WATER QUALITY OF COLDSTREAM CREEK AND NEARBY AGRICULTURE IN 1977.

Ministry of Agriculture
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INTRODUCTION

This report is intended to supplement the committee's report, "Water Quality of Coldstream Creek and Nearby Agriculture in 1976" (Anon. MS 1977).

There are 4 parts to this report:

1. A description of recommendations for, and changes in waste management along Coldstream Creek.

2. A presentation of further results of water quality analysis at various points along Coldstream Creek.

3. A chronology of the activities of the committee involved with the Coldstream Creek study.

4. Conclusion.

This report concludes the activities of the committee whose objectives were to:

1. locate sources of pollution along Coldstream Creek,

2. determine whether agricultural practices could be altered to reduce the nutrient load to Coldstream Creek and, if so, to encourage farmers to improve agricultural practices.

AGRICULTURAL WASTE MANAGEMENT IMPROVEMENTS AND RECOMMENDATIONS

A survey conducted in May 1977 determined areas where improvements could be made and offered technical assistance to remedy the problem areas. Some agricultural operators were not in favour of the recommendations for improvements presented to them, while others took action and did their part to reduce the nutrient load to Coldstream Creek.

The Coldstream Ranch, Peter Collins dairy farm, S. Harrer, O. Hensel, and R. Postill are the only agricultural operators known to the committee who have made improvements to their operation which will reduce nutrient load to Coldstream Creek.

1. The Coldstream Ranch improvements include: fencing along creek to keep cattle from having direct access to creek, installation of heated waterers to provide water to livestock rather than livestock having to go directly to creek, winter feeding facilities located far enough away from creek to reduce potential runoff of livestock waste to creek.

2. Peter Collins dairy farm has installed a concrete liquid waste tank to collect dairy wastes and feedlot runoff thus preventing this waste from entering Coldstream Creek.

3. S. Harrer has moved his cattle feedlot area further away from the creek and has fenced the area and installed water devices.

4. O. Hensel has provided fencing to keep his livestock from entering Coldstream Creek and has installed a watering device so the animals do not have to go to the creek for water.

5. R. Postill is in the process of installing a culvert on his property to prevent livestock waste from entering the water flowing in ditches through his property. Water supply for the livestock will be provided in troughs.

Many of the situations observed during the May 1977 survey were similar:

- livestock were pastured in summer months such that grass in the pasture was sufficient feed.
- livestock had free access to the creek for water.
- livestock density was about 1 animal per acre (average herd - 7.8 animals; average pasture - 8.3 acres).
- overwintering areas were rudimentary with some locations poor because they were too close to the creek.
- no winter watering facilities were provided so that livestock had to drink from the creek.
- often the potential of pollution through runoff was high.

Recommendations

1. Fencing is desirable but in some cases not practical.

2. Cattle should be discouraged from watering at the creek by:
   (a) installing watering device well back from the creek,
   (b) ensuring that good shade and salt licks are provided well back from the creek.

3. Overwintering areas can stand improvement. Where cattle are confined during the winter in a corral for the purpose of providing shelter and feed and water, these guidelines should apply:
   (a) Good drainage is essential so that the corral area stays as dry as possible.
   (b) "Clean runoff from surrounding land should be diverted around the corral using ditches or berms.
   (c) Runoff from the corral must be prevented from flowing to the creek.
      - collect runoff in a catchment pond and dispose by irrigation on pasture.
      - using ditches, spread runoff over pasture area, well back from creek (grassed waterway).
      - catchment capacity is determined by area of corral and should be sized to impound two inches of runoff from the corral.
   (d) Locate corral such that runoff will not flow into the creek. Corral should slope away from the creek if possible.
   (e) A good, heated watering device should be provided so that cattle no longer water at the creek during the winter.

The basic objectives to improve existing small farms to protect Coldstream Creek should be as follows (in order of relative importance):

1. Improve overwintering areas to prevent contaminated runoff from reaching the creek.

2. Install heated watering devices so that cattle will be discouraged from drinking from the creek. The same waterer should be used to discourage cattle on pasture in the summer months from watering at the creek.

3. Provide shade areas and mineral licks well back from the creek to discourage cattle from loitering near the creek.

4. When the above provisions have been complied with, and to prevent all access to the creek by cattle, fencing should be installed.

The overriding effects of additional livestock and new agricultural operations occurring along Coldstream Creek are detrimental to the cleanup done by the conscientious parties mentioned above. There are still some agricultural operators who have not complied with the committee's recommendations. Steps need to be taken to further encourage agricultural operators towards better methods of environmental control along Coldstream Creek if the quality of the water is to be improved or even maintained.

WATER QUALITY

Methods and Results

Figure 1 shows the Coldstream Creek watershed and the locations of stations where water quality was sampled. A detailed description of each sampling location is given in Appendix 1. At each station, water quality was sampled by filling a bottle in a manner which collected water in about equal volume between the surface and the bottom. Immediately after a water sample was collected, pH was measured with a Metrohm Herisau E 488 pH meter, and specific conductance with a Beckman RB-3 conductivity meter. For all other analyses, water was shipped to the B.C. Environmental Laboratory.

Table 1 shows that the average levels of nutrients were higher near the mouth of Coldstream Creek than in upper reaches. The nutrients and fecal coliform bacteria counts do not indicate a steady increase, but rather high values near areas of known contribution such as downstream of the dairy farm. Indeed, the average concentration of all parameters shown in Table 1 increased downstream of the dairy farm. For Station 10, average total nitrogen is less than the average of the component nitrogen parameters because of one day's sample when neither total nor nitrate plus nitrite could be performed due to chemical interference in the sample. Consequently, there are only 9 values for Total N and nitrate and nitrite; the additional value for the other nitrogen components was very high. The average nutrient levels in the creek for 1977 were similar to those observed in 1976. Thus, any decrease in amount reaching the creek due to improved agricultural waste management was not obvious in the water quality data of 1977.

The data for coliform bacteria may be misleading for two reasons. One is that the counts vary in an exponential rather than an arithmetic way and consequently that the only meaningful differences in number

Figure 1. Water quality station locations on Coldstream Creek.

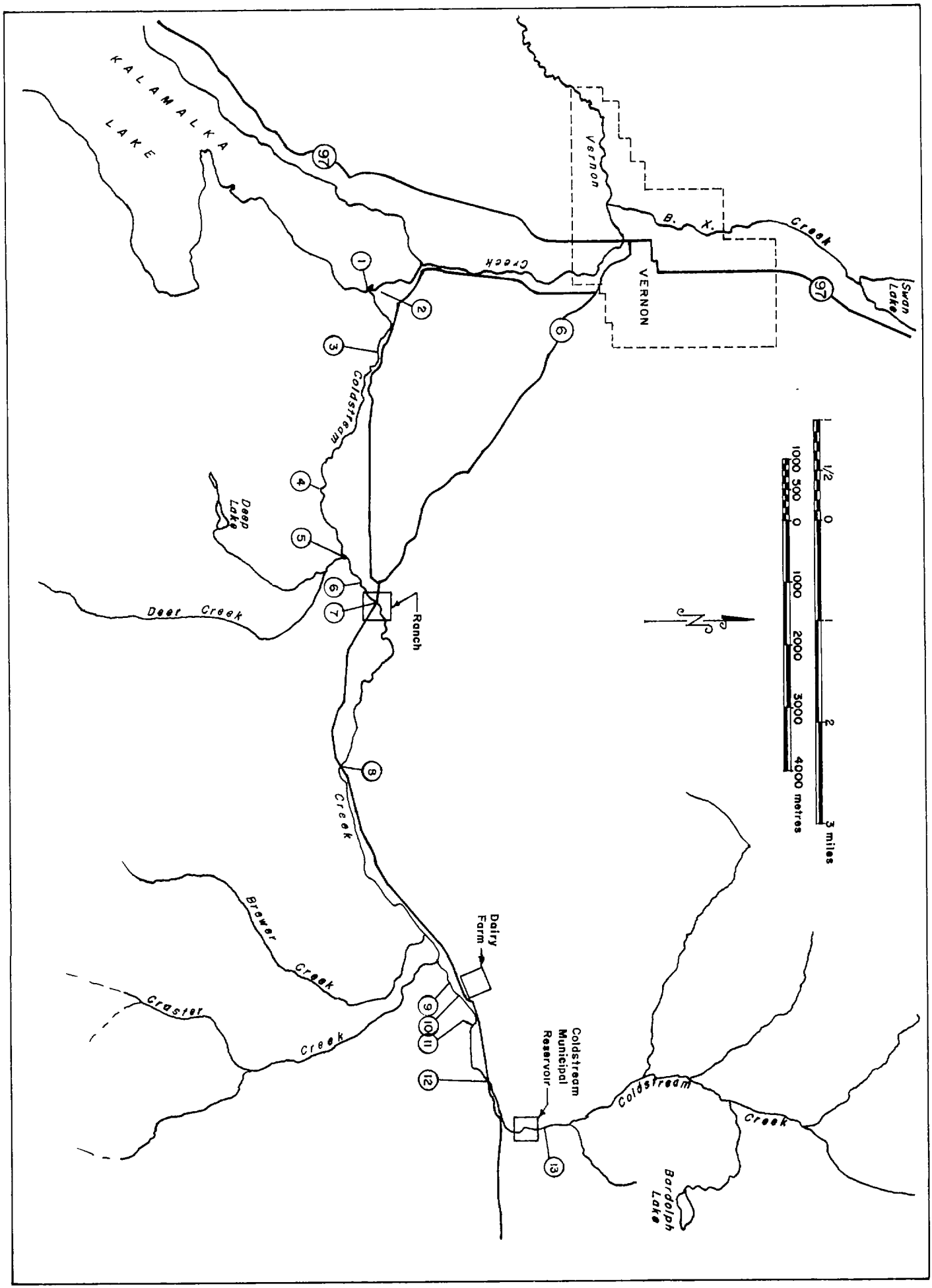

Table 1. Mean levels of macronutrients and coliform bacteria observed in Coldstream Creek during 1977. Except as specified, values are mg/L.

STATION		Sample size	Phosphorus, total	Phosphorus, soluble	Phosphorus, ortho	Nitrogen, total	Nitrogen, total organic	Nitrogen, ammonia	Nitrogen, nitrate & nitrite	Potassium	Carbon, organic	Carbon, inorganic	Coliforms, total (MPN/100 ml)	Coliforms, fecal (MPN/100 ml)
u/s Reservoir	(13)	10	0.007	0.006	0.004	0.137	0.072	0.006	0.063	2.6	2.5	48.	10.	4.
Parklane Rd	(12)	6	0.010	0.005	0.003	0.157	0.093	0.005	0.067	2.4	3.	45.	23.	5.
u/s Dairy Farm	(11)	5	0.008	0.005	0.004	0.268	0.208	0.005	0.062	2.4	3.3	44.	88.	4.
d/s Dairy Farm	(10)	10	4.162	0.287	1.570	4.299	7.49	5.375	2.149	58.7	6.2	62.	1417.	1286.
School Rd	(9)	8	0.155	0.082	0.063	3.199	1.163	0.165	1.871	4.9	5.4	59.	2058.	1630.
Vimy Rd	(8)	11	0.053	0.036	0.029	1.752	0.347	0.063	1.342	4.4	3.5	55.	940.	540.
u/s Ranch	(7)	10	0.060	0.025	0.020	1.580	0.313	0.022	1.246	4.2	4.3	54.	1153.	265.
Deer Cr	(5)	11	0.052	0.024	0.020	1.881	0.297	0.027	1.559	4.1	3.	55.	729.	209.
Howe Dr	(4)	11	0.050	0.024	0.020	1.806	0.280	0.024	1.503	4.2	3.2	53.	830.	467.
McClounie Rd	(3)	20	0.045	0.022	0.018	1.662	0.269	0.015	1.378	4.7	2.7	54.	1160.	472.
Kirkland Dr	(1)	20	0.045	0.022	0.018	1.592	0.258	0.015	1.285	4.7	3.7	52.	1135.	512.

are logarithms or powers of ten. The other is that the number of bacteria in some samples was greater than measured in the sample, so that some of the means are not as high as they should be. The reason that the bacteria counts underestimate the number in the sample was that special dilutions are required to estimate the total if it is greater than 2400. Consequently, some of the values were greater than 2400 but 2400 was usually the maximum value used in computing the mean. In some cases special dilutions were requested which resulted in estimates greater than 2400. However, such special dilutions were requested more frequently in 1976 than in 1977 so that at Station 10 the mean bacteria count appeared to be lower in 1977 than in 1976 when in fact it may not have been. Indeed, none of the 1977 fecal coliform counts seem significantly different from those of 1976.

Table 2 shows that most other water quality parameters had a general increase from the headwaters to the mouth. The values are similar to those observed in 1976. Some of the dissolved parameters were slightly greater than in 1976 (filterable residue, silica, total alkalinity, magnesium, calcium, sodium, and chloride). As in 1976, most of the parameters increased downstream of the dairy farm.

The seasonal patterns of most water quality parameters were similar in both 1976 and 1977. For example, the seasonal fluctuations of total phosphorus were similar in both years near the mouth and the headwaters (Figures 2 and 3). The same is true for filterable residue (Figures 4 and 5) as for most dissolved constituents of the water. The figures illustrate two differences in water quality trends between 1976 and 1977. One difference is that dissolved parameters were higher in 1977 (Figures 4 and 5) whereas parameters with a large component of suspended material were lower then (Figures 2 and 3). The other difference is that water quality changed more during freshet in 1976 than in 1977. Suspended material increased during freshet in both years but increased

Table 2. Mean levels of some chemical and physical parameters observed in Coldstream Creek during 1977. Except as specified, values are mg/L.

STATION		Sample size	Filt. Res.	Spec. Conduct. (umho/cm)	Nonfilt. Res.	Turbidity (JTU)	Silica	Colour (TAC)	pH	Total Alkalinity	Magnesium	Calcium Total	Sodium	Chloride
u/s Reservoir	(13)	10	289.	456.	2.6	0.6	14.6	8.0	8.4	196.	14.1	72.3	6.1	0.69
Parklane Rd	(12)	6	273.	441.	3.2	0.7	14.2	7.7	8.4	186.	12.3	69.1	4.7	0.73
u/s Dairy Farm	(11)	6	277.	424.	4.	0.9	14.2	5.6	8.4	183.	12.3	68.3	4.7	0.73
d/s Dairy Farm	(10)	10	364.	710.	167.	7.1	15.3	14.0	8.2	251.	20.2	79.2	9.0	26.05
School Rd	(9)	8	337.	566.	43.	14.9	15.0	10.0	8.2	228.	20.8	76.7	8.7	4.51
Vimy Rd	(8)	11	323.	525.	9.3	2.9	18.5	7.2	8.2	220.	19.9	68.1	11.7	4.8
u/s Ranch	(7)	10	322.	518.	13.7	7.9	18.0	11.2	8.4	219.	20.0	68.6	11.8	4.81
Deer Cr	(5)	11	316.	528.	21.	6.3	18.6	8.2	8.3	216.	18.3	7 .7	10.7	3.88
Howe Dr	(4)	11	318.	520.	19.	5.8	18.6	7.9	8.3	213.	18.2	69.7	10.7	3.8
McClounie Rd	(3)	20	347.	559.	19.	5.4	18.2	9.5	8.4	218.	20.9	73.9	14.1	4.25
Kirkland Dr	(1)	20	343.	534.	20.	4.9	17.7	9.1	8.4	215.	19.7	68.1	13.6	4.07

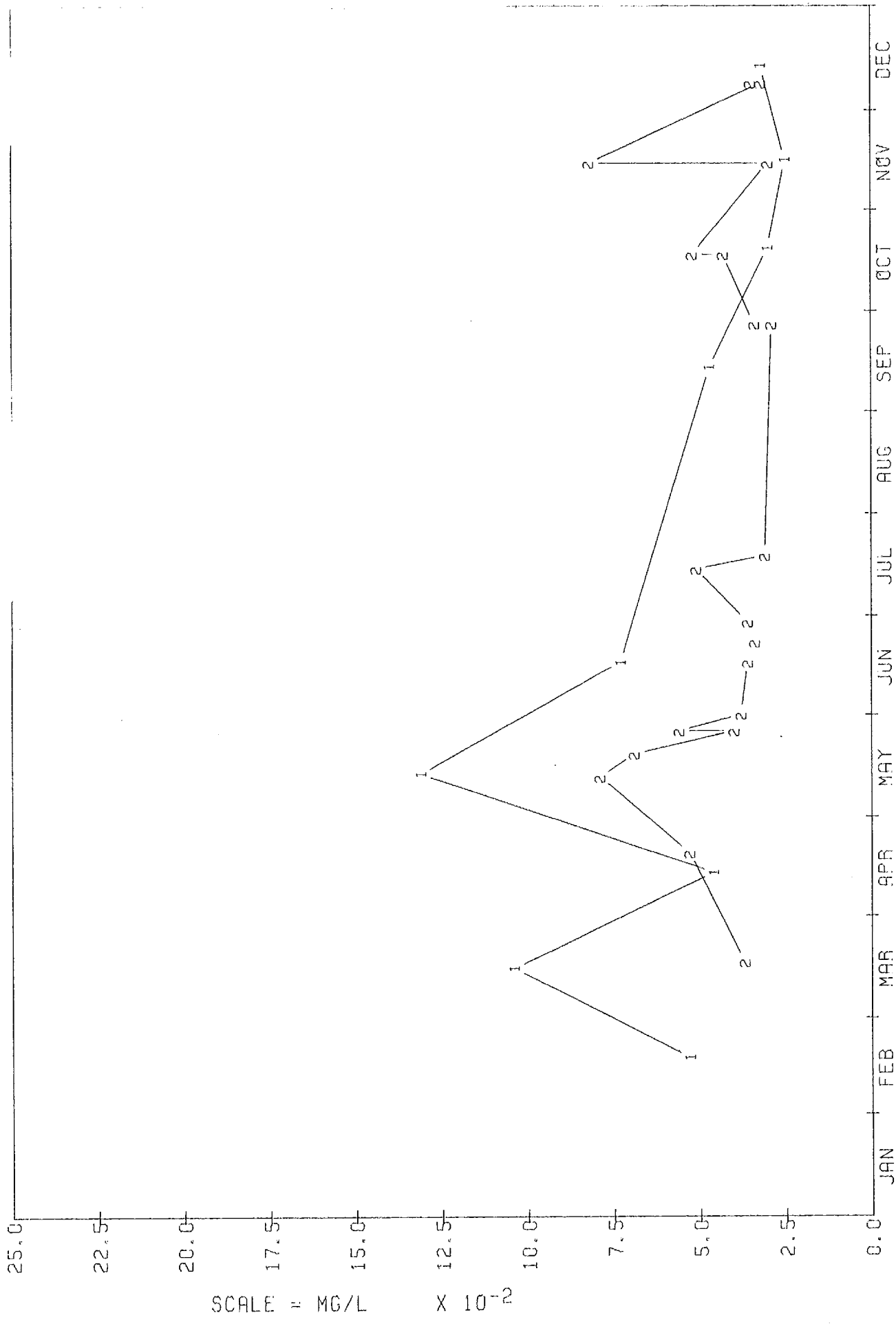

Figure 2. Total phosphorus concentrations in Coldstream Creek at McClounie Road in 1976 (1's) and 1977 (2's).

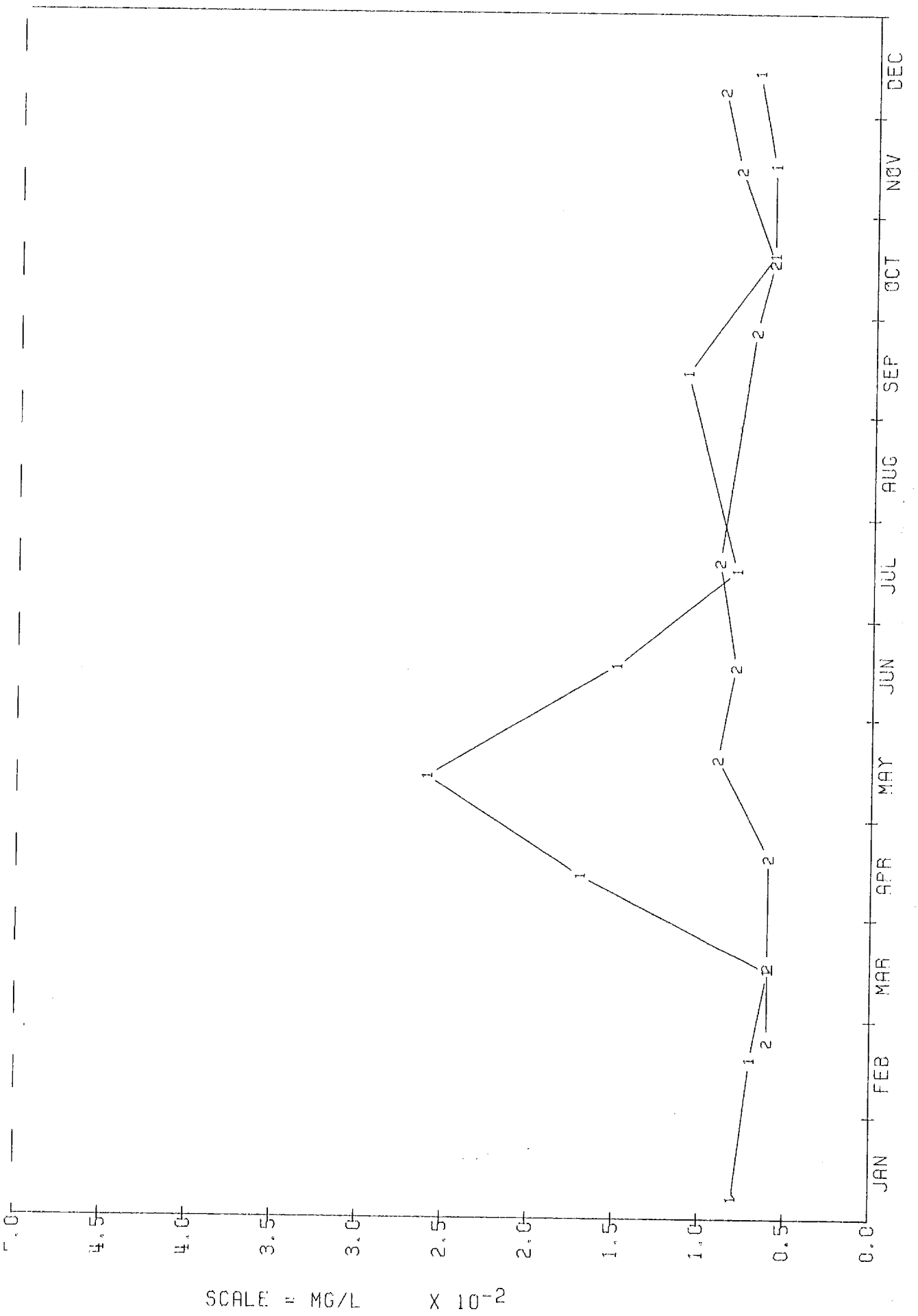

Figure 3. Total phosphorus concentrations in Coldstream Creek upstream of the reservoir in 1976 (1's) and 1977 (2's).

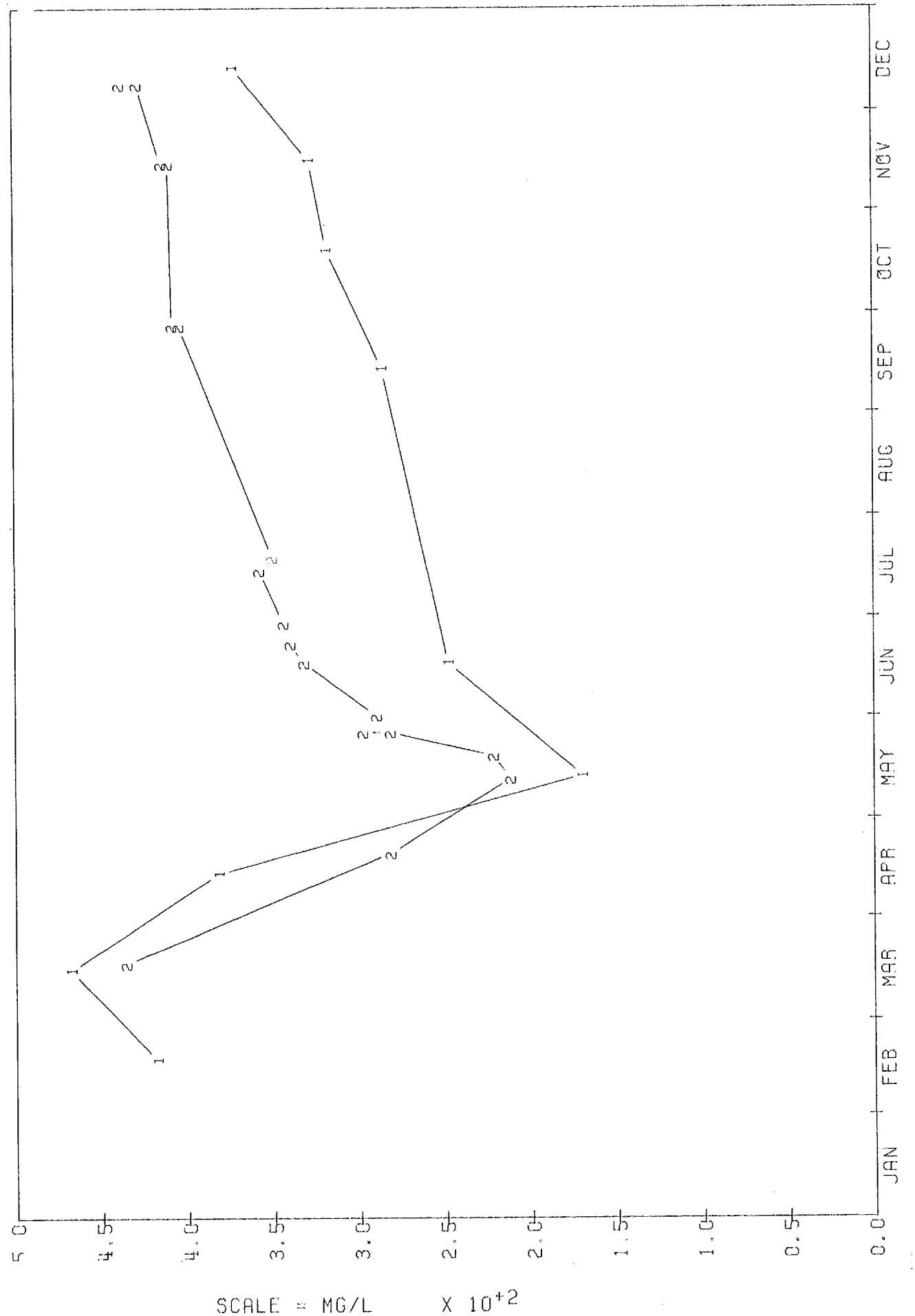

Figure 4. Filterable residue concentrations in Coldstream Creek at McClounie Road in 1976 (1's) and 1977 (2's).

