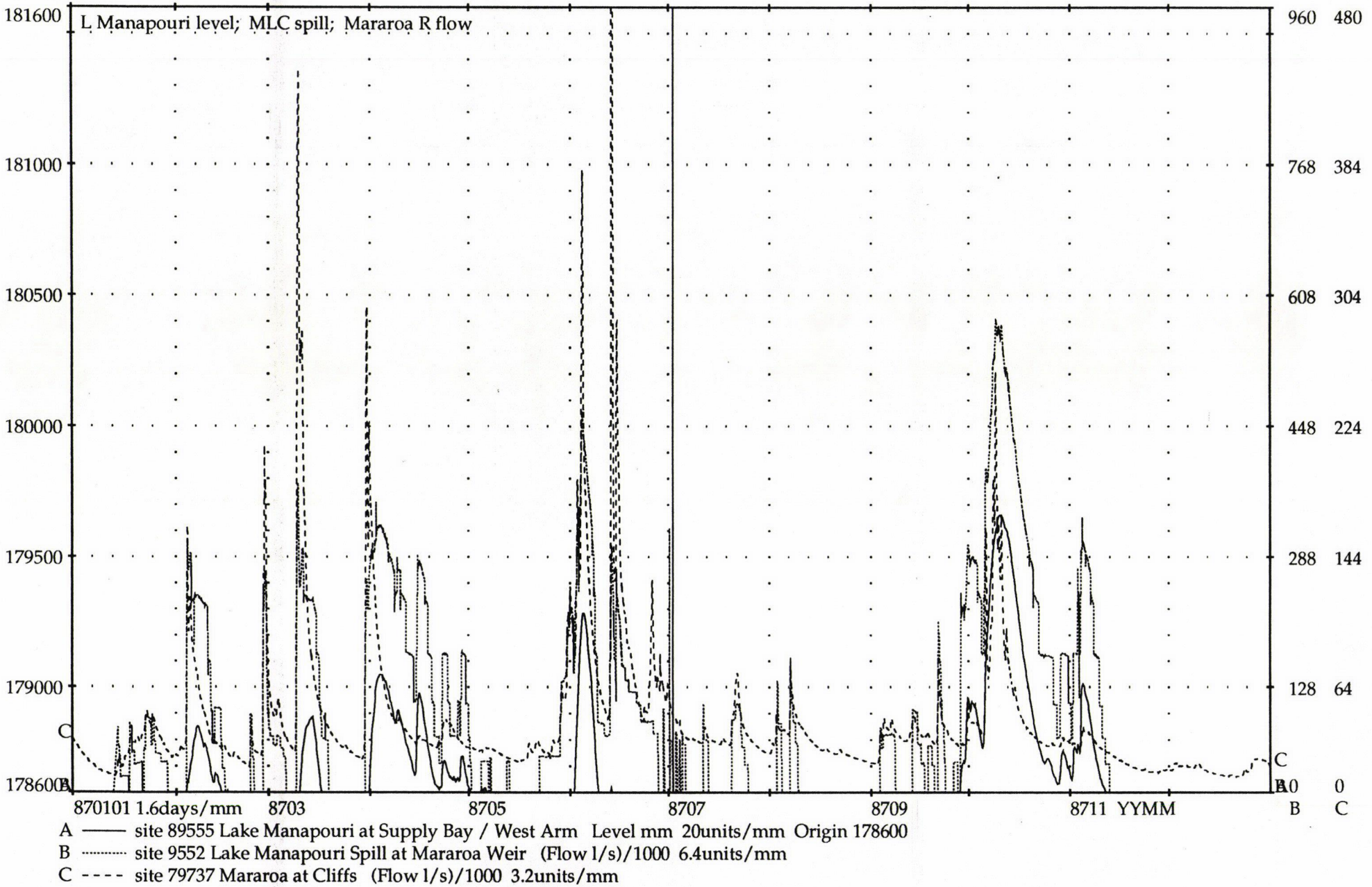

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