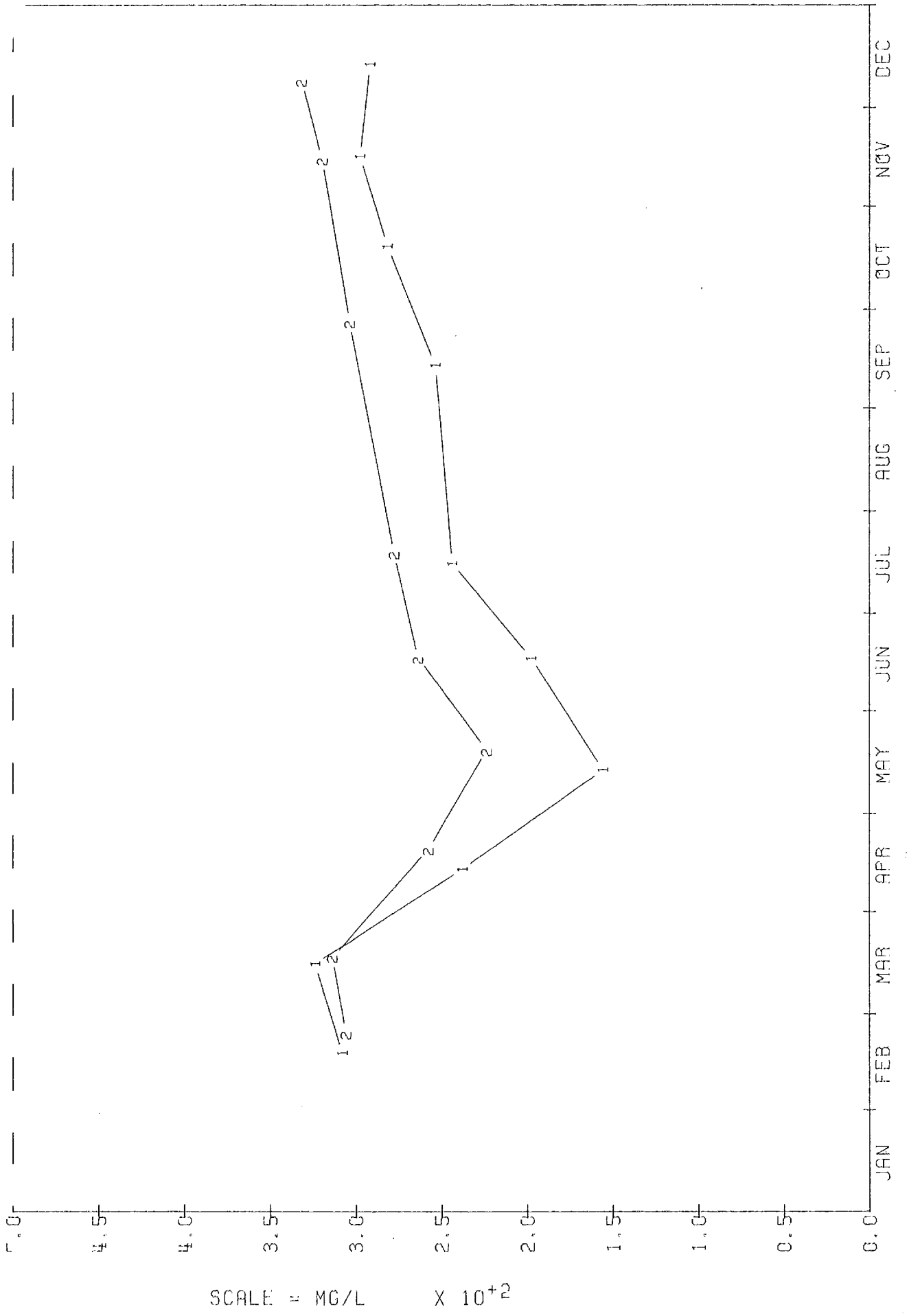

Figure 5. Filterable residue concentrations in Coldstream Creek upstream of the reservoir in 1976 (1's) and 1977 (2's).

less in 1977. Dissolved material decreased during freshet in both years but decreased less in 1977 than in 1976. These differences may have resulted because water quantity was greater in 1976 than in 1977. Additional parameters are plotted for the two stations during 1976 and 1977 in Figures A1 to A12.

Seasonal variation for several parameters at 6 sites is presented by figures in Appendix 2. Figures A13 to A27 show the same parameters plotted in the same order as in the 1976 report (Anon. MS 1977). All parameters show patterns of variation very similar to those of 1976. As in 1976, concentrations of most parameters increased toward the mouth of the creek. As in 1976, the change during freshet involved a decrease for most of the dissolved parameters but an increase for most of those with a large component of suspended material. Some parameters showed the same lack of trend in 1977 as in 1976. Some of these did show an interesting characteristic in both years: sporadic high values occurred at pre- and post-freshet for some of the parameters (total dissolved and ortho-phosphorus, ammonia, and total nitrogen). Such occasional high values during low flows probably result from large inputs of agricultural waste. Figure A27 shows that sulphate levels were usually higher near the mouth and near the headwaters than at intermediate sites. This was evident in the 1976 data too and indicates that water low in sulphate enters the creek upstream of the Vimy Road and Howe Drive stations.

Figures 6 and 7 plot the total phosphorus and total nitrogen values obtained at Kirkland Drive from 1972 to 1977. The data suggest that there was no general increase or decrease in phosphorus or nitrogen over the last 6-year period. Figure 6 shows that the freshet increase in total phosphorus occurred in other years than just 1976 and 1977. Figure 7 indicates that Total Nitrogen generally decreased during freshet. Six-year trend plots for other parameters are presented by Figures A28 to A40 in Appendix 2. The figures indicate that the parameters had the same seasonal variation and about the same average value as in 1976 and 1977. It is interesting that silica concentrations reached minima in late winter and high values during freshet and post-freshet (Figure A39).

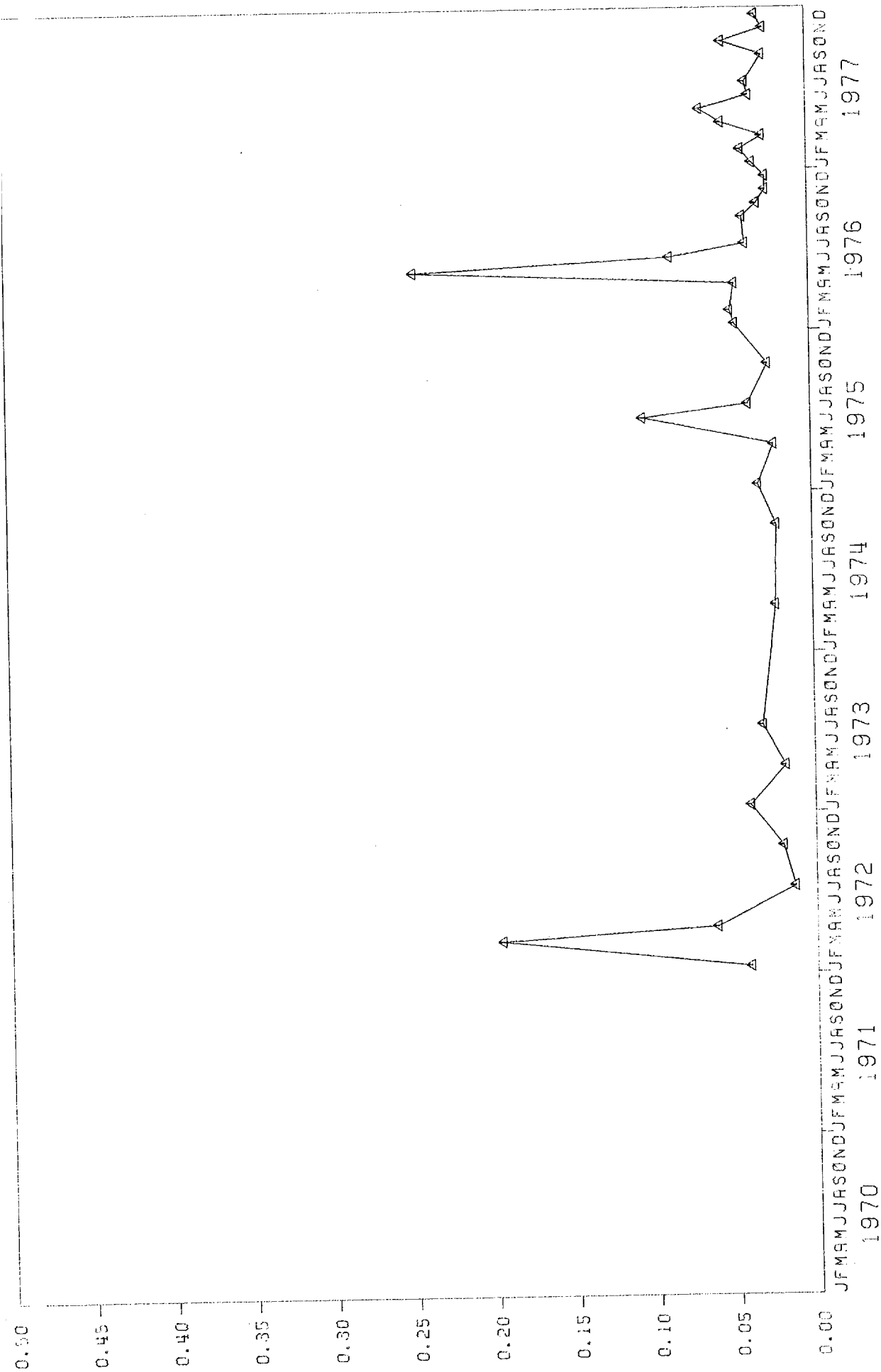

Figure 6. Mean monthly concentrations of total phosphorus in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

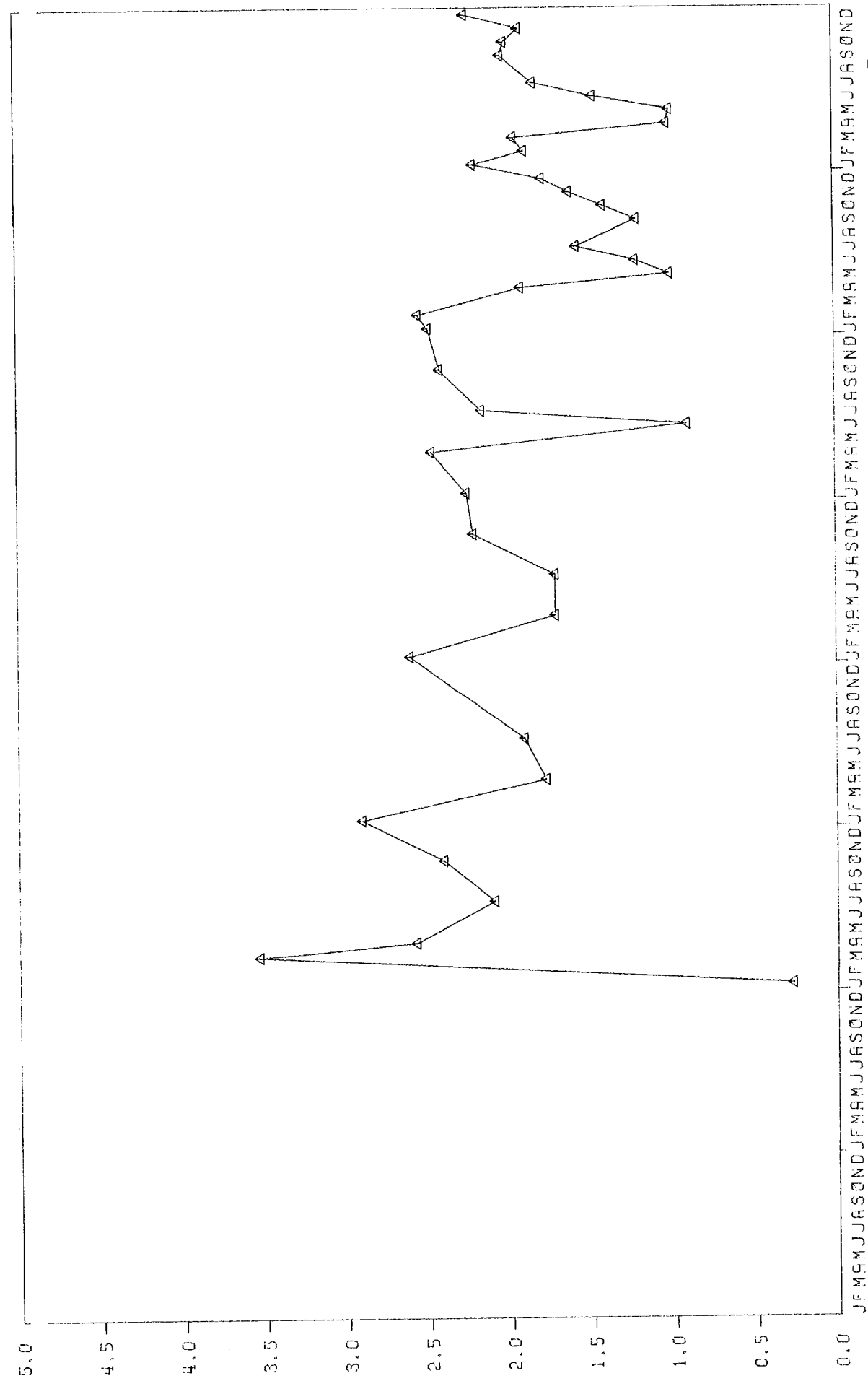

Figure 7. Mean monthly concentrations of total nitrogen in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

Table 3 shows the total amount of nitrogen and phosphorus near the mouth of Coldstream Creek, and therefore the total amount entering Kalamalka Lake from Coldstream Creek. The estimates were made by multiplying daily concentrations by daily discharges, then multiplying these loadings by the number of days when flow and concentrations were similar, and adding to obtain monthly totals. The nitrogen load in 1977 was higher than estimated for an average year by the Kalamalka-Wood Lake Basin Study (14,513 kg; Anon. 1974). The 1977 load of phosphorus, however, was very similar to that calculated for an average year by the Kalamalka-Wood Lake Basin Study (765 kg; Anon 1974). No explanation is readily apparent for the discrepancy in nitrogen values although it may be relevant that flows were lower than normal in 1977 (Tables 4 and 5).

Table 3. Load (kg) of total nitrogen and total phosphorus near the mouth of Coldstream Creek (Stations 1 or 3). Daily flows and nutrient data were used to estimate average loads for each month. The data for Station 1 was used in January and February and for Station 3 the rest of the year. Nitrogen and phosphorus concentrations in August were assumed to be the same as in July.

Month	Nitrogen	Phosphorus
January	1581.	24.5
February	1366.4	29.7
March	1463.2	26.7
April	1920.	98.7
May	3220.6	234.5
June	1406.	33.6
July	1754.6	27.8
August	1754.6	27.8
September	1587.	24.5
October	1940.	43.6
November	1611.	46.1
December	5766.	83.9
Total	25,370.	701.

Table 4. Mean daily discharge values (CFS) for Coldstream Creek near the mouth (above Kalvista diversion). All data were taken from Water Survey of Canada publications or preliminary records (1976 & 1977 data) subject to revision. The station was temporarily discontinued in 1976.

	1971	1972	1973	1974	1975	1976	1977
Jan	5.6	7.0	8.0	9.0	7.3	7.6	9.4
Feb	5.6	7.8	9.0	9.4	6.2	7.2	10.9
Mar	6.1	13.2	13.0	10.9	7.9	-	9.7
Apr	12.9	22.3	13.5	49.9	11.7	16.7	39.5
May	70.3	196.	38.5	129.	112.	91.6	57.1
Jun	37.9	60.9	10.9	51.7	49.1	-	16.0
Jul	17.0	33.5	6.6	16.2	15.5	-	10.8
Aug	9.1	23.9	6.1	10.4	11.0	-	8.3
Sep	9.2	20.0	6.5	8.9	10.3	-	10.0
Oct	8.6	12.3	8.1	616	12.0	-	12.4
Nov	10.1	9.7	9.1	9.8	10.3	-	10.3
Dec	8.5	8.9	8.6	9.1	8.3	-	-
Mean	16.8	34.9	11.5	26.8	21.9		
Max	108.	293.	64.	189.	161.		116.
Min	3.4	4.9	5.8	4.0	4.2		7.0

Table 5. Mean daily discharge values (CFS) for Coldstream Creek upstream of municipal intake. All data were taken from Water Survey of Canada publications or preliminary records (1977 data) subject to revision.

	1969	1970	1971	1972	1973	1974	1975	1976	1977
Jan	1.9	1.4	0.65	0.65	1.2	1.0	1.2		3.2
Feb	1.9	1.4	0.92	0.64	1.4	1.2	1.2	1.0	2.8
Mar	2.0	1.6	0.77	3.0	1.9	1.7	1.2	1.4	2.9
Apr	46.9	4.3	8.3	12.5	6.0	26.1	4.1	9.4	18.3
May	39.5	15.4	40.0	79.5	16.4	68.4	53.4	55.1	25.2
June	7.1	6.4	19.3	29.7	7.4	31.1	23.8	25.5	11.7
Jul	3.6	1.7	7.5	11.9	3.1	10.3	6.7	12.5	4.9
Aug	1.2	0.65	2.1	4.2	0.93	3.1	2.9	18.7	2.3
Sep	1.8	0.79	1.3	3.3	0.77	1.6	1.8	15.8	1.9
Oct	2.0	1.3	1.4	2.9	1.4	1.5	1.4	6.8	1.8
Nov	2.0	1.2	1.7	2.7	1.3	1.4	1.4	5.3	1.6
Dec	1.6	0.62	0.94	1.2	1.3	1.7	1.5	3.9	1.0
Mean	9.3	3.1	7.1	12.8	3.6	12.5	8.5	14.2	6.5
Max	84.3	19.2	70.3	111.0	21.5	98.0	93.5	84.2	49.8
Min	0.77	0.39	0.57	0.55	0.21	0.77	1.1	0.90	0.77

CHRONOLOGY OF THE COLDSTREAM CREEK POLLUTION STUDY COMMITTEE

July 4, 1975

- The findings of the Kalamalka-Wood Lake Basin Water Resources Management Study prompted a meeting of the Ministry of Agriculture officials and Pollution Control Branch staff.

- In order to assess agriculture's impact on the quality of water flowing Coldstream Creek, a committee was formed from the Ministry of Agriculture and Pollution Control Branch of the Ministry of the Environment.

- It was decided at this meeting that, in order to assess agricultural pollution, an inventory of all operations along the creek would need to be undertaken; and that the best time for this inventory would be when conditions were worst (ie. when snow was on the ground, when the ground was frozen, and when the concentration of animals along the creek was likely to be the greatest).

August 8, 1975

- A meeting was held in order to hear Melvin Maxnuk's findings about water quality along Coldstream Creek. From this presentation, the committee decided to tour portions of Coldstream Creek to view some problem areas along the creek.

- The committee decided to have a series of air photos taken to determine more about the nature of operations along the creek.

August 29, 1975

- The committee toured various parts of Coldstream Creek.

September 8, 1975

- A meeting was held to discuss the tour and hear the final report of M. Maxnuk (Maxnuk MS 1976).

- The committee then set some objectives to guide its actions:

1) to eliminate obvious problem areas along Coldstream Creek,

2) to do an inventory of all operations, especially farming, along Coldstream Creek,

and, 3) to continue monitoring the water of Coldstream Creek.

October 20, 1975

- The meeting was told that the Health Branch was conducting land use surveys along various creeks in the area. The committee agreed to hold off any inventory until it was determined that the information was not available from other sources.

January 30, 1976

- At this meeting it was learned that the Health Branch was not doing any appropriate surveys.

- It was decided that the committee's inventory should be carried out during winter.

- A decision was made to notify all landowners along Coldstream Creek and Coldstream Council before doing the inventory.

February 2 - 6, 1976

- Letters advising of the upcoming survey of Coldstream Creek were sent to all those homes on R.R. 1 and R.R. 2.

February 4, 1976

- A representative from the Department of Health was invited to participate in the inventory.

- A news release was made to further inform people of the upcoming inventory of Coldstream Creek.

February 9 - 12, 1976

- J. Tessaro, E. Jackson and E. Bruggen-Cate carried out an inventory of Coldstream Creek by walking along the creek.

February 16 - 19, 1976

- Various residents were interviewed to obtain further information.

February 24 - 26, 1976

- The tributary area north of Kalamalka Road from Coldstream Ranch to McClounie Drive was studied.

March 4, 1976

- The findings of the inventory were presented to the committee. A repeat inspection of several areas (after the snow was gone) was suggested.

- The committee decided to postpone any action to attempt to remedy any waste management practices until a report on the findings of these surveys had been prepared.

March 30, 1976

- J. Tessaro, K. May, and E. Jackson took a low level flight over the creek channel in order to better appreciate the tributaries and their effect on the creek.

May 6, 1976

- Air photos of Coldstream Creek (made in March 1976) were viewed and related to the flight of the committe members and inventory of operations along Coldstream Creek.

- The committee decided that another survey should be done in early June or July.

- A letter was received from E. Barber urging the committee to take immediate action on "small" or "hobby" farmers. The committee decided to stay with its earlier decision of waiting until the reports were completed before taking any direct action.

June 3, 1976

- A follow-up inspection of various areas of Coldstream Creek was made by J. Tessaro and E. Jackson.

June 24, 1976

- The committee discussed the findings of the most recent survey and decided that due to the high water condition of the creek on June 3, 1976 it would be necessary to do further inspections of the creek.

- E. Barber discussed progress in his efforts with P. Collins dairy farm and Coldstream Ranch.

September 7, 1976

- The Agriculture representatives on the committee met to determine a strategy for approaching residents along Coldstream Creek, who appeared to have waste management problems.

- It was decided that letters should be sent to all those who had livestock along the creek. E. Barber was to draft the letter for the committee.

- The committee decided to release an interim report to the media by October 19, 1976.

- All requests for assistance from these farmers would be handled by Agriculture officials.

- It was recommended that a report including the next "low water" survey and results of the extension approach be included in a report to be issued early in 1977.

October 21, 1976

- The committee was told that creek flow recording had been curtailed but was to be started again.

- The letter, to be sent to problem operations along Coldstream Creek, was discussed and approved.

- The committee decided to send an explanatory letter and a sample letter to the Mayor of Coldstream. A press release would be made at the time the letters were sent.

October 22, 1976

- Further survey of Coldstream Creek carried out by J. Tessaro and E. Jackson.

October 27, 1976

- 38 letters were sent to farmers whose operations were believed to be contributing nutrients to Coldstream Creek. Information was provided to media upon request.

November 25, 1976

- The committee was presented with information from the October 22, 1976 survey.

- Response to the October 27, 1976 letter to farmers, which explained the problem and offerred assistance, was discussed. The committee decided that a follow-up questionnaire would be appropriate to determine the impact of the first letter.

- The committee decided to turn the P. Collins case over to the Agricultural Environmental Control Dairy Committee for processing.

- A sub-committee to write the report was appointed.

December 7, 1976

- The report sub-committee met to decide the format, nature and audience for the committee's report.

December 9, 1976

- Questionnaires were mailed to those farmers who had received the previous letter.

January 20, 1977

- The committee discussed the action of the Agricultural Environmental Control group which had inspected the P. Collins dairy farm.

- Responses to the questionnaire were discussed.

- The committee decided that the next action would be to invite Coldstream Council to discuss the situation and to possibly hold a public meeting.

- The committee decided to have two reports prepared. The first report to cover the surveys and water quality data along with some recommendations for improvement of a general nature. The second report to include improvements and changes made in operations along the creek, as well as a listing of the committee actions.

February 4, 1977

- R. Miller requested "immediate contact on a face to face basis" be made with Coldstream Mayor and Council to resolve any misunderstandings.

February 21, 1977

- After a meeting had been set up with Coldstream Council, a meeting to decide the topics to be discussed was held. Committee spokesmen on each topic were assigned.

March 24, 1977

- The committee met with members of Coldstream Council and other interested parties. Discussion centered on the inventory taken and its significance. A defensive position was taken by Council but the basic objectives of the committee were accepted by them.

April 13, 1977

- The committee decided to send the minutes of the March 24, 1977 meeting to Coldstream Council.

- There was agreement with the view of Coldstream Council that some of the original survey should be brought up-to-date and that several visits to farming operations along the creek should be made. A representative of Coldstream Council would be asked to participate. Visits would be made on the basis of individual appointments.

May 1977

- P.D.A. Johnson, J.E. Tessaro, J.E. Bryan, and the late Alderman Kosty re-visited most of the farms inspected during the first survey to document the changes which had been made and to urge all operators to make the other changes discussed in the first section of this report.

June 21, 1977

- A draft of the first report was discussed.

- A summary of the most recent visits was presented to the committee.

July 6, 1977

- A draft copy of the first report was sent to various Ministry of Agriculture and Pollution Control Branch (Ministry of the Environment) officials for their comments.

September 29, 1977

- Upon the recommendation of the Ministry of Agriculture, the committee agreed to prepare a Summary Report for distribution to farmers and the media. This type of report would be less likely to antagonize those who still had problems.

- Changes occurring at the Collins farm were discussed.

November 10, 1977

- It was reported to the committee that the summary report had been approved by both the Ministry of Agriculture and the Ministry of the Environment (Pollution Control Branch).

- The committee decided to send summary reports to those residents who were surveyed, as well as the media and the Coldstream Council.

- Copies of the longer complete report would go to Dr. Smart (Health) and to Coldstream Council.

- The committee discussed the preparation of the final report and suggested a completion date of February, 1978 for it. A committee was appointed to look after this report preparation.

November 24, 1977

- The Summary Report, "Water Quality of Coldstream Creek and Nearby Agriculture 1976" were distributed.

November 30, 1977

- The final report committee met and decided the format of, and the material to be included in the final report of the committee.

CONCLUSIONS

The committee feels that the following three actions are required to bring about further reductions in amount of agricultural waste entering Coldstream Creek:

1) Ministry of Agriculture should continue to implement the measures described in the first section of this report. For the most part, this will only be done when farmers come to the Ministry office seeking advice about agricultural practice. When an agricultural waste problem becomes apparent, Ministry of Agriculture and Pollution Control Branch will investigate the situation and work together to resolve it. Whenever appropriate, this will be done by notifying the Agricultural Environmental Control Committee.

2) There are no provincial or municipal laws controlling the location of feedlots along most of Coldstream Creek. Consequently, the committee recommends that Coldstream Municipality institute zoning to control feedlot location relative to the creek outside the residential zone where such control presently exists. In addition, the committee recommends that the Okanagan Basin Implementation Program adopt Recommendation 23 for better control over livestock wastes throughout the Okanagan.

3) The committee recommends that Water Investigations Branch evaluate the feasibility of a settling lagoon to reduce the organic component of nutrients as well as suspended sediment reaching Kalamalka Lake. The committee recognizes the need for a well-designed settling pond which would not conflict with fishery resources nor create a nuisance when sediment is removed. The committee also recognizes the need for sediment control at the source (Anon. MS 1976) to prevent loss of land.

REFERENCES

Anon. 1974. Kalamalka-Wood Lake basin water resource management study. B.C. Water Investigations Branch (File 0273896-1). 208 p.

Anon. MS 1976. Coldstream Creek erosion control. Water Resources Service, Water Investigations Branch, Department of Environment, file P 74-103. 11 p.

Anon. MS 1977. Water quality of Coldstream Creek and nearby agriculture in 1976. Unpublished report by Ministry of Agriculture and Ministry of Environment of British Columbia. 52 p.

Maxnuk, M.D. MS 1976. Aspects of agriculture and water quality in the Coldstream Creek watershed during the summer of 1975. Unpublished report to Pollution Control Branch. 28 p.

Appendix 1. Location of Stations in Coldstream Creek

Station 1 Coldstream Creek @ Kirkland Drive (0500016)

Station 1 is located at Kirkland Drive bridge approximately 50 m upstream of the mouth of Coldstream Creek. This is one of two stations sampled in this study which are permanent sampling stations, having been sampled 4 times per year since 1971.

Station 2 Coldstream Creek @ lagoon outlet (0500519)

Station 2 is located at the Kalavista Road bridge approximately 50 m upstream of the lagoon outlet to Kalamalka Lake.

Station 3 Coldstream Creek at McClounie Road (0500518)

Station 3 is located at the culvert under McClounie Road at its intersection with Kalamalka Lake Road. The station is approximately 1.3 km (0.8 miles) upstream of the mouth.

Station 4 Coldstream Creek @ Howe Drive (0500517)

Station 4 is located approximately 4.2 km (2.6 mi.) upstream of the mouth at the bridge where Howe Drive intersects Coldstream Creek.

Station 5 Coldstream Creek downstream of Ranch (0500516)

Station 5 is located 2 km upstream of Station 4 and about 75 m downstream of a dam located in the main yard of a ranch. The station is located immediately upstream of the Deer Creek confluence with Coldstream Creek.

Station 6 Coldstream Creek @ Dam Spillway (0500558)

Station 6 is located in the main yard of a ranch immediately downstream of a small dam. This station has been sampled for coliforms only.

Station 7 Coldstream Creek upstream of Ranch (0500515)

Station 7 is located about 75 m upstream of a pond created by the ranch dam.

Station 8 Coldstream Creek @ Vimy Road (0500514)

Station 8 is located at the bridge where Highway 6 crosses Coldstream Creek, immediately west of the intersection of Highway 6 and Vimy Road. This point on Coldstream Creek is approximately 9.7 km (6 mi) upstream of the mouth.

Station 9 Coldstream Creek @ School Road (0500513)

Station 9 is located at the bridge where School Road in Lavington crosses Coldstream Creek.

Station 10 Coldstream Creek downstream of dairy (0500512)

Station 10 is located immediately downstream of the point of discharge from a dairy. The station is approximately 12.9 km (8 miles) upstream of the mouth.

Station 11 Coldstream Creek upstream of dairy (0500511)

Station 11 is located immediately upstream of the point of discharge from a dairy. The station is approximately 12.9 km (8 miles) upstream of the mouth.

Station 12 Coldstream Creek @ Hwy. 6 bridge, Lavington (0500015)

Station 12 is located on Hwy. 6 east of Lavington at its intersection with Coldstream Creek. The station is located approximately 13.7 km (8.5 miles) upstream of the mouth. This is one of two stations sampled in this study which are permanent sampling stations, having been sampled 4 times per year since 1971.

Station 13 Coldstream Creek upstream of Coldstream Reservoir (0500510)

This is the headwater location of Coldstream Creek, located approximately 1.2 km (0.75 mi) north of Highway 6 in Noble Canyon, about 20 m upstream of the Coldstream Municipality Reservoir.

Appendix 2. Plots of water quality in Coldstream Creek.

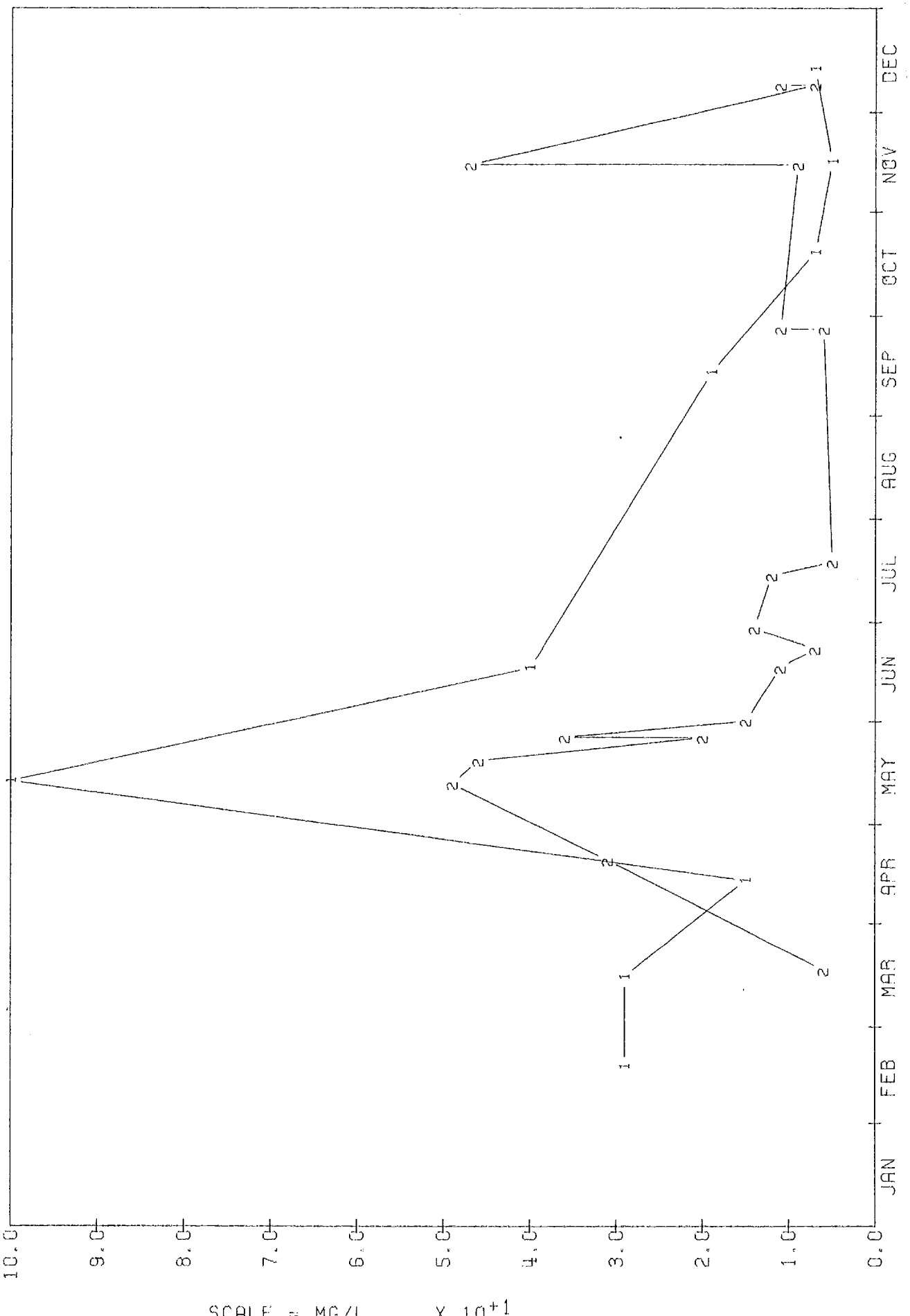

Figure A1. Nonfilterable residue concentrations in Coldstream Creek at McClounie Road in 1976 (1's) and 1977 (2's).

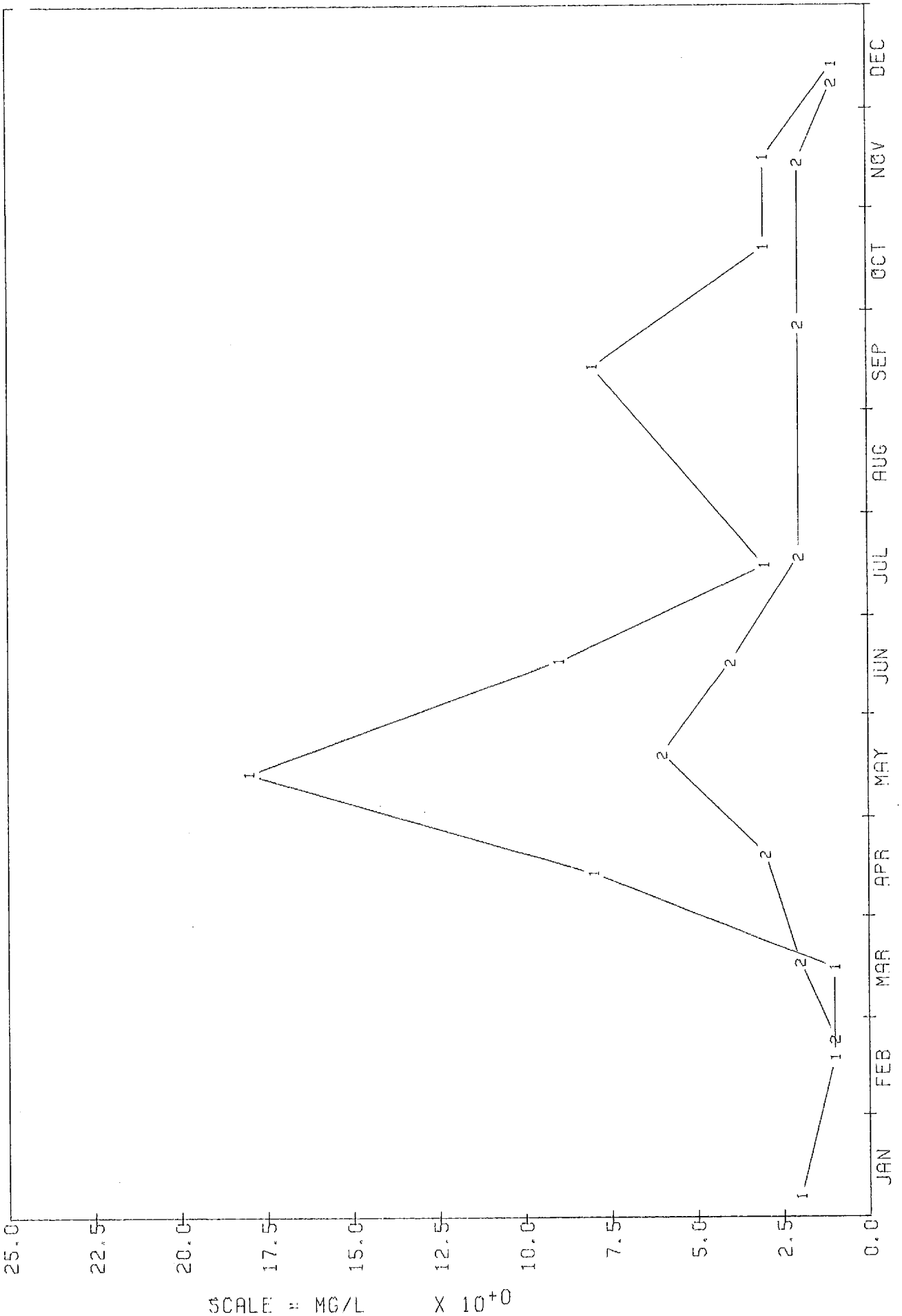

Figure A2. Nonfilterable residue concentrations in Coldstream Creek upstream of the reservoir in 1976 (1's) and 1977 (2's).

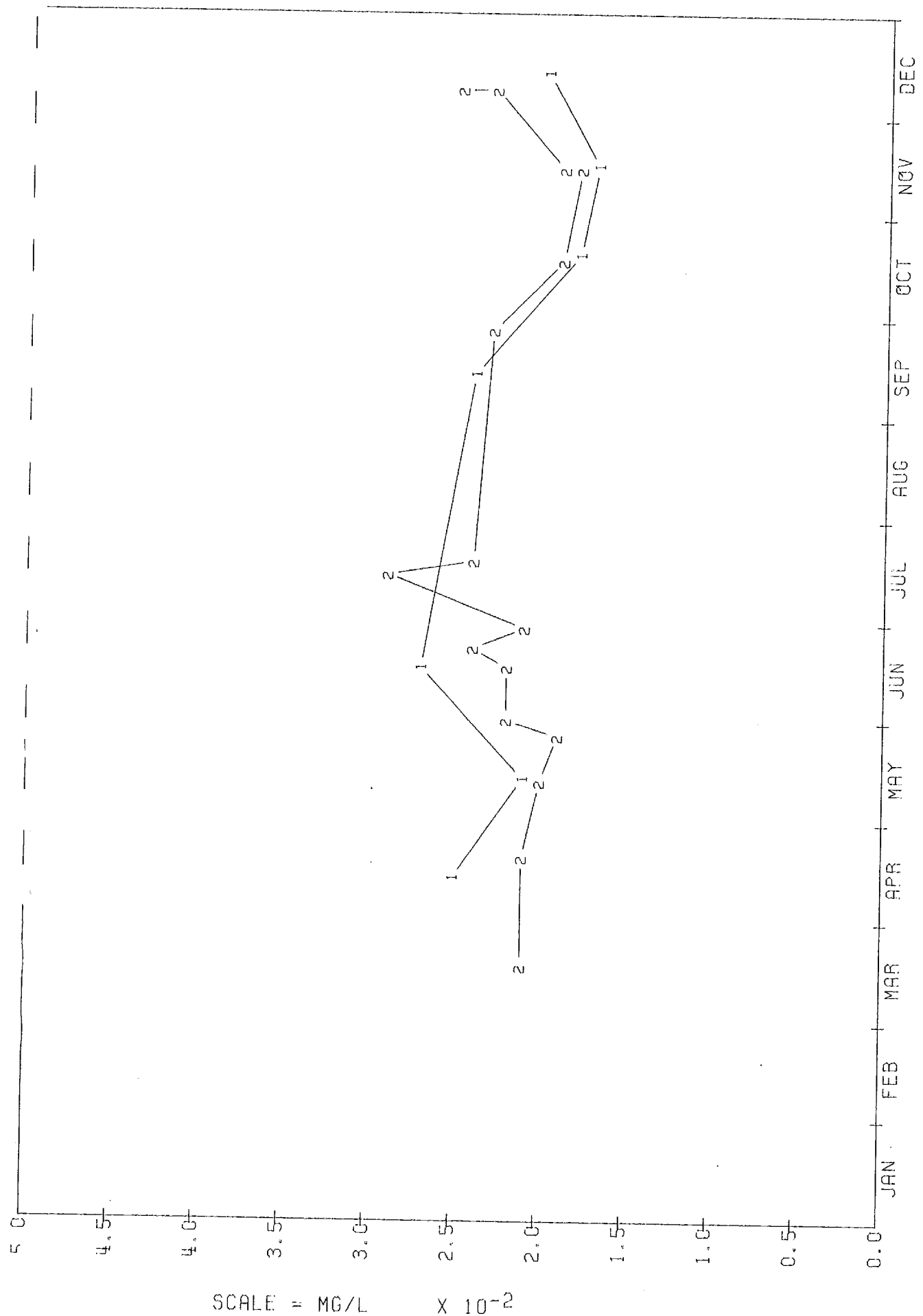

Figure A3. Total phosphorus concentrations in Coldstream Creek at McClounie Road in 1976 (1's) and 1977 (2's).

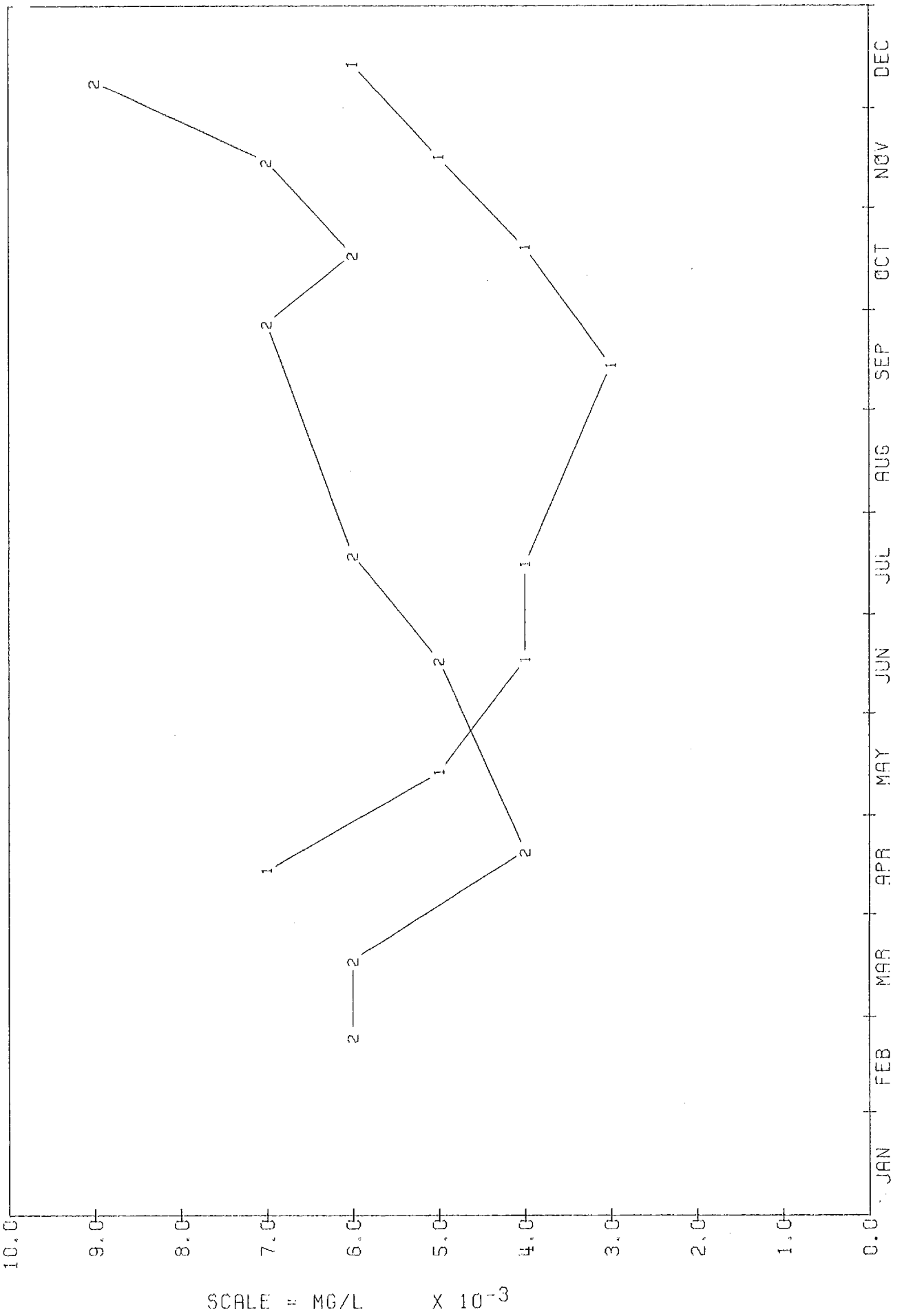

Figure A4. Total phosphorus concentrations in Coldstream Creek upstream of the reservoir in 1976 (1's) and 1977 (2's).

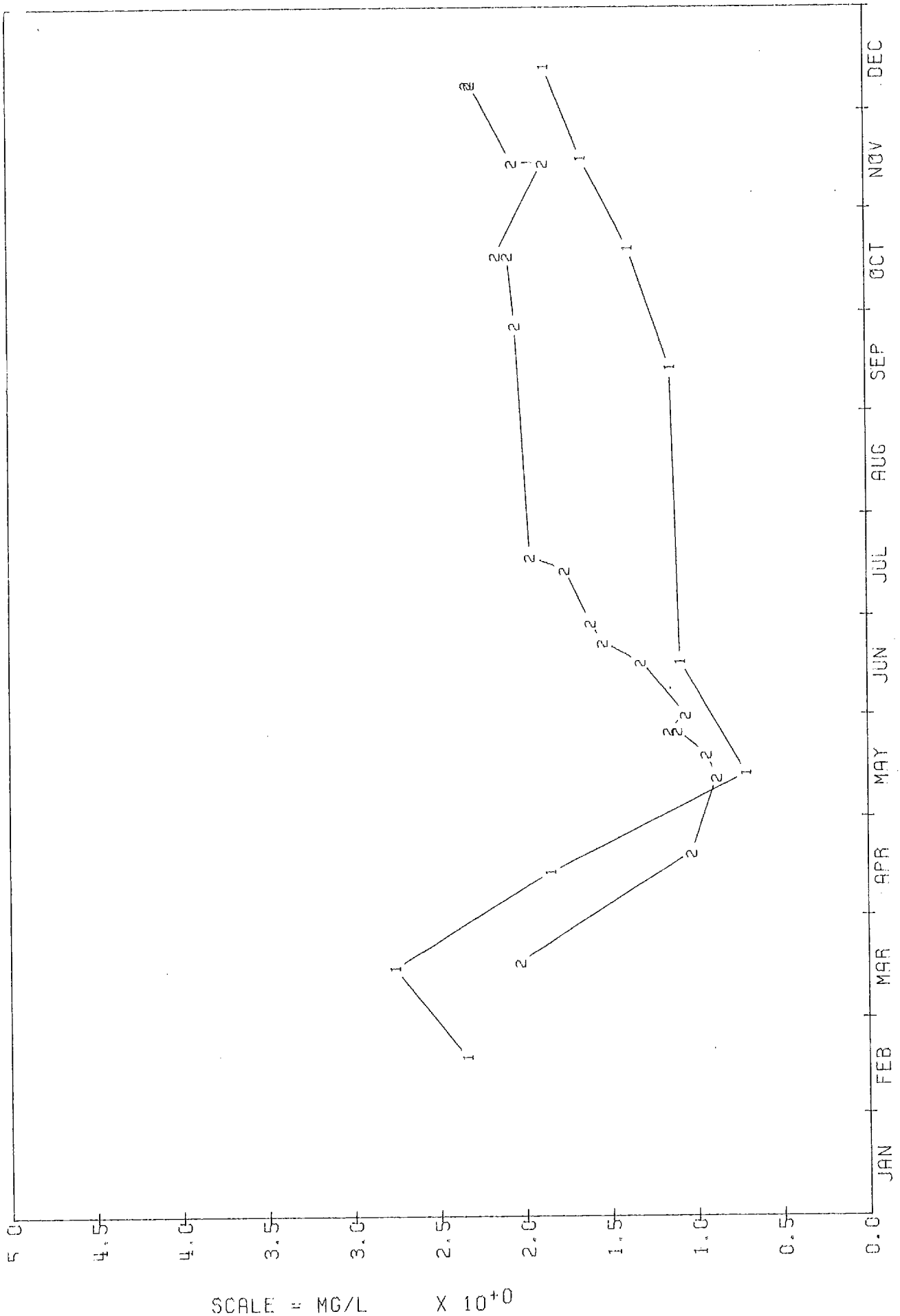

Figure A5. Total nitrogen concentrations in Coldstream Creek at McClounie Road in 1976 (1's) and 1977 (2's).