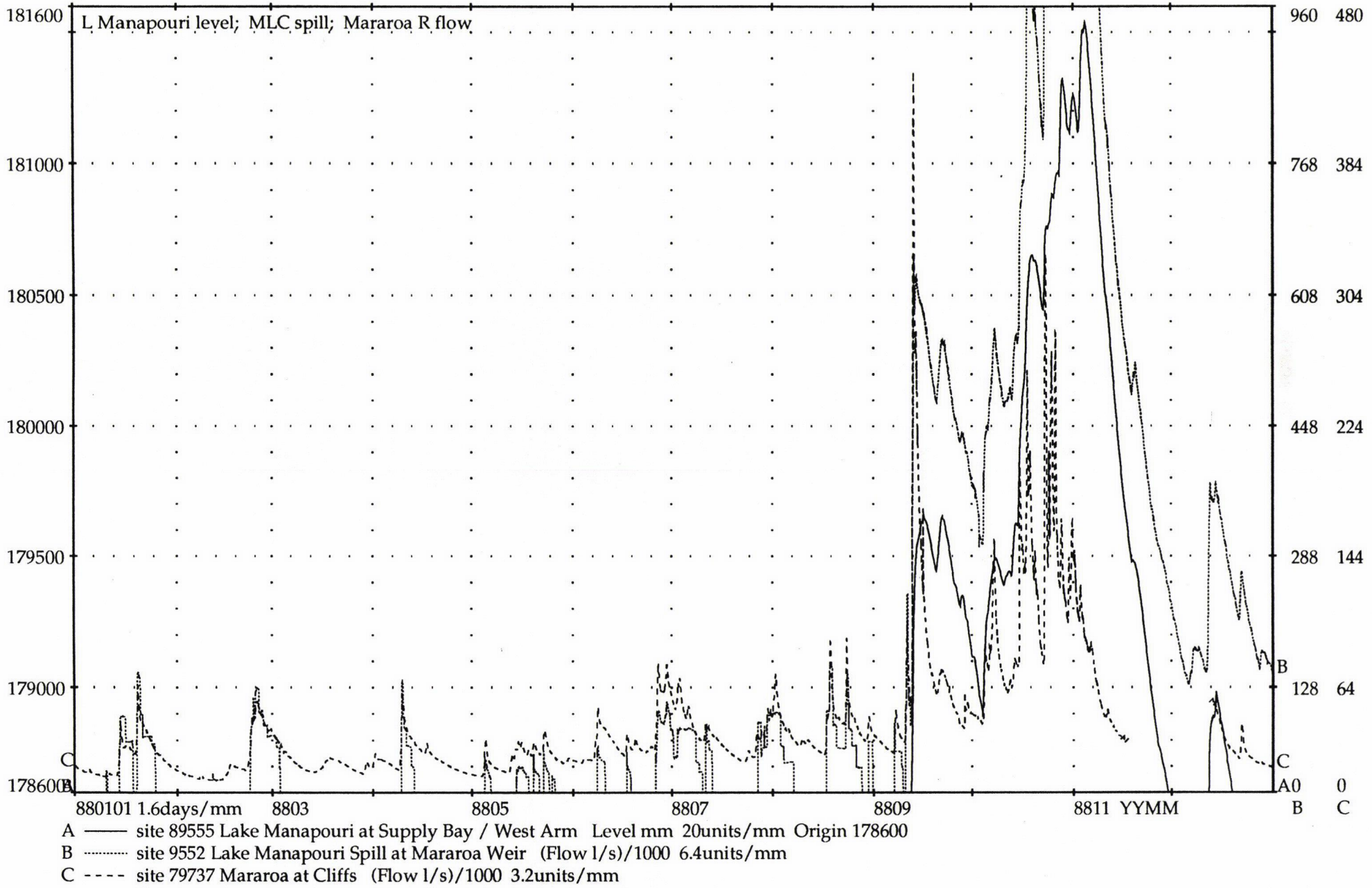

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