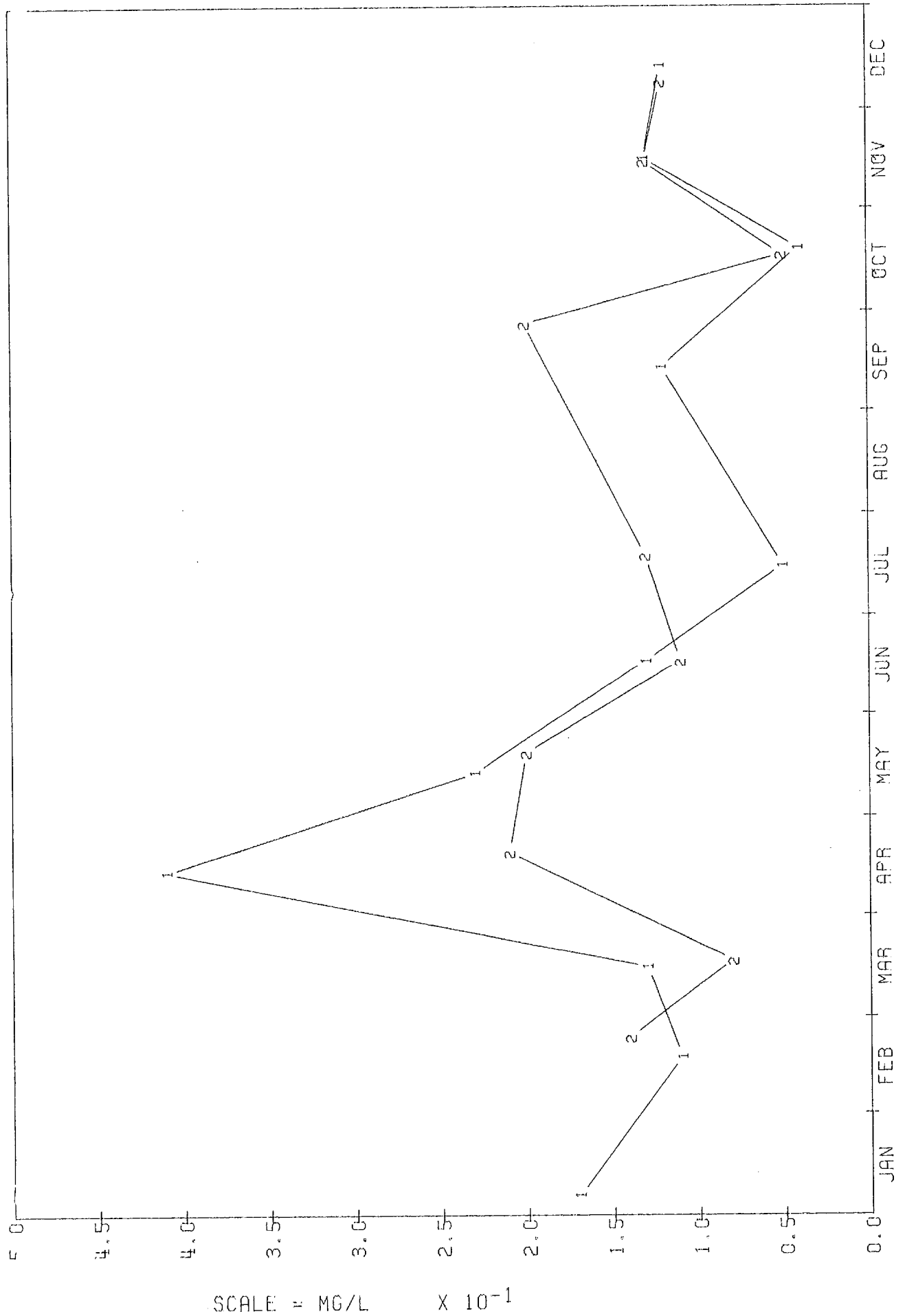

Figure A6. Total nitrogen concentrations in Coldstream Creek upstream of the reservoir in 1976 (1's) and 1977 (2's).

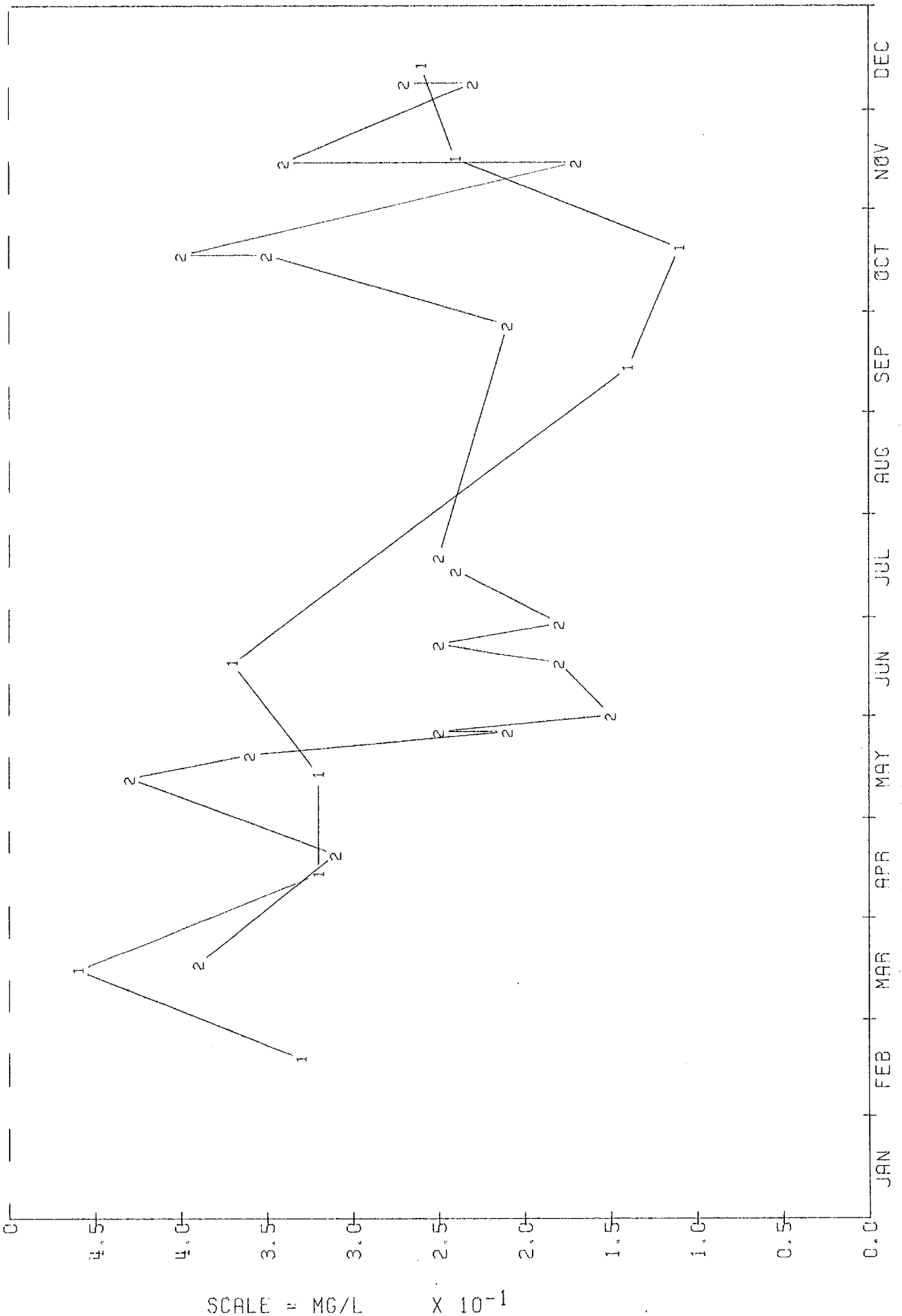

Figure A7. Organic nitrogen concentrations in Coldstream Creek at McClounie Road in 1976 (1's) and 1977 (2's).

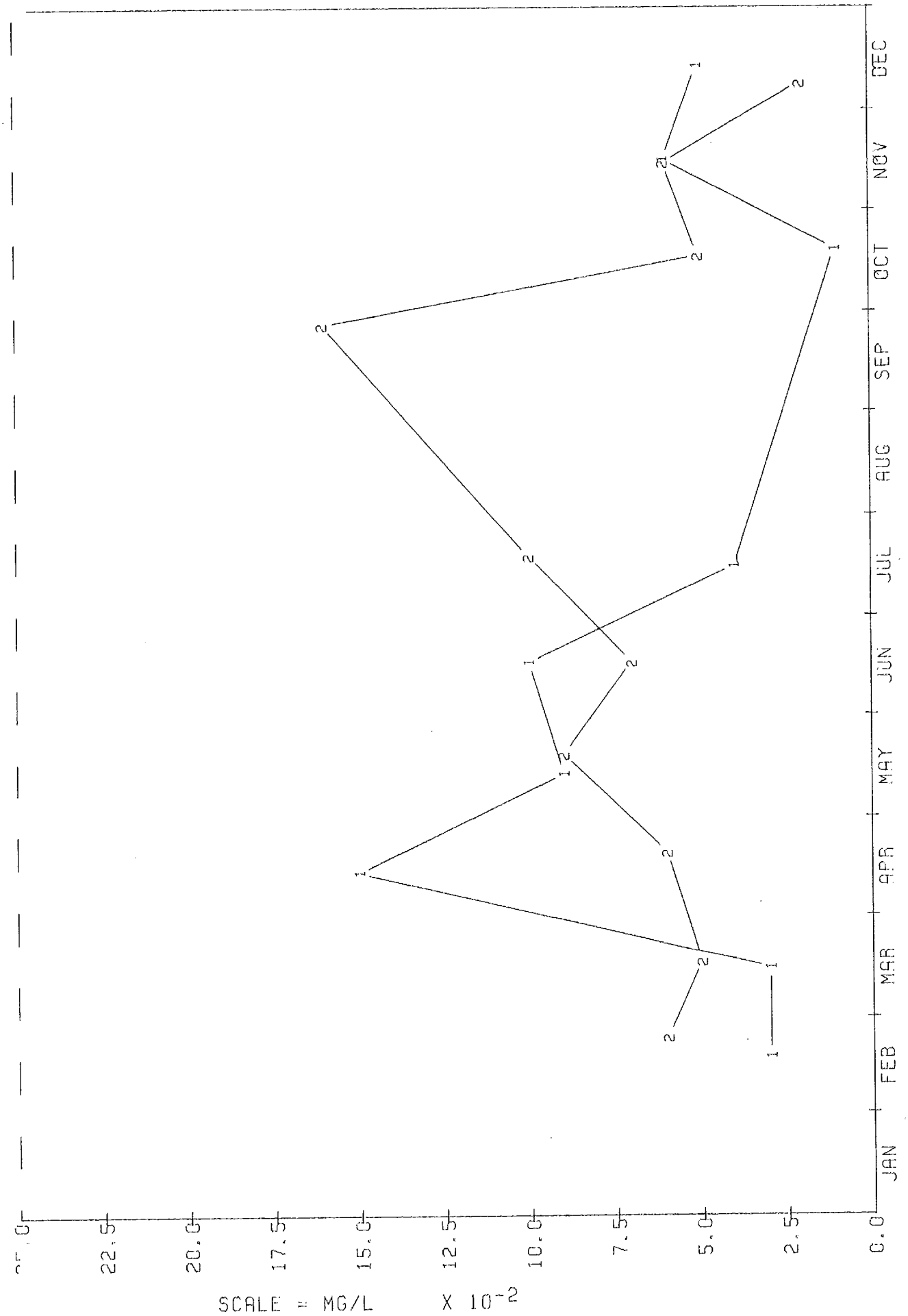

Figure A8. Organic nitrogen concentrations in Coldstream Creek upstream of the reservoir in 1976 (1's) and 1977 (2's).

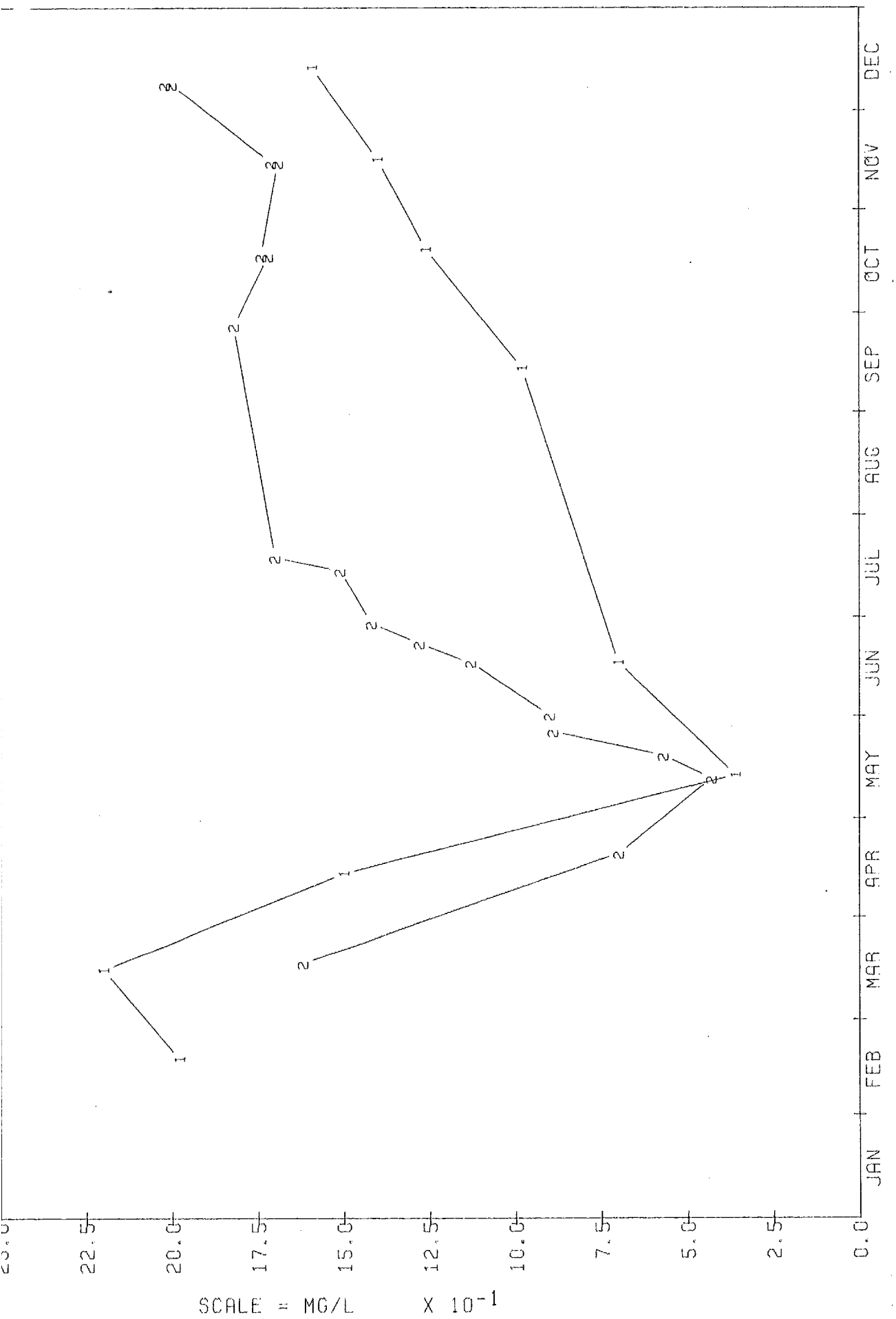

Figure A9. Nitrate & nitrite concentrations in Coldstream Creek at McClounie Road in 1976 (1's) and 1977 (2's).

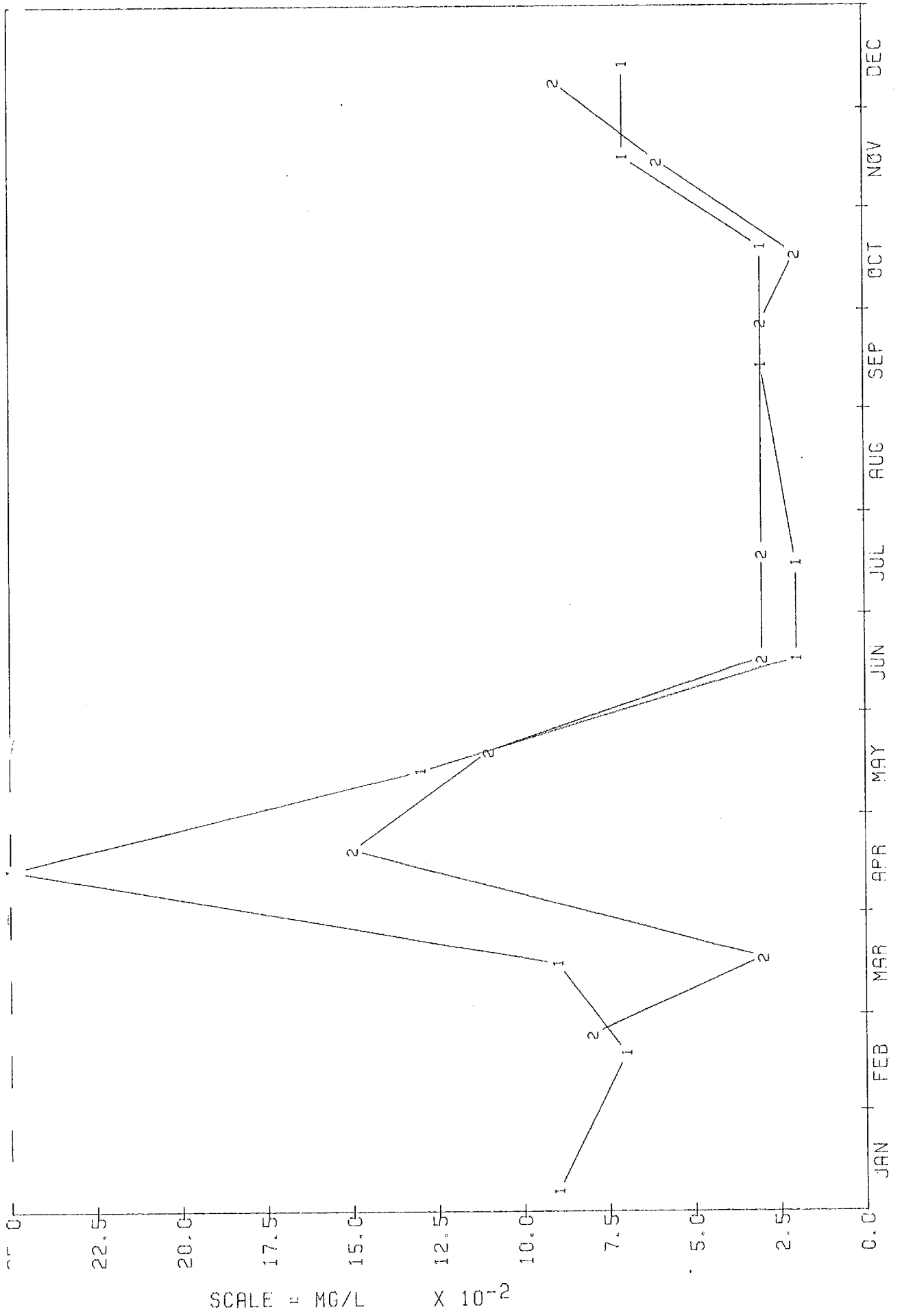

Figure A10. Nitrate & nitrite concentrations in Coldstream Creek upstream of the reservoir in 1976 (1's) and 1977 (2's).

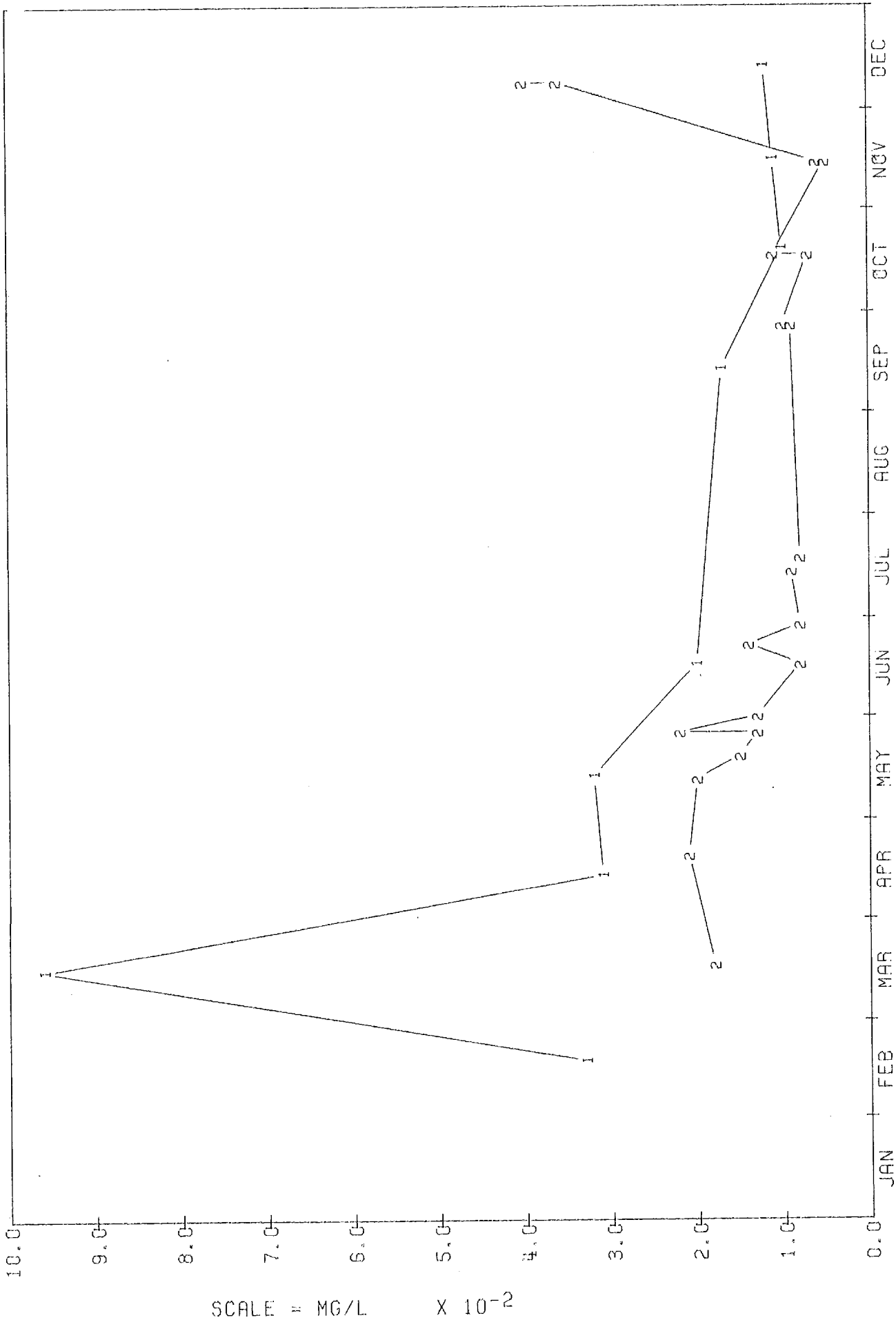

Figure A11. Ammonia nitrogen concentrations in Coldstream Creek at McClounie Road in 1976 (1's) and 1977 (2's).

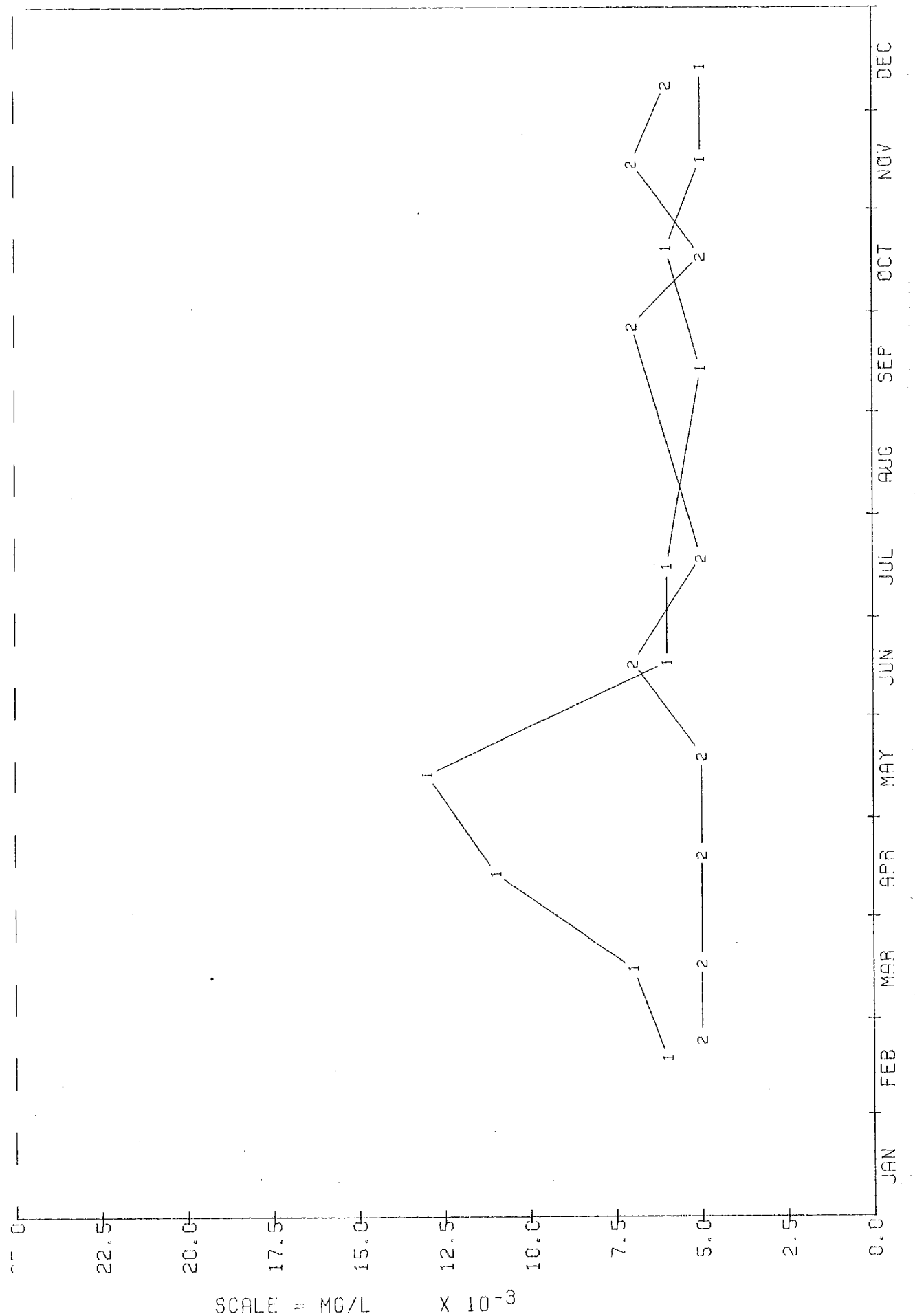

Figure A12. Ammonia nitrogen concentrations in Coldstream Creek upstream of the reservoir in 1976 (1's) and 1977 (2's).

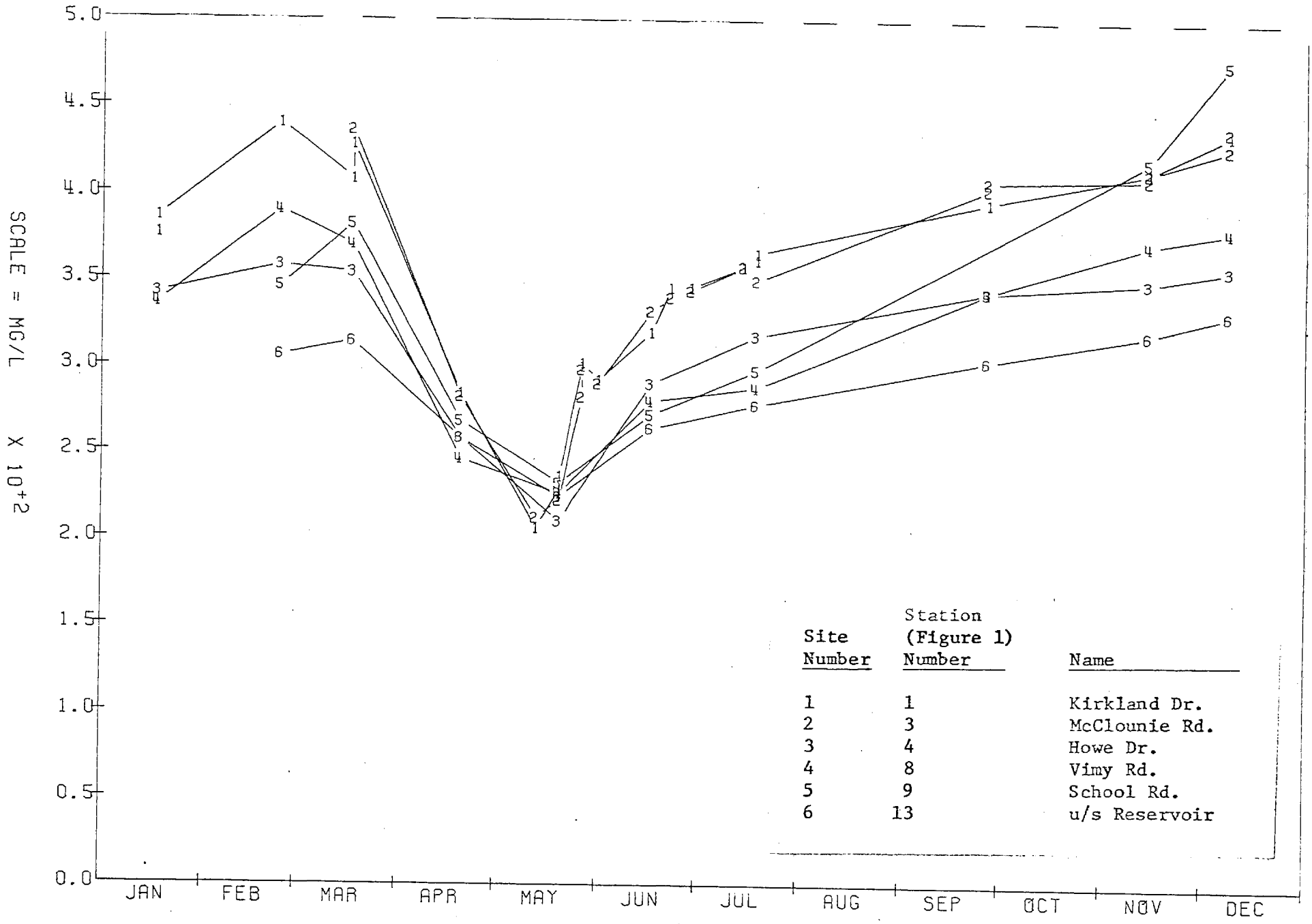

Figure A 13. Filterable residue levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

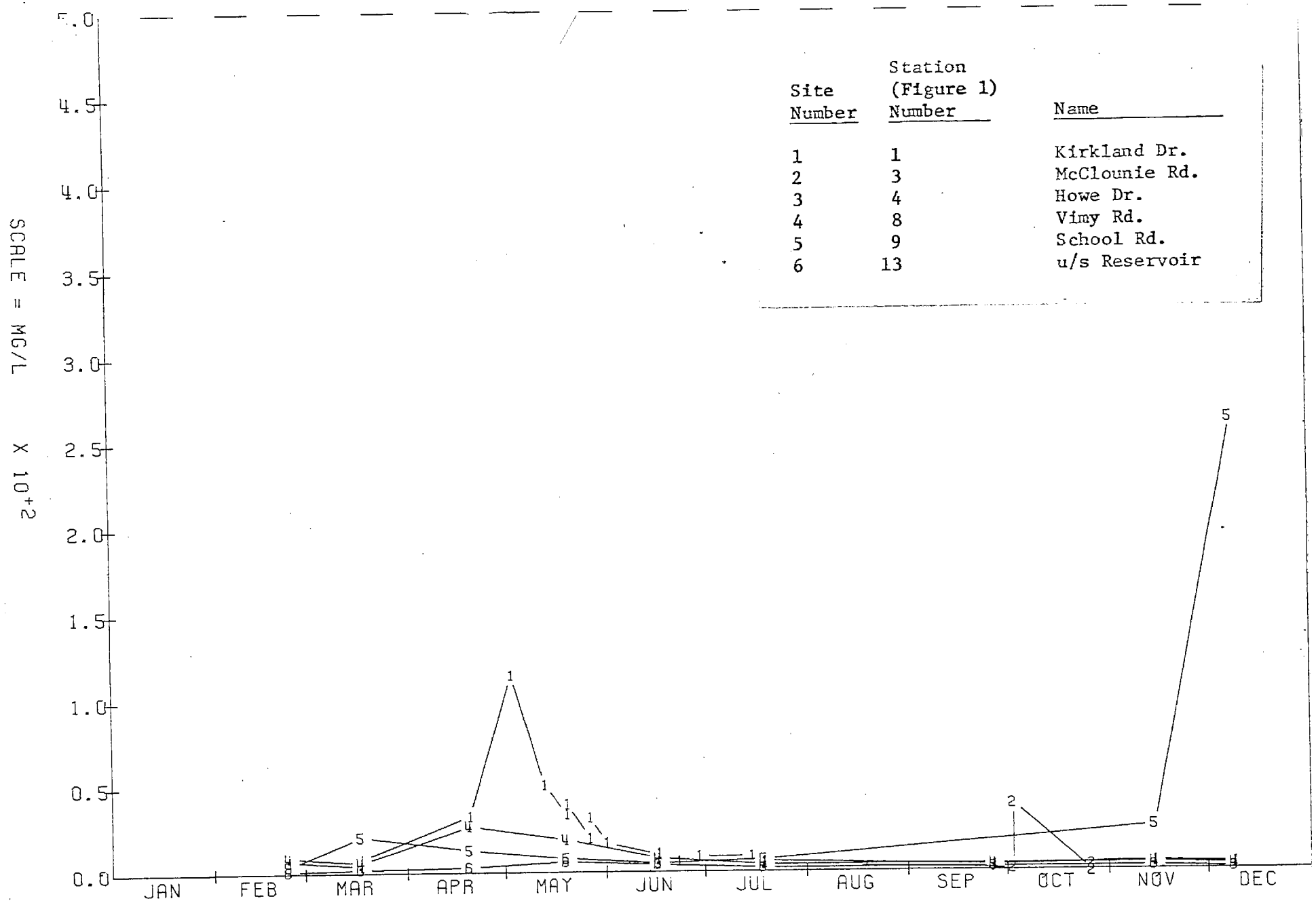

Figure A 14. Nonfilterable residue levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

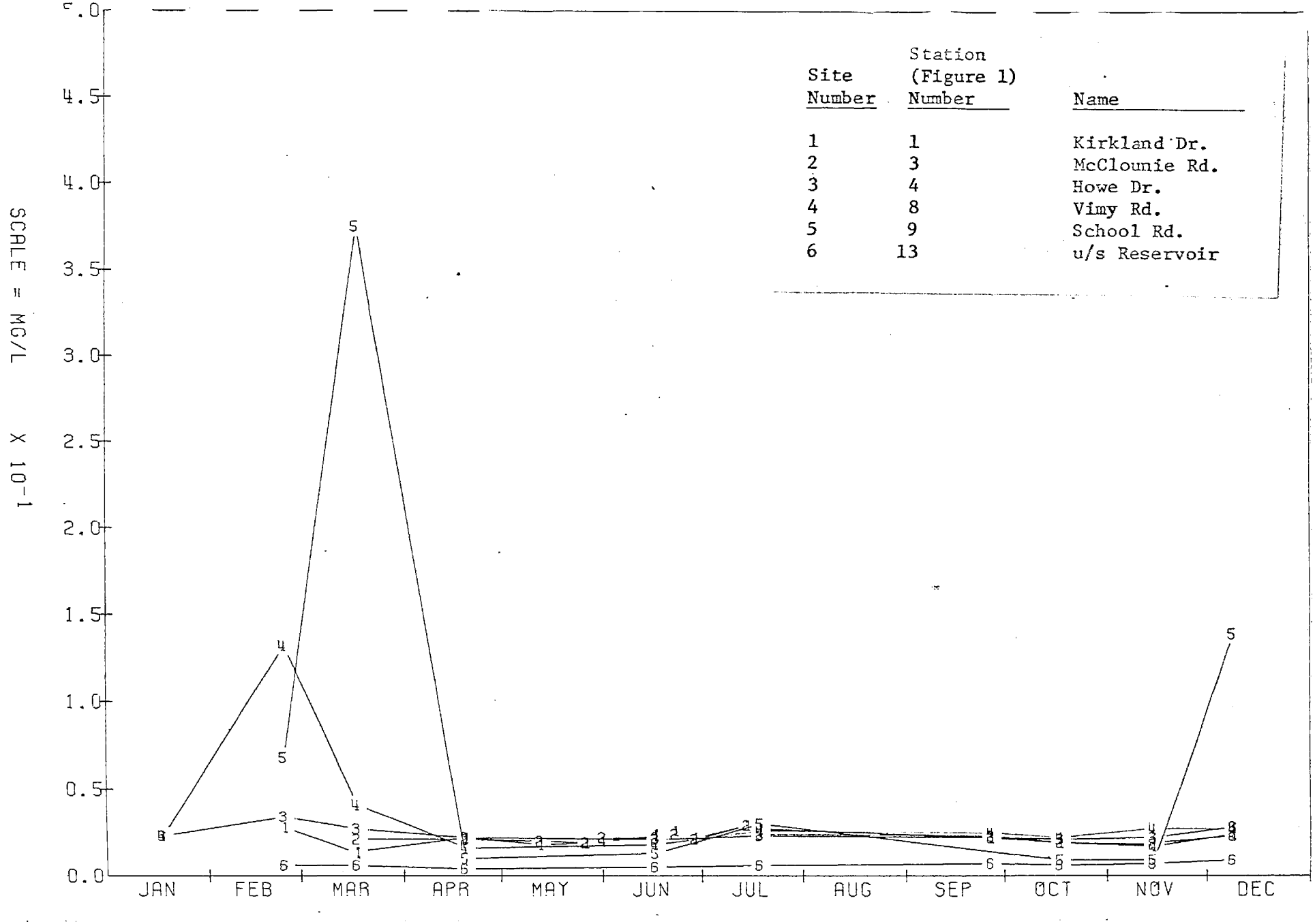

Figure A 15. Dissolved phosphorus levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

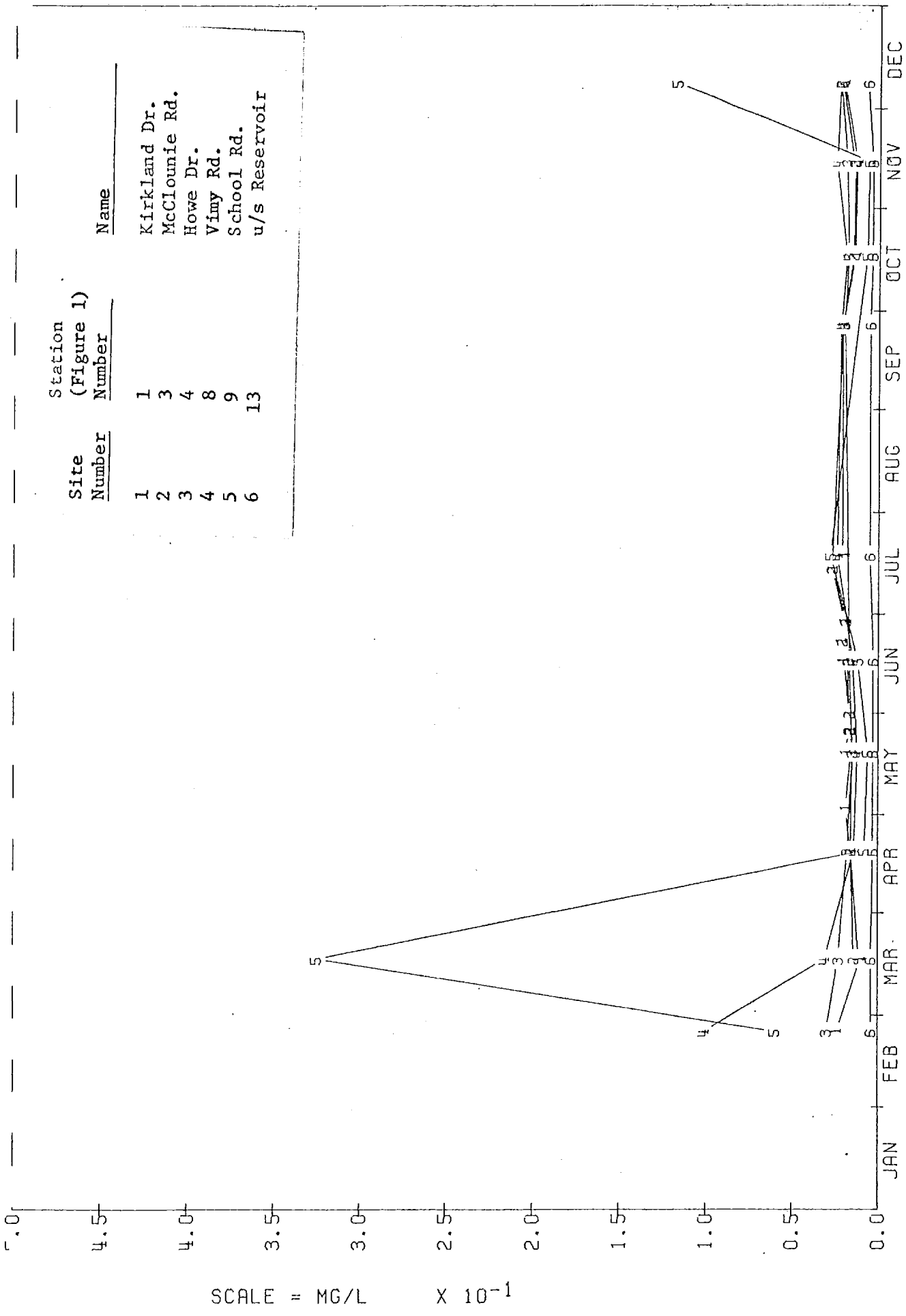

Figure A 16. Ortho-phosphorus levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

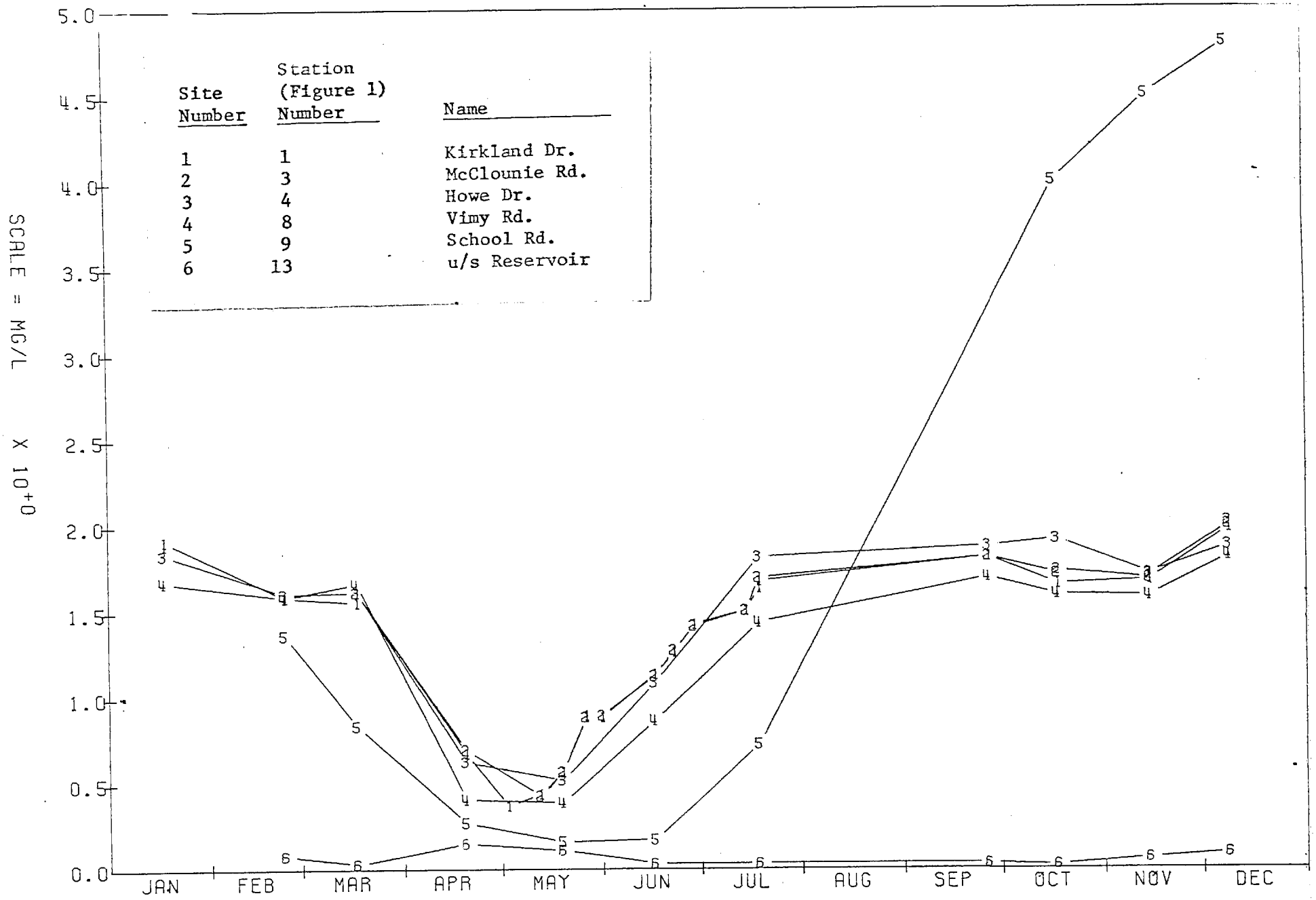

Figure A 17. Nitrate & nitrite levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

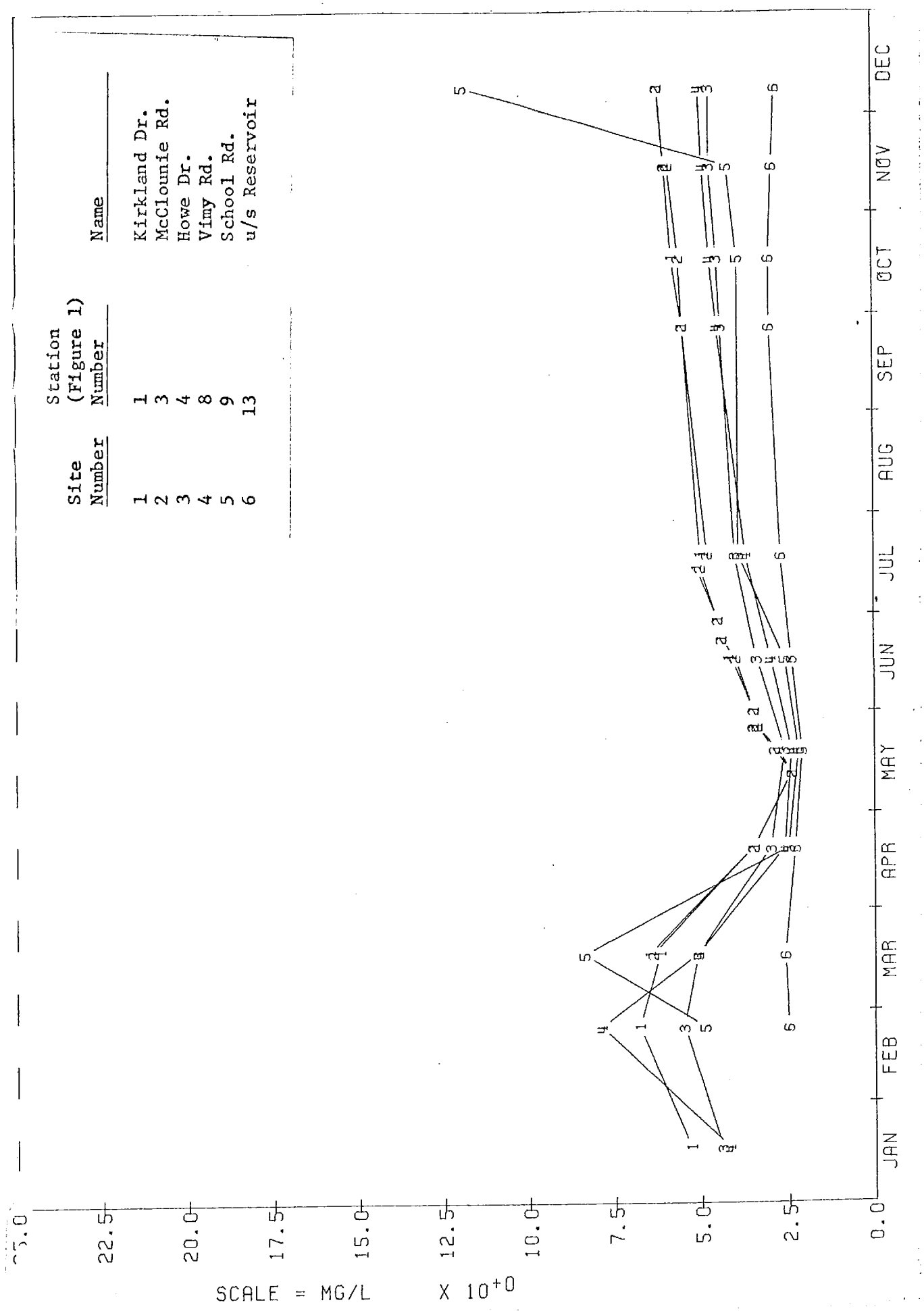

Figure A 18. Potassium levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

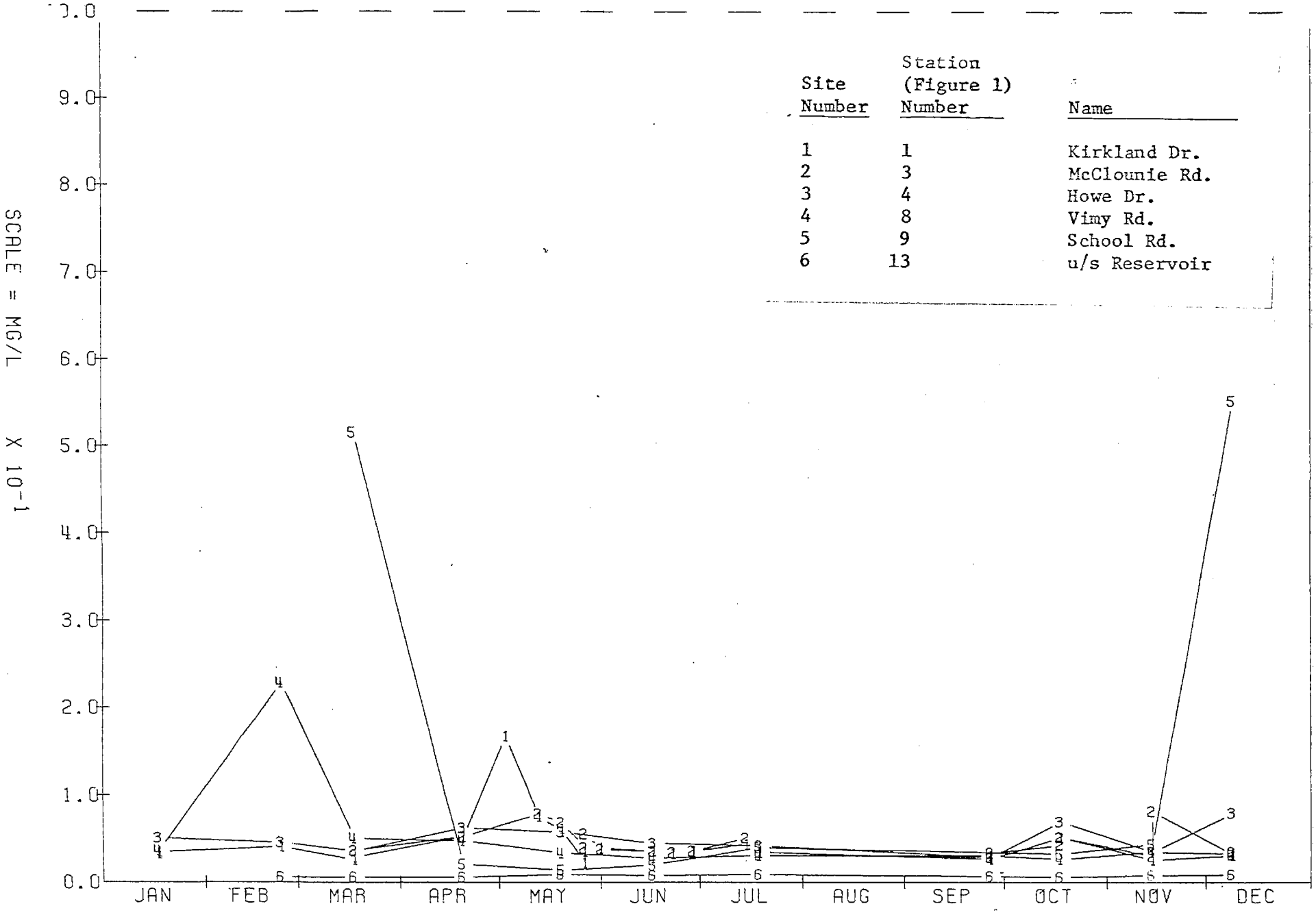

Figure A 19. Total phosphorus levels observed at different locations in Coldstream Creek during 1977. The Sites are arranged in sequence from the mouth (1) to upper reaches (6).

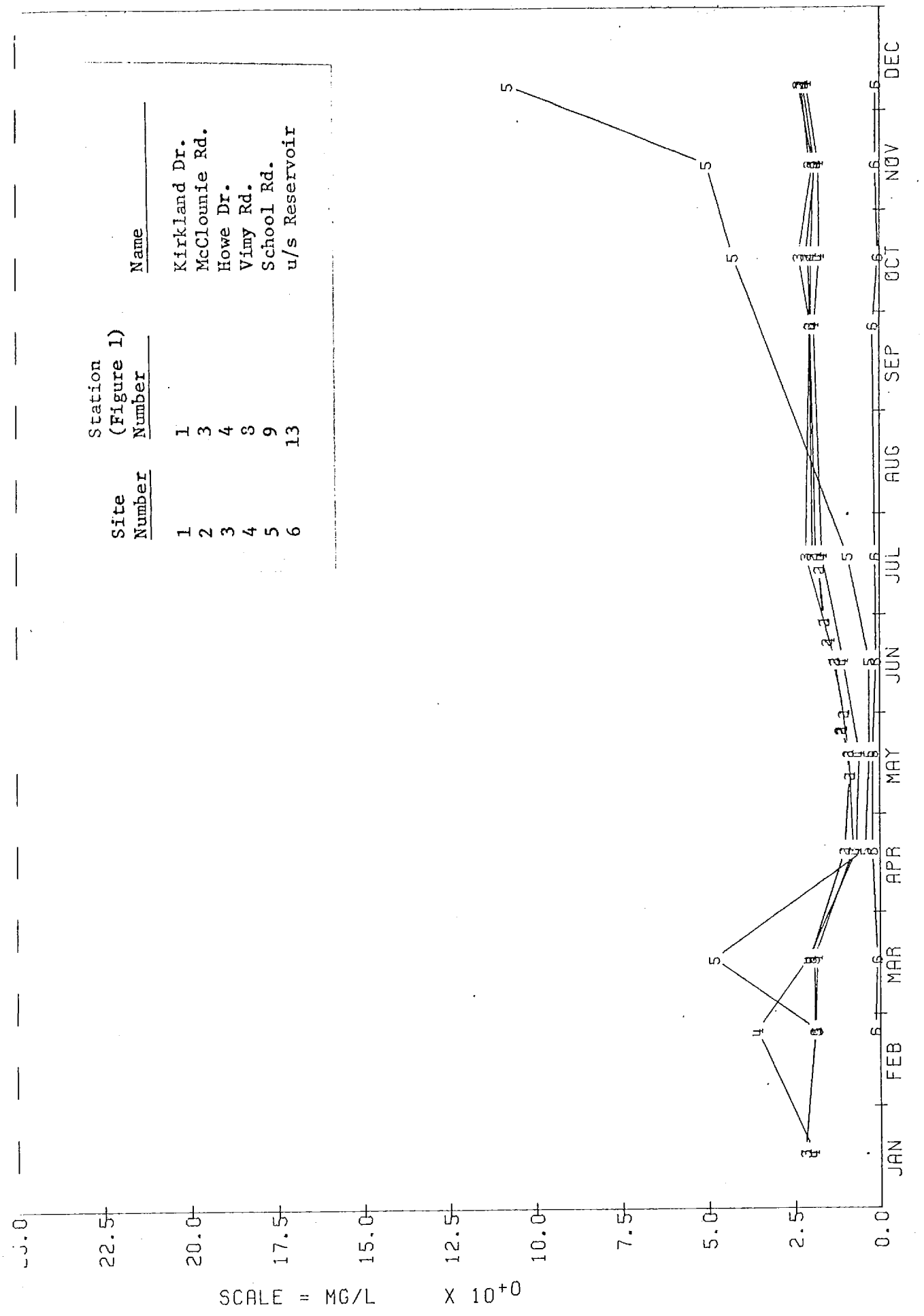

Figure A 20. Total nitrogen levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

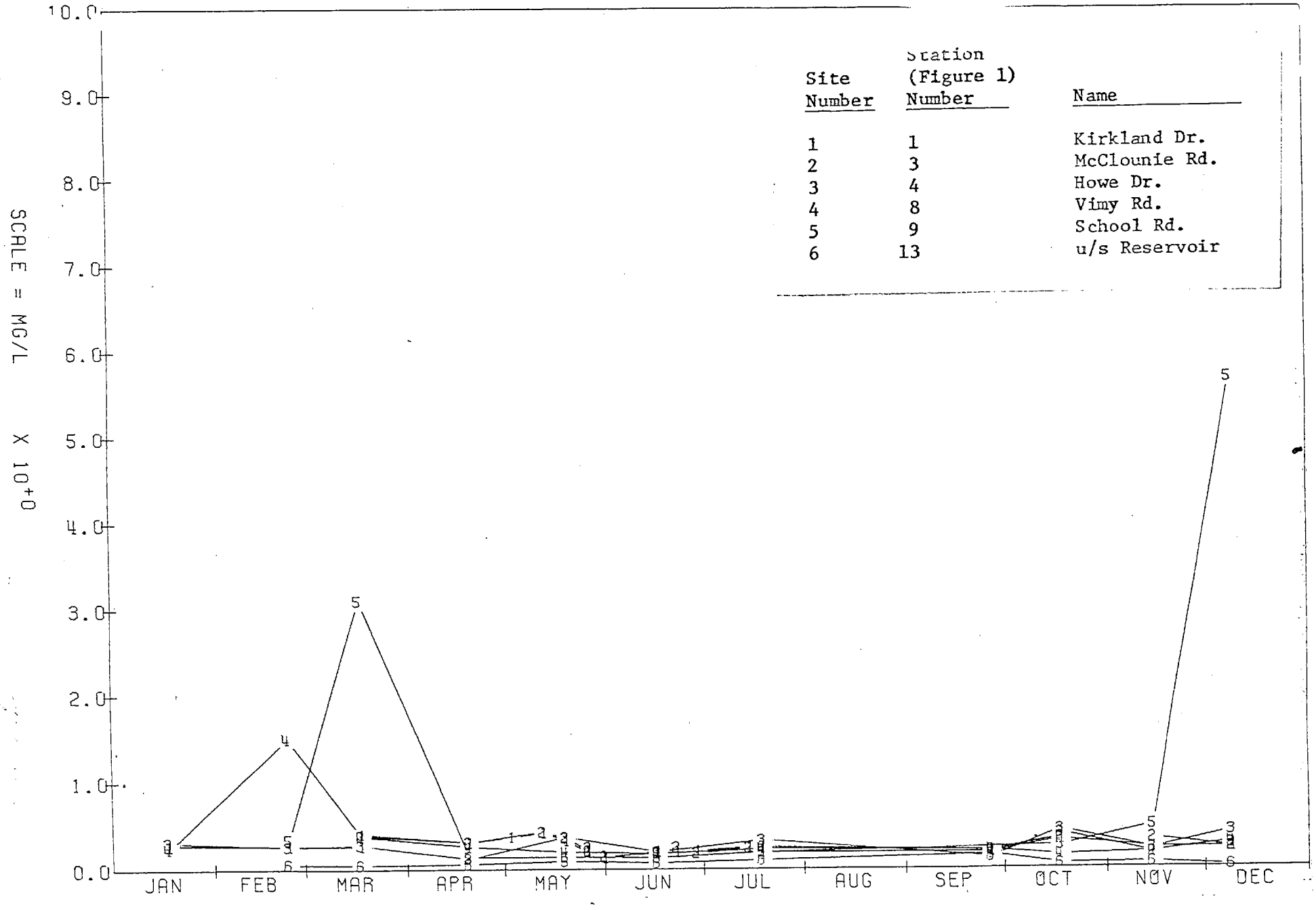

Figure A 21. Organic nitrogen levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

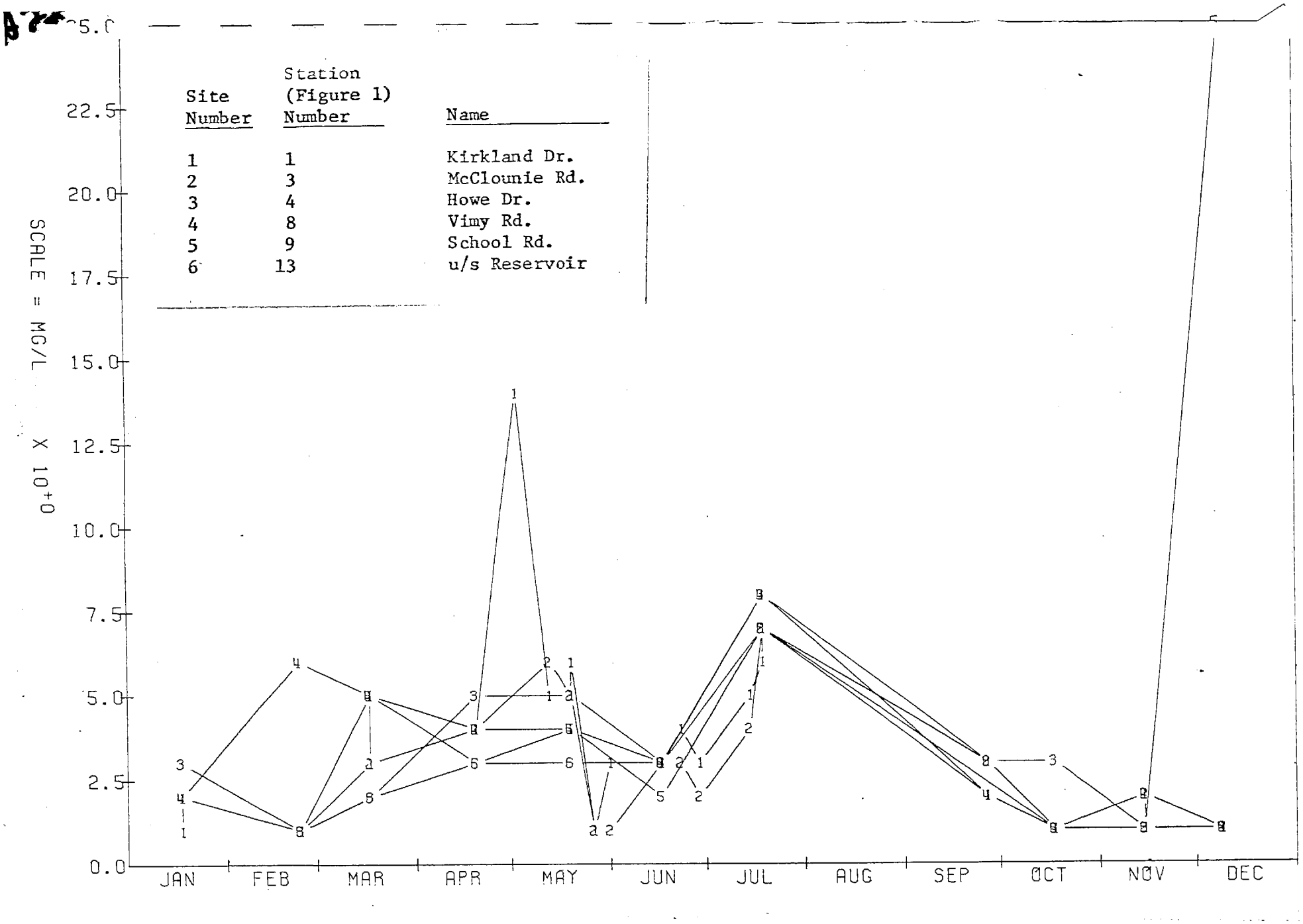

Figure A 22. Organic carbon levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

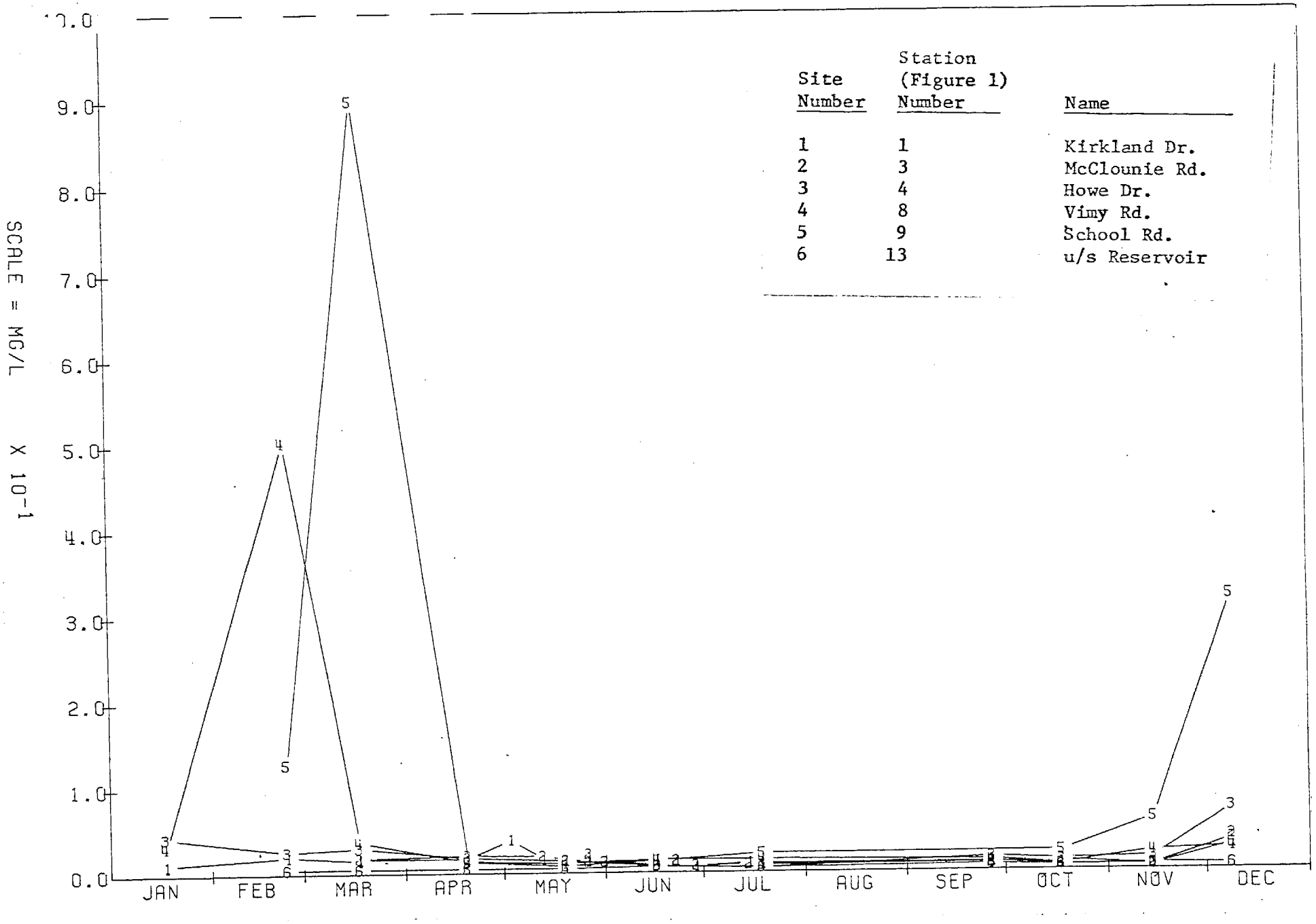

Figure A 23. Ammonia levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

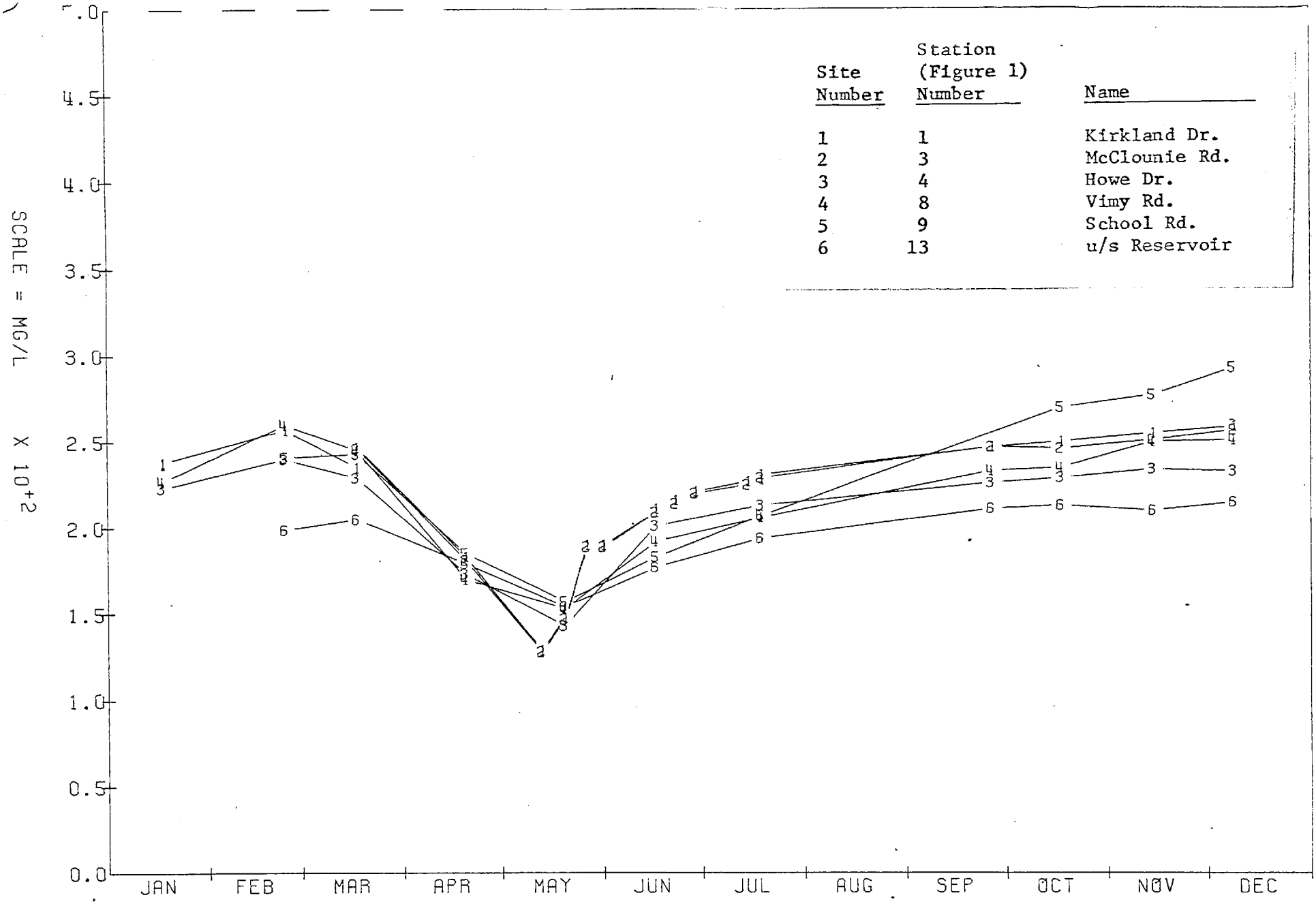

Figure A 24. Total alkalinity levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

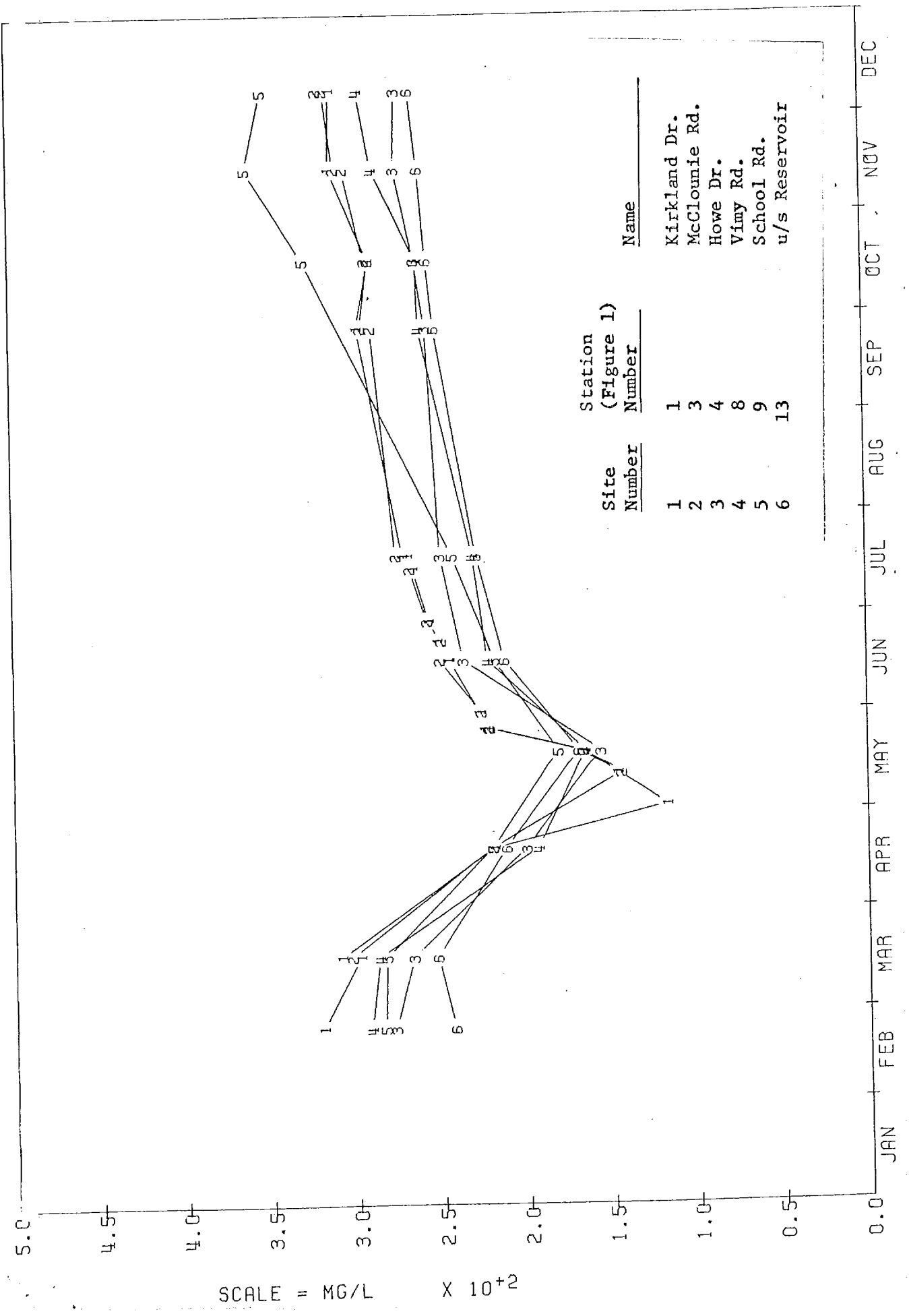

Figure A 25. Hardness levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

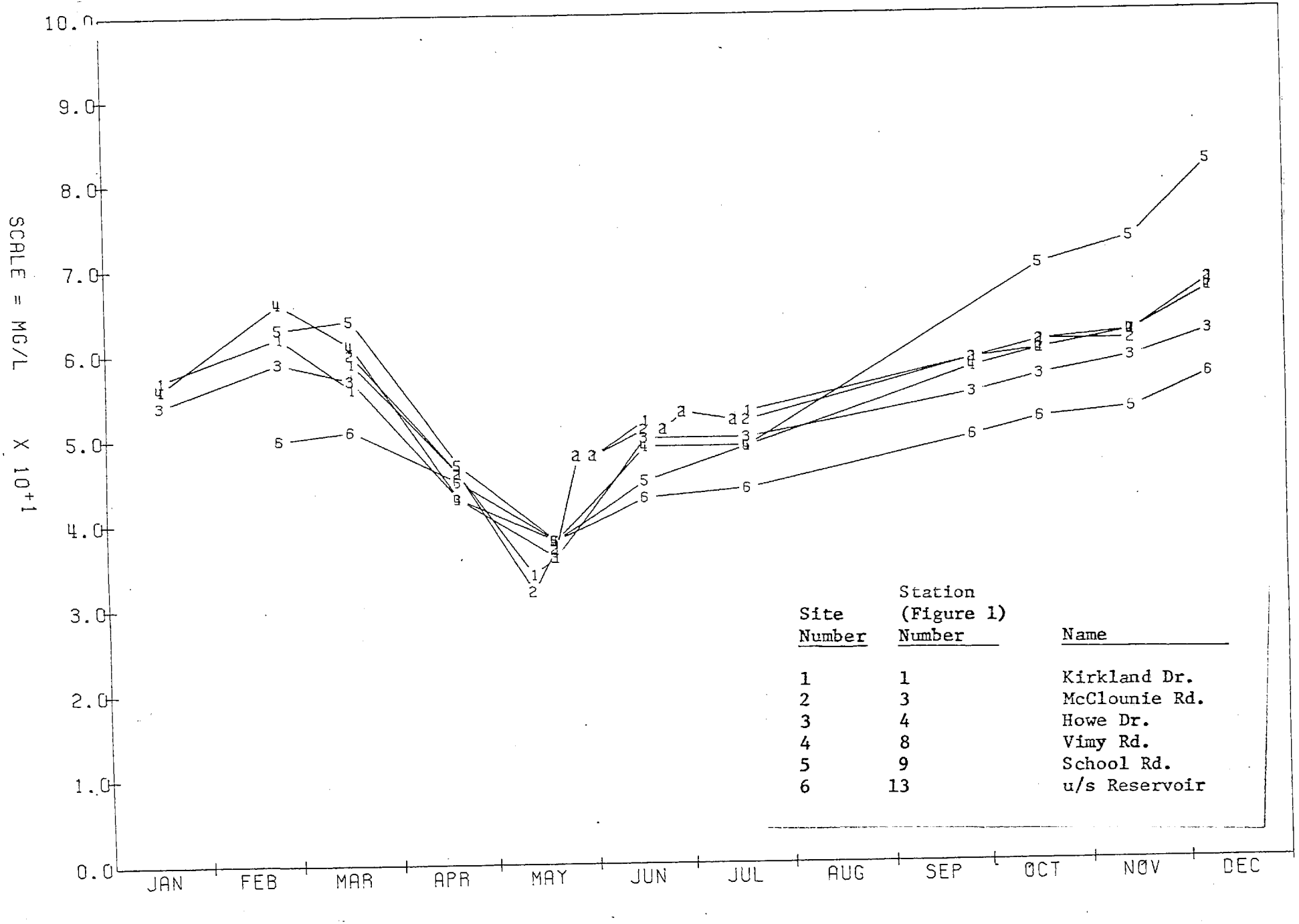

Figure A 26. Inorganic carbon levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

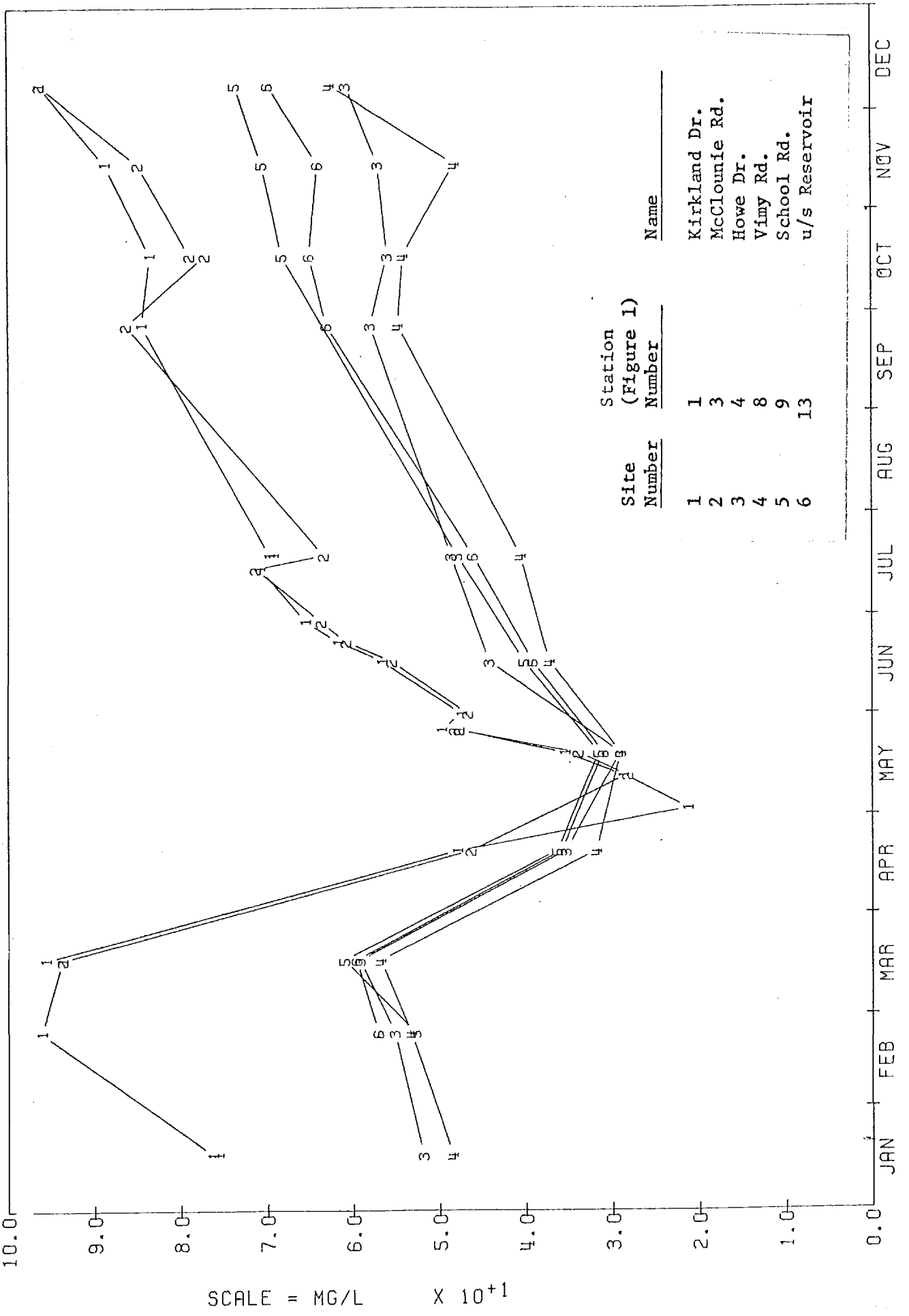

Figure A 27. Sulphate levels observed at different locations in Coldstream Creek during 1977. The sites are arranged in sequence from the mouth (1) to upper reaches (6).

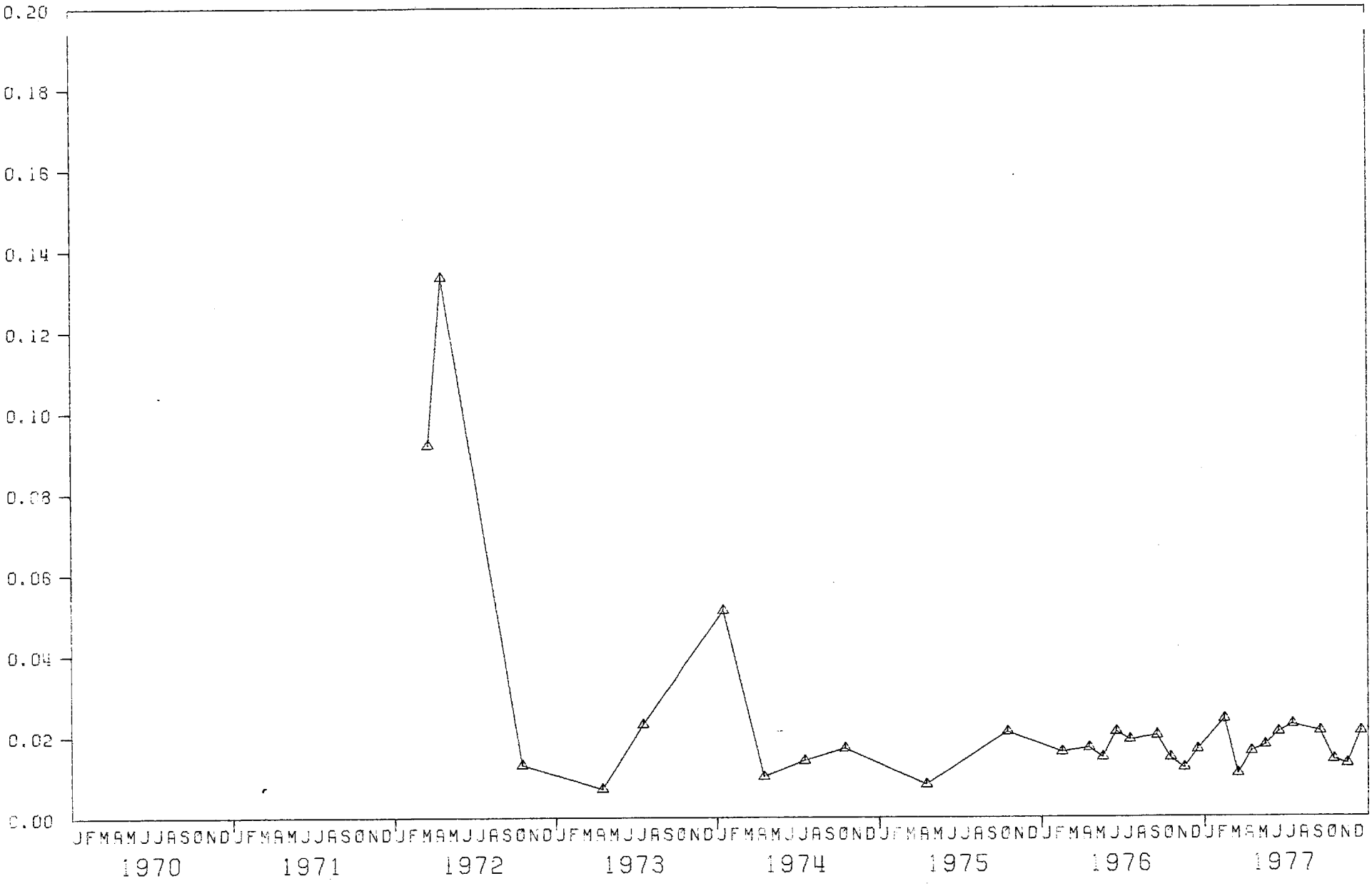

Figure A28. Mean monthly concentrations of ortho-phosphorus in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

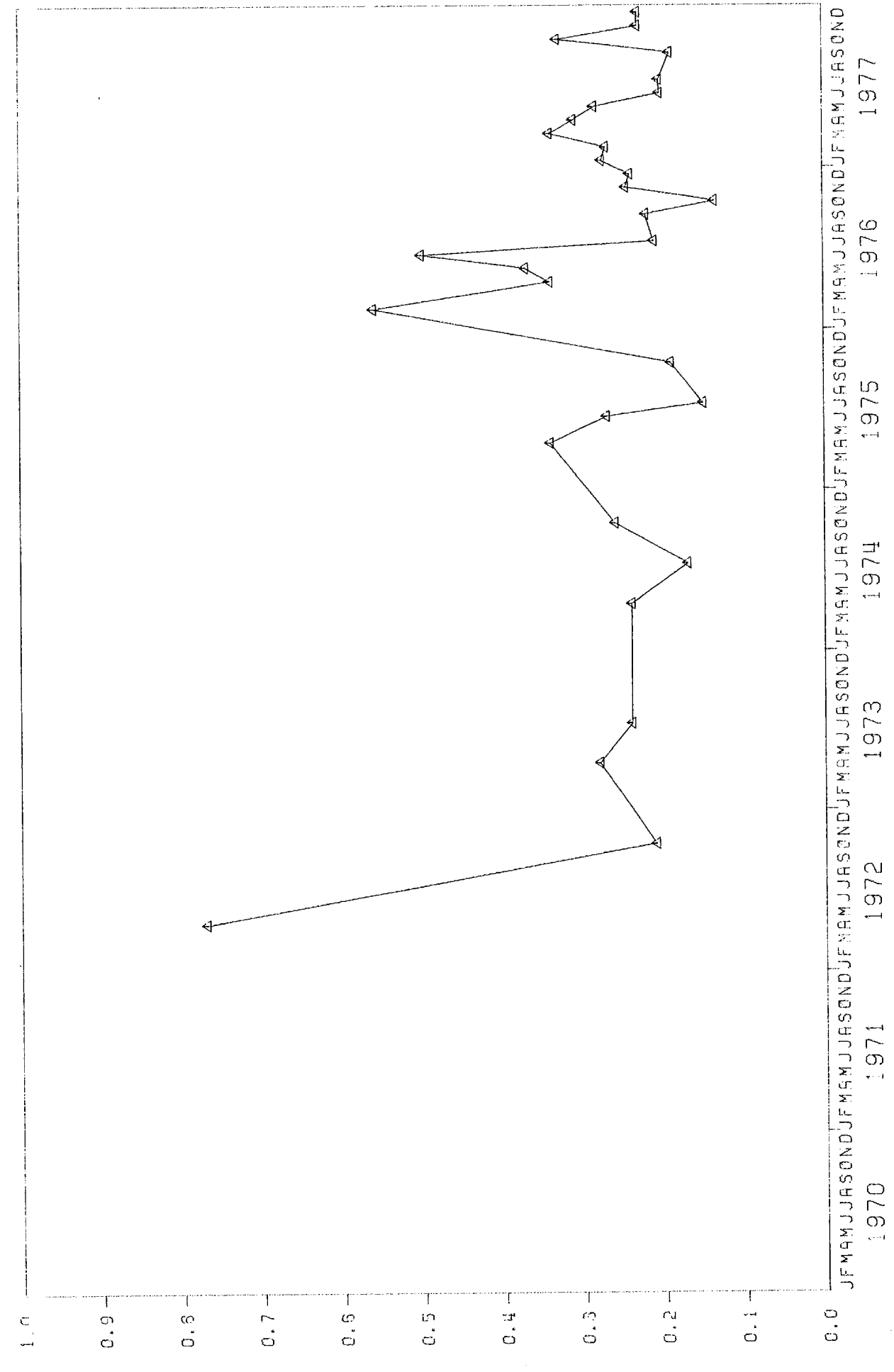

Figure A29. Mean monthly concentrations of organic nitrogen in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

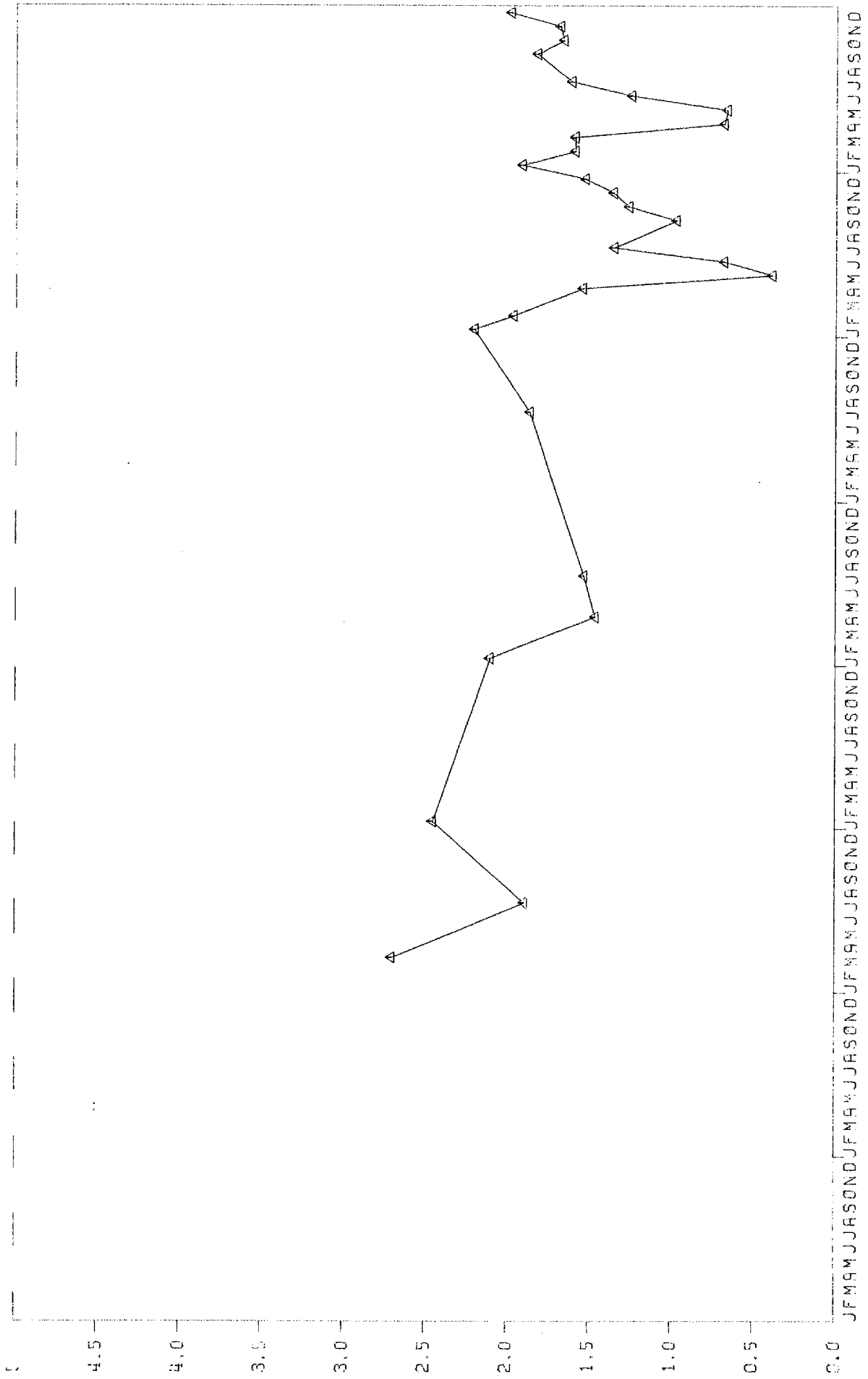

Figure A30. Mean monthly concentrations of nitrate & nitrite in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

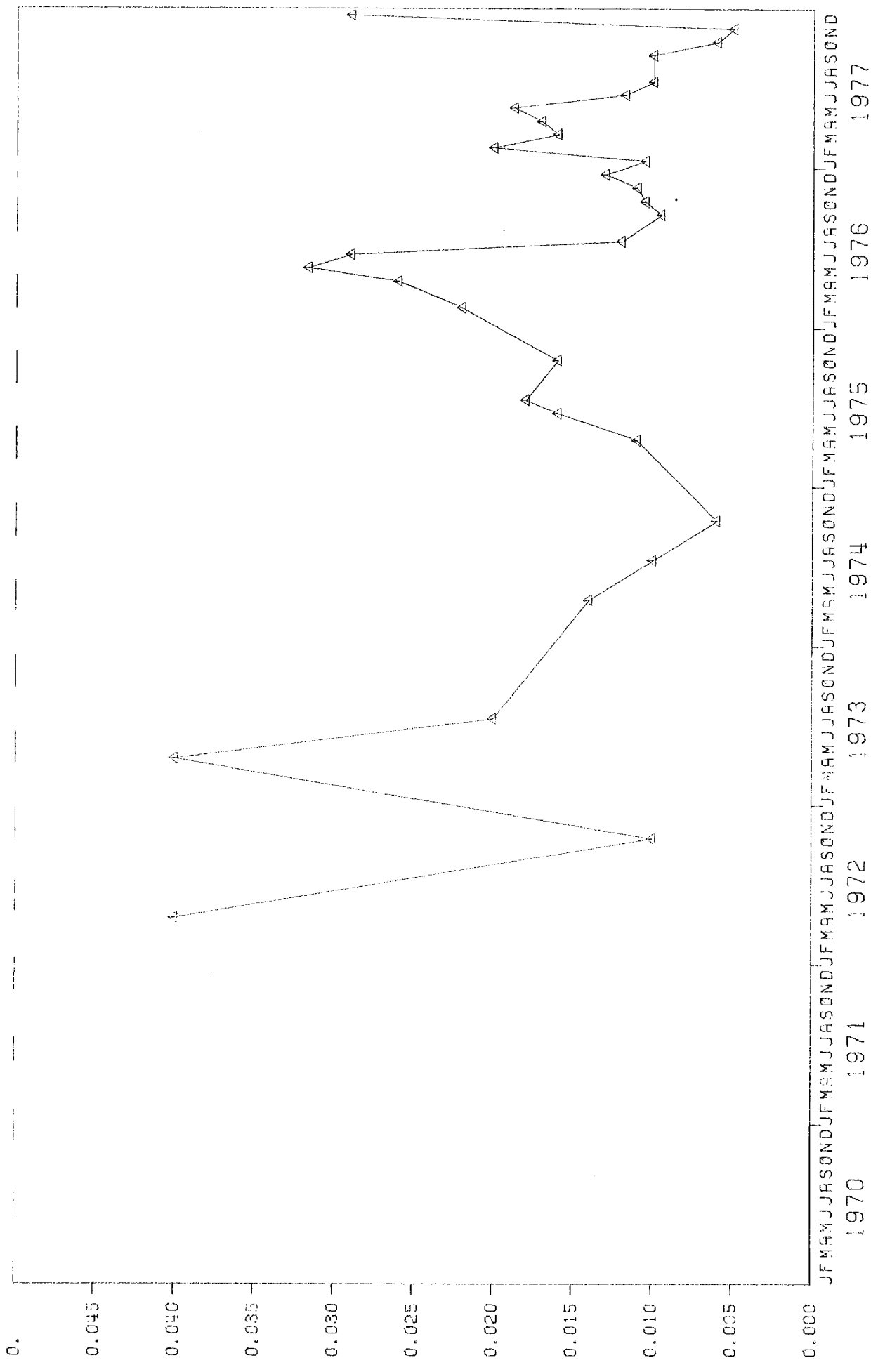

Figure A31. Mean monthly concentrations of ammonia nitrogen in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

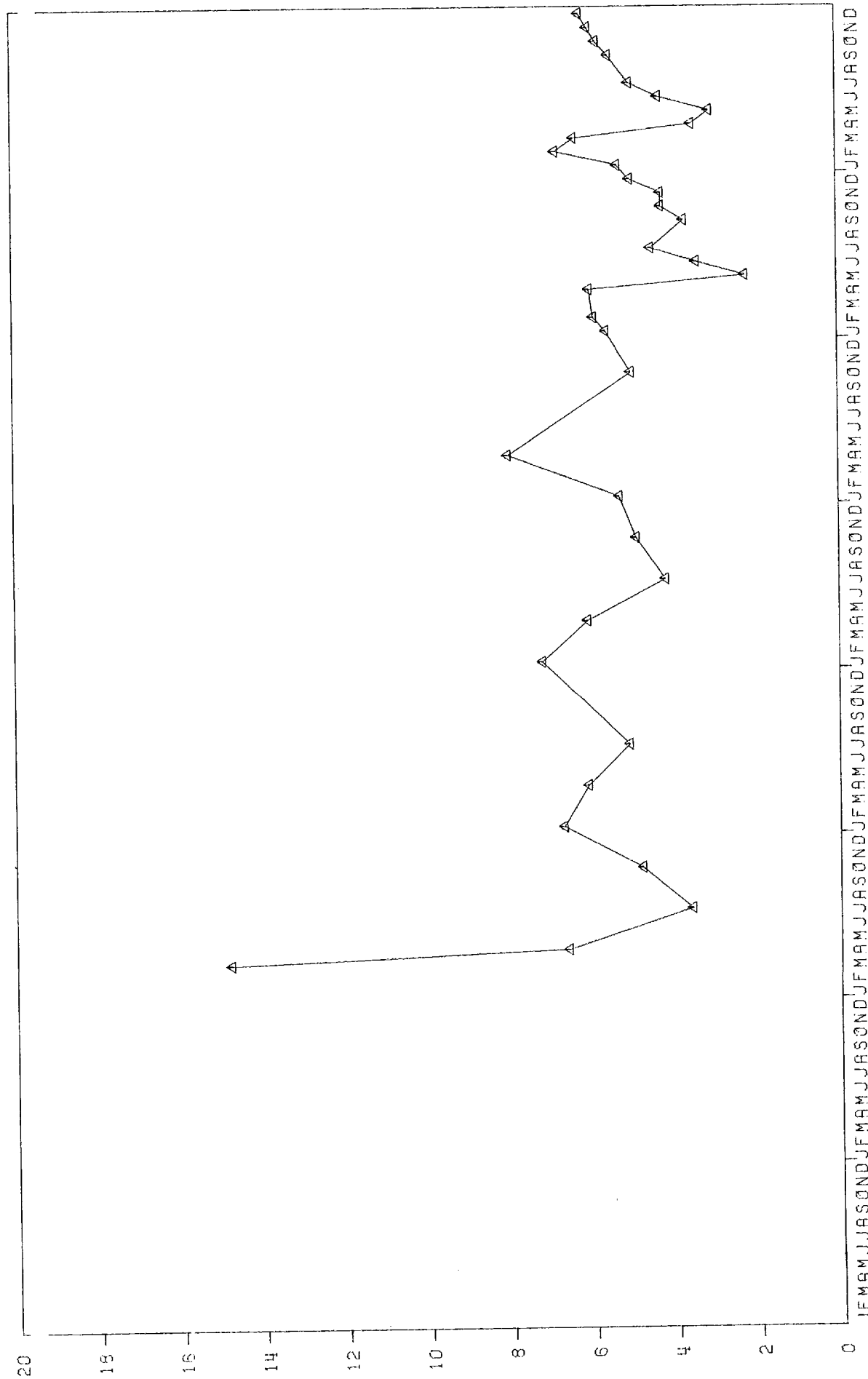

Figure A32. Mean monthly concentrations of potassium in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

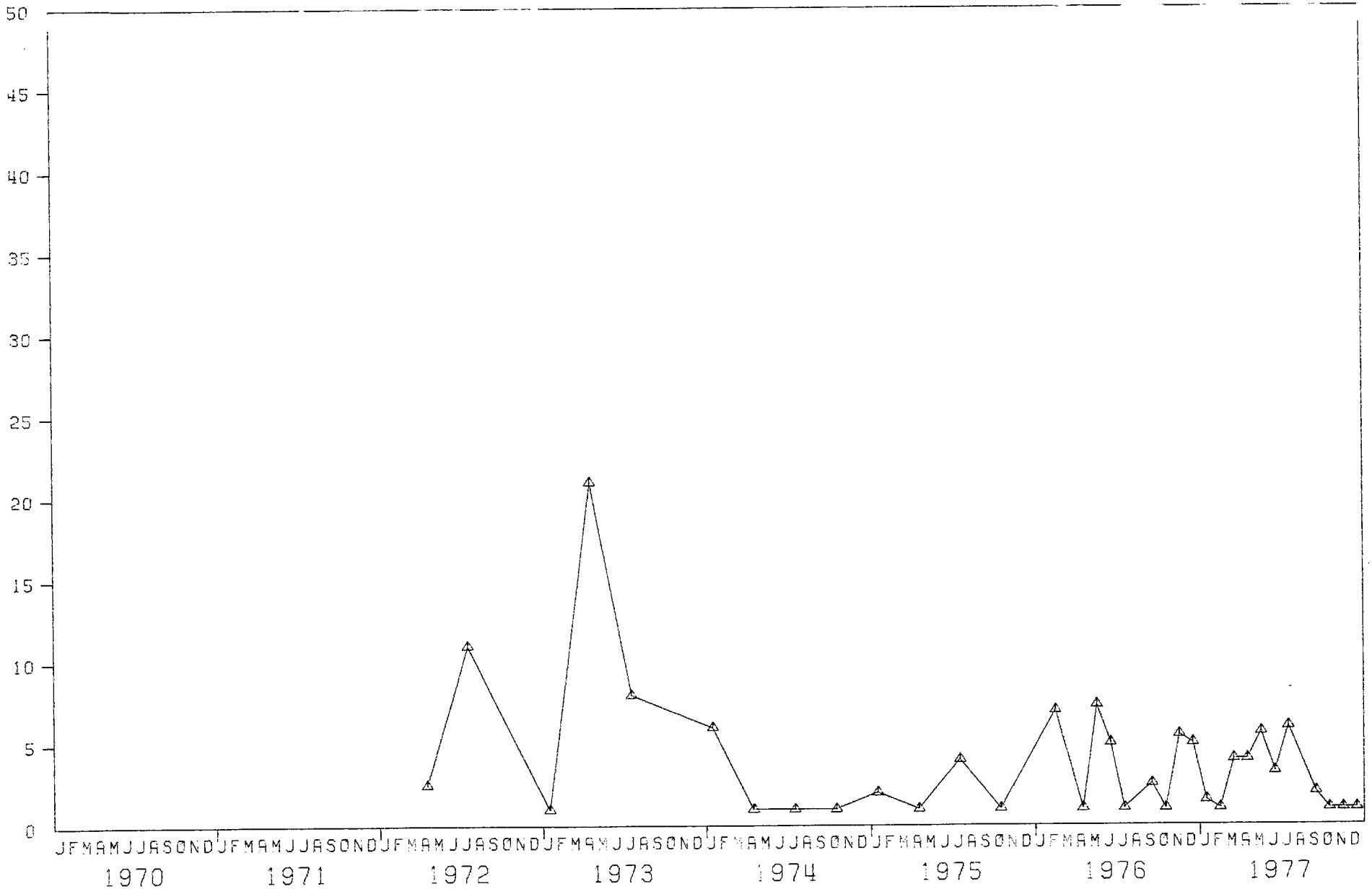

Figure A33. Mean monthly concentrations of organic carbon in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

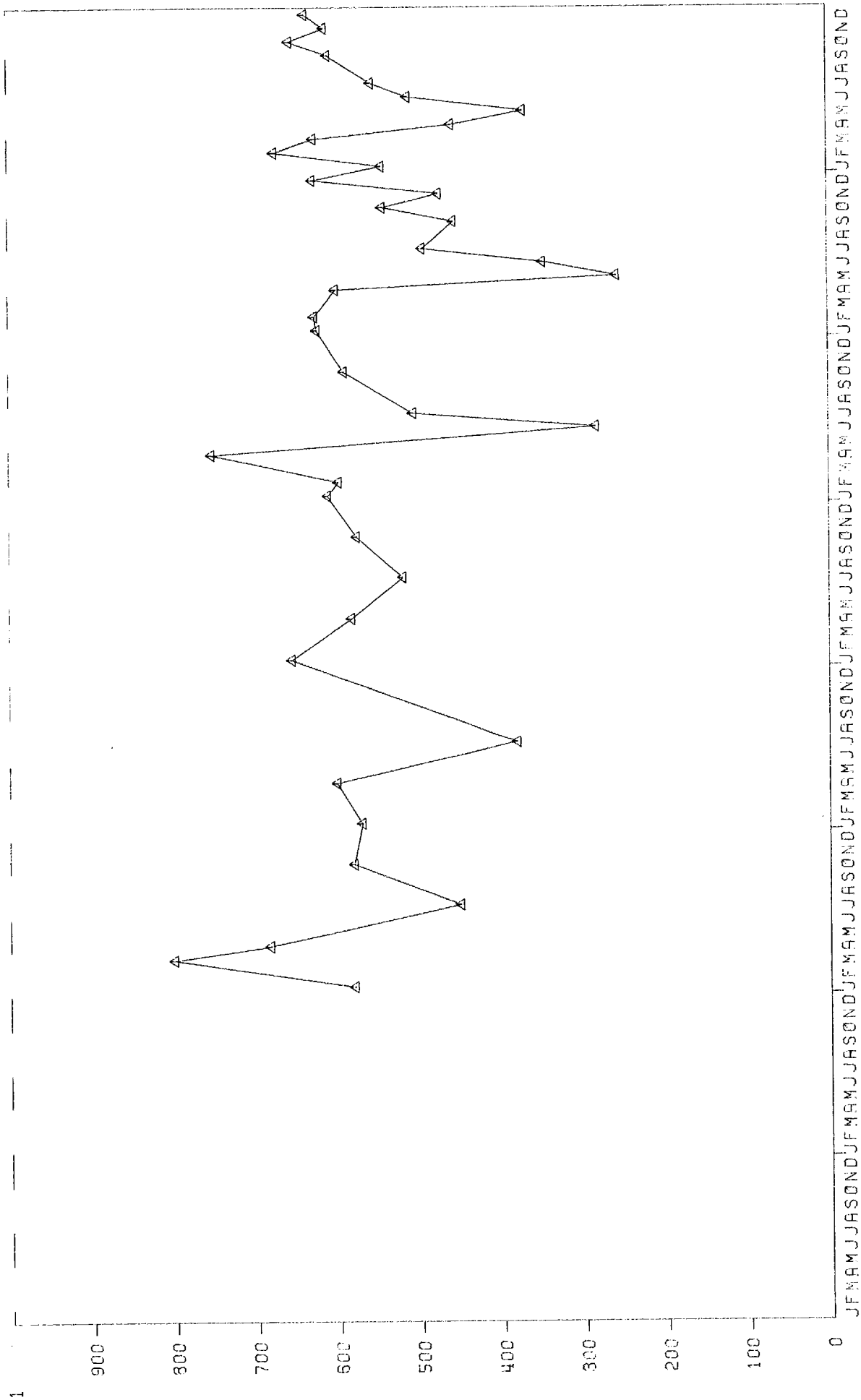

Figure A34. Mean monthly specific conductance values in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

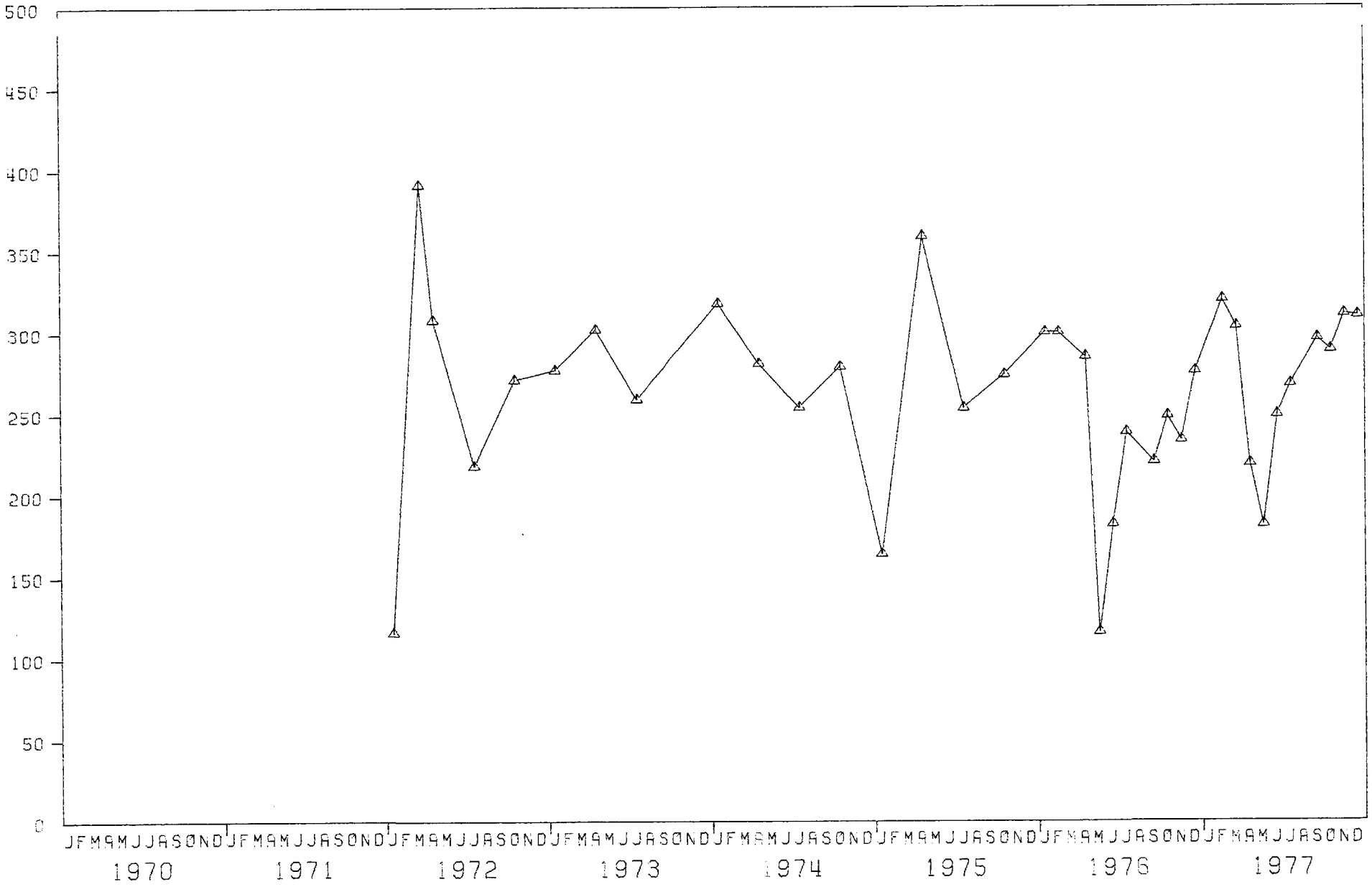

Figure A35. Mean monthly concentrations of hardness ($CaCO_3$) in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

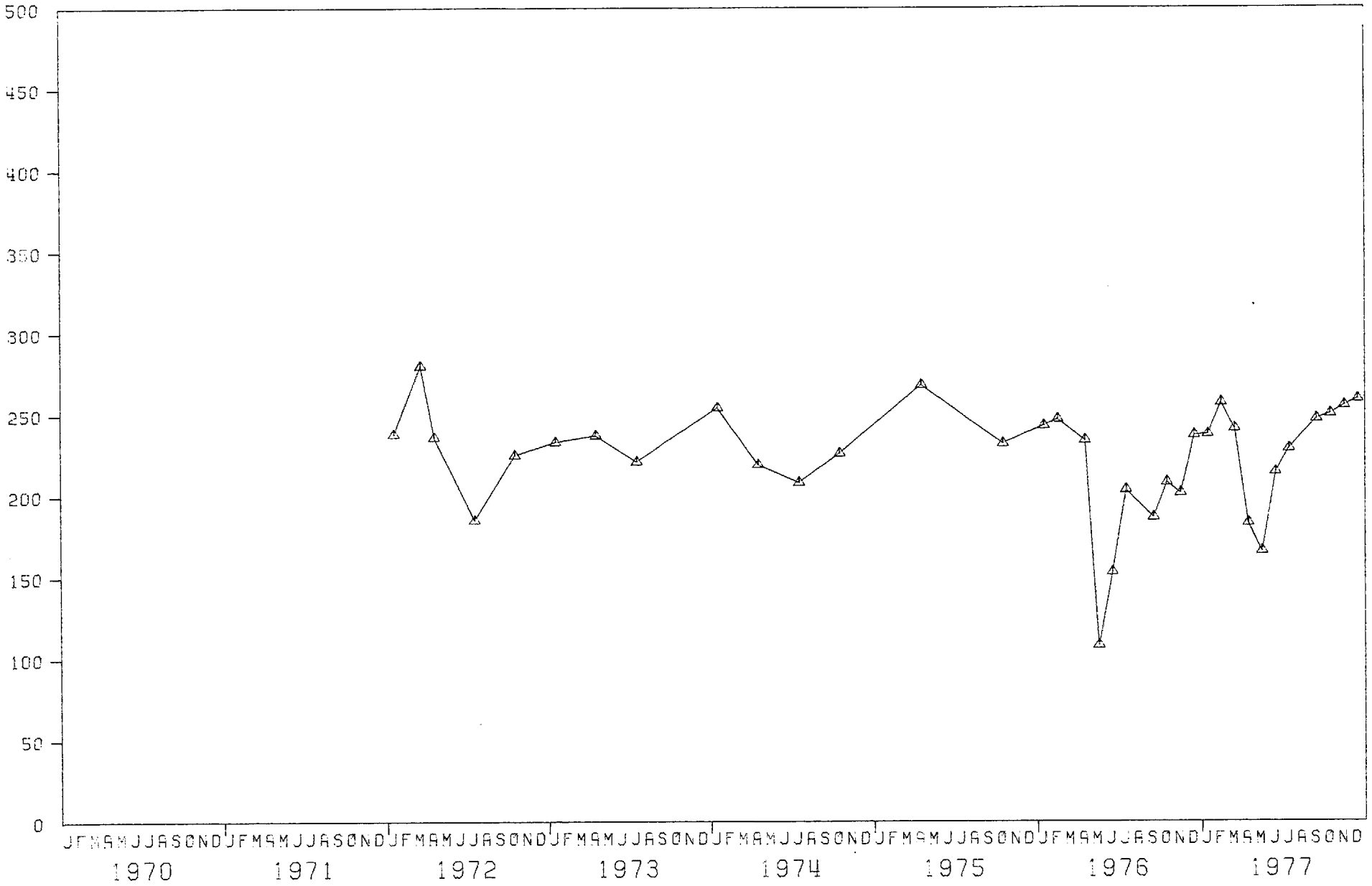

Figure A36. Mean monthly concentrations of total alkalinity in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

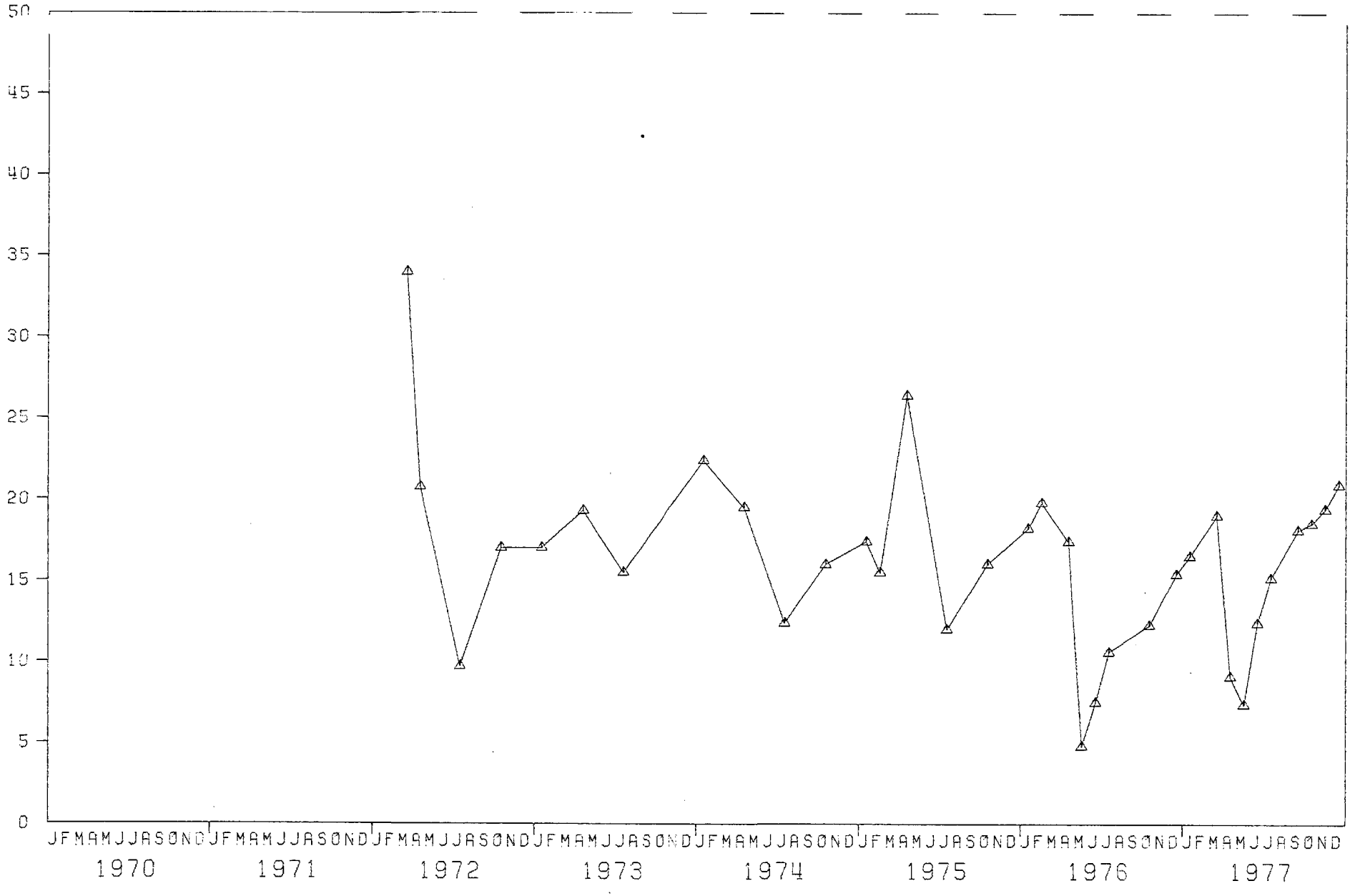

Figure A37. Mean monthly concentrations of Sodium in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

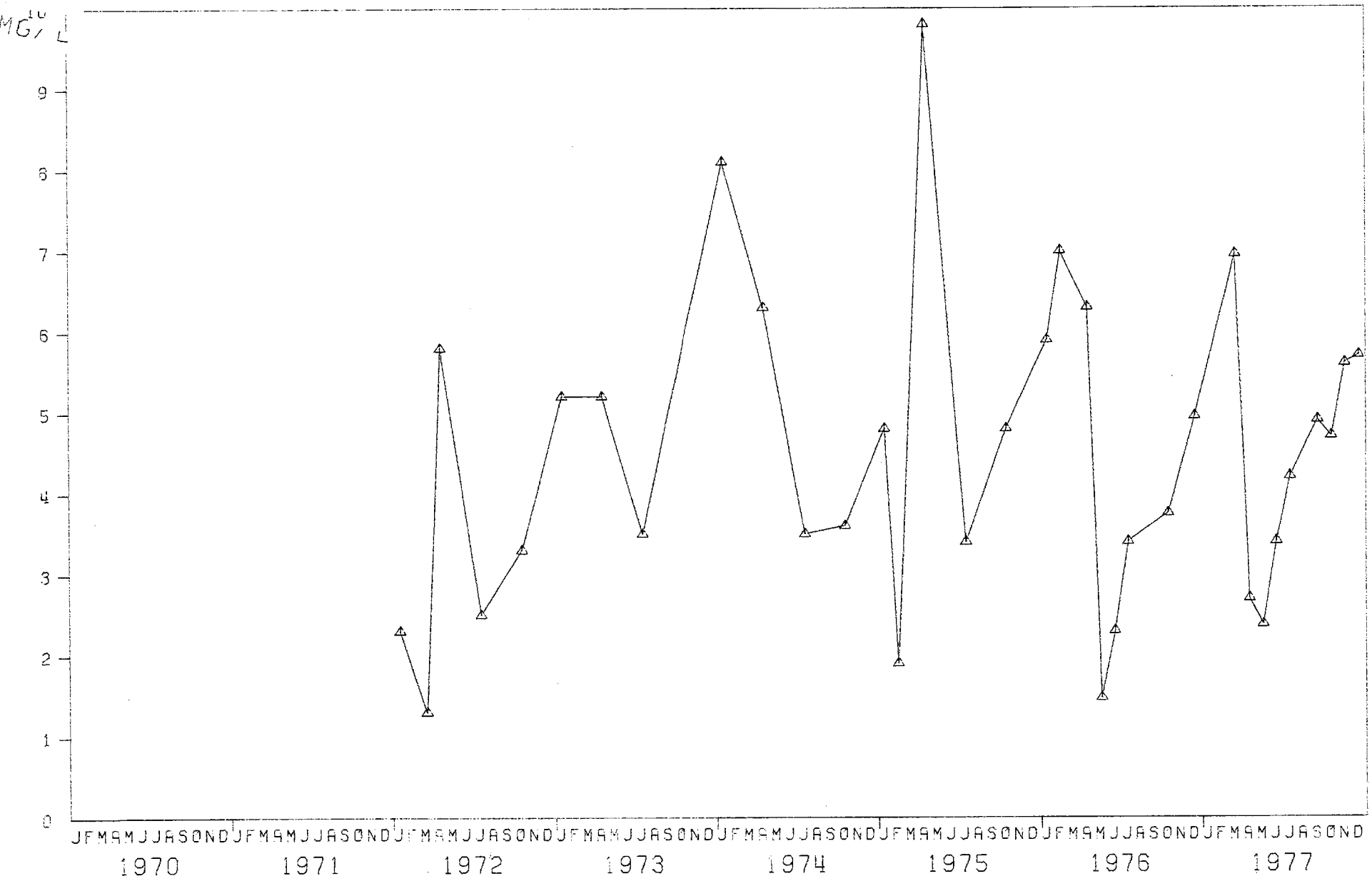

Figure A38. Mean monthly concentrations of Chloride in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