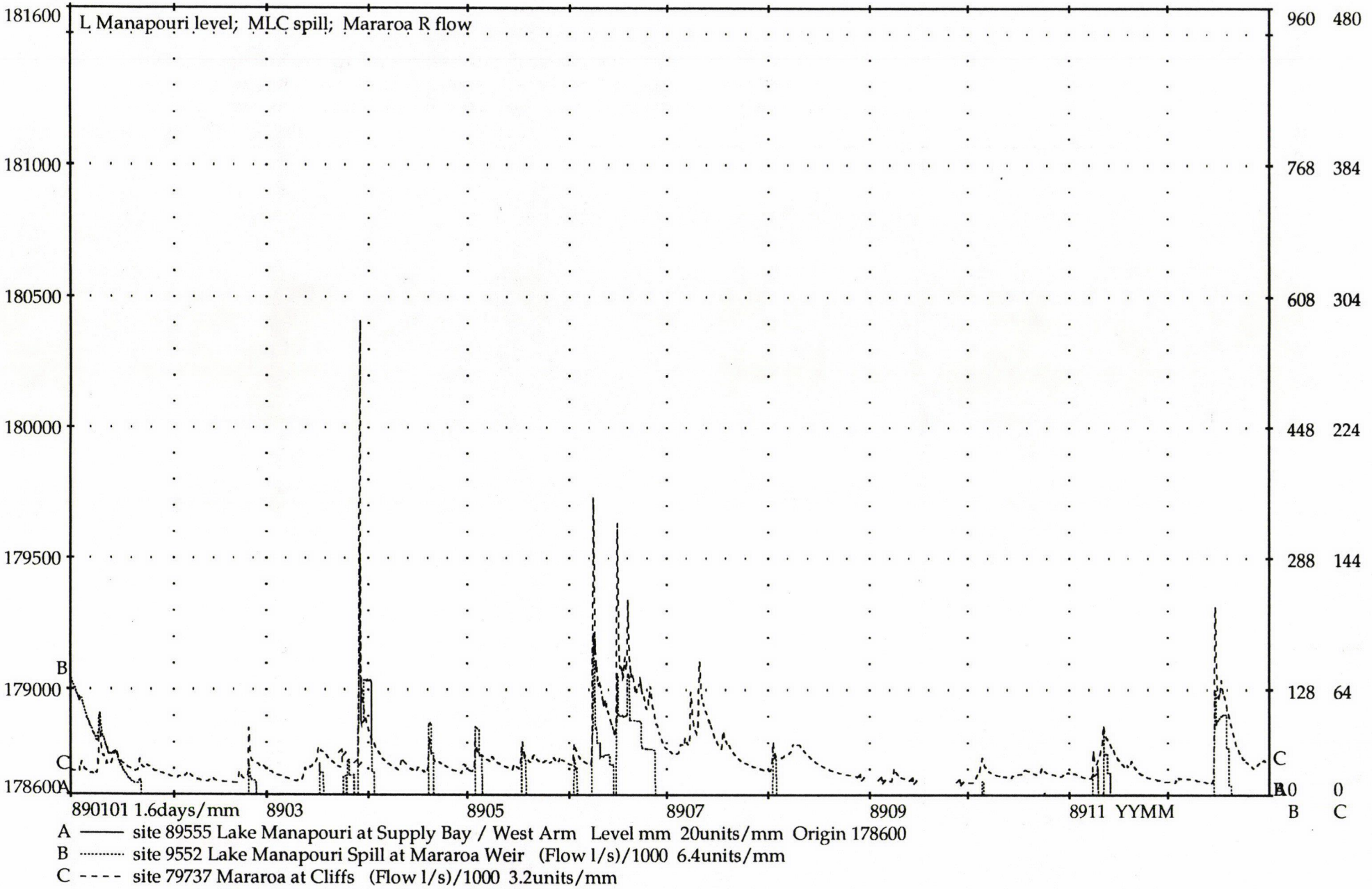

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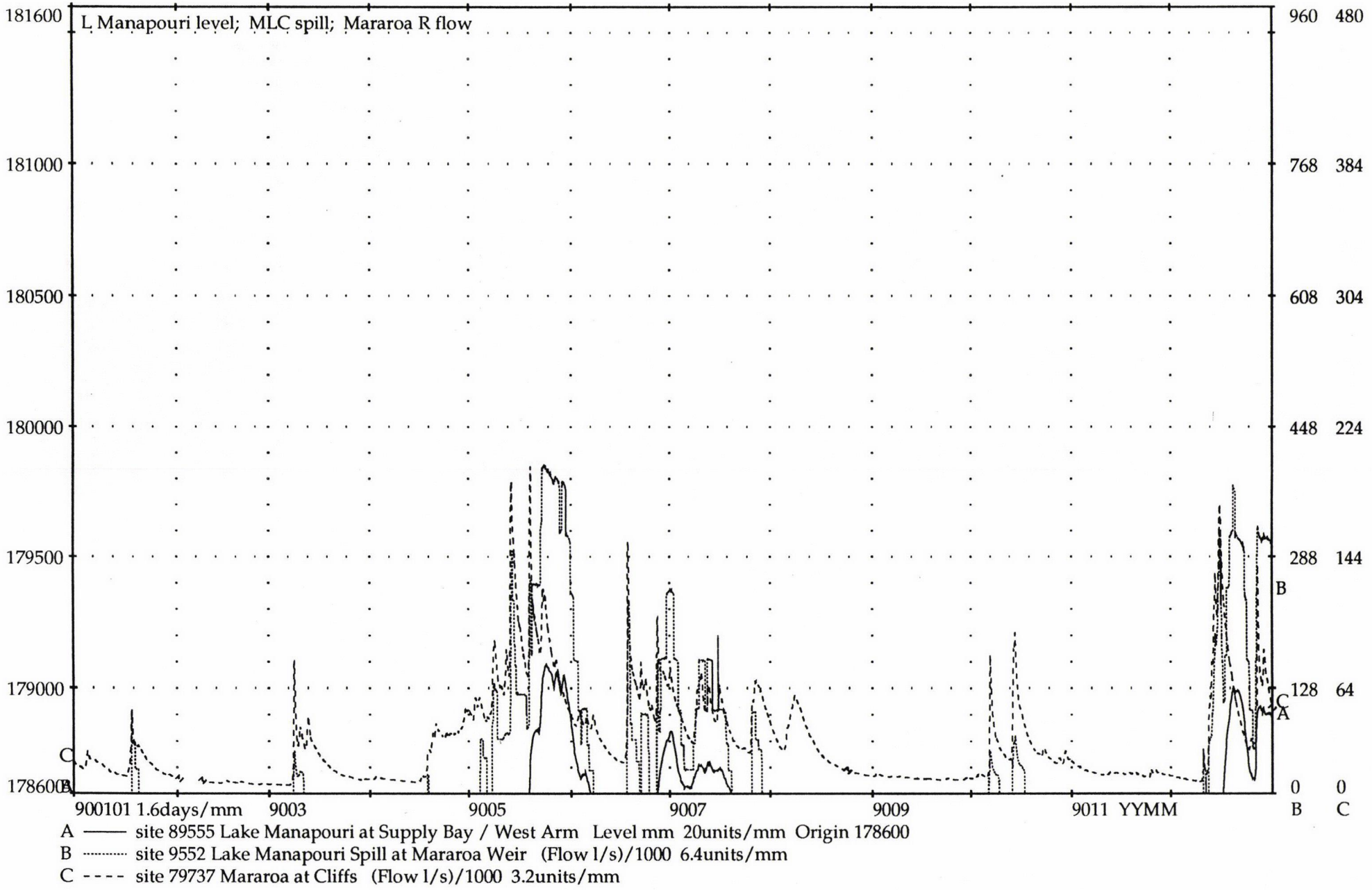

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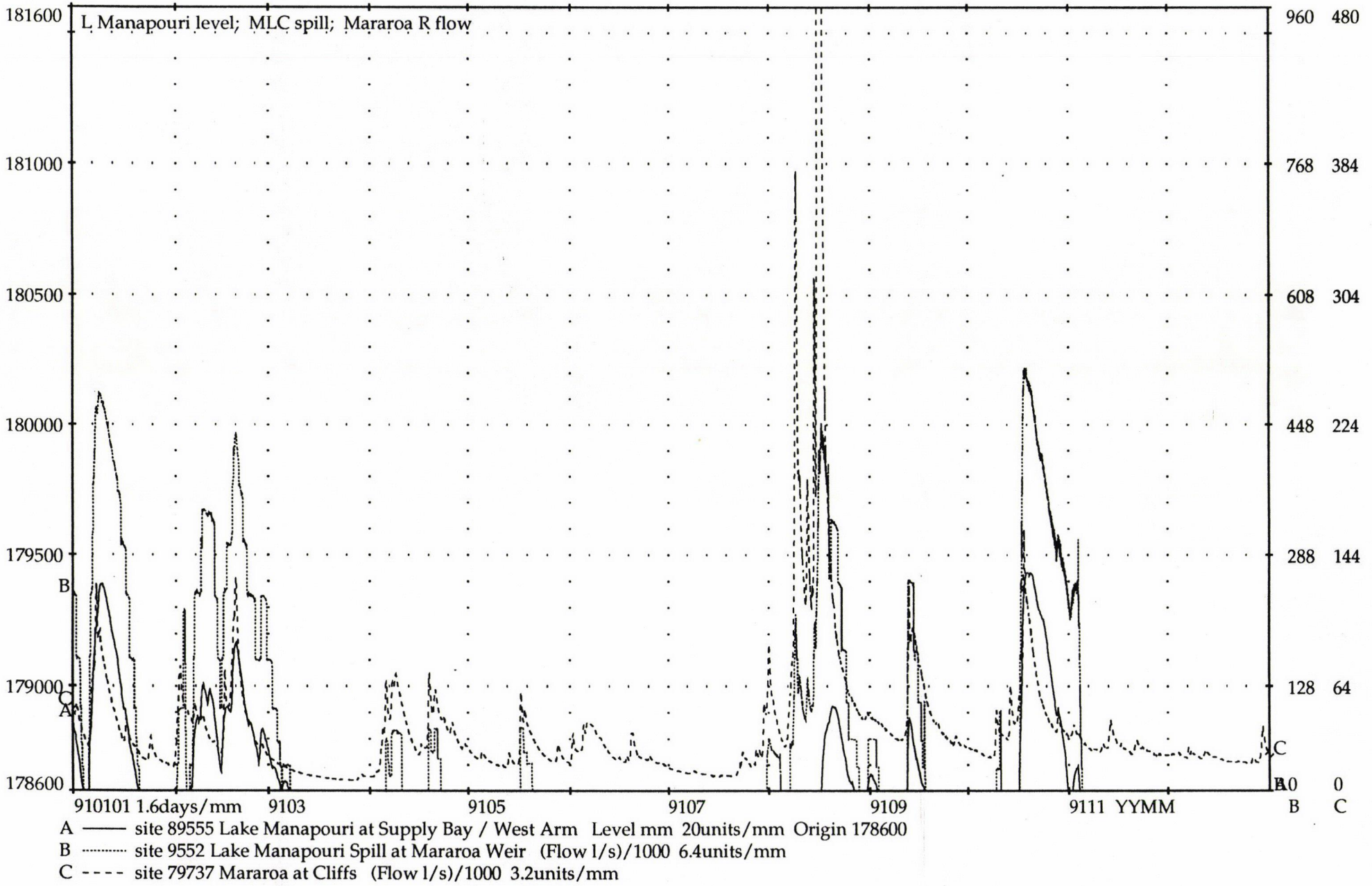

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FIGURE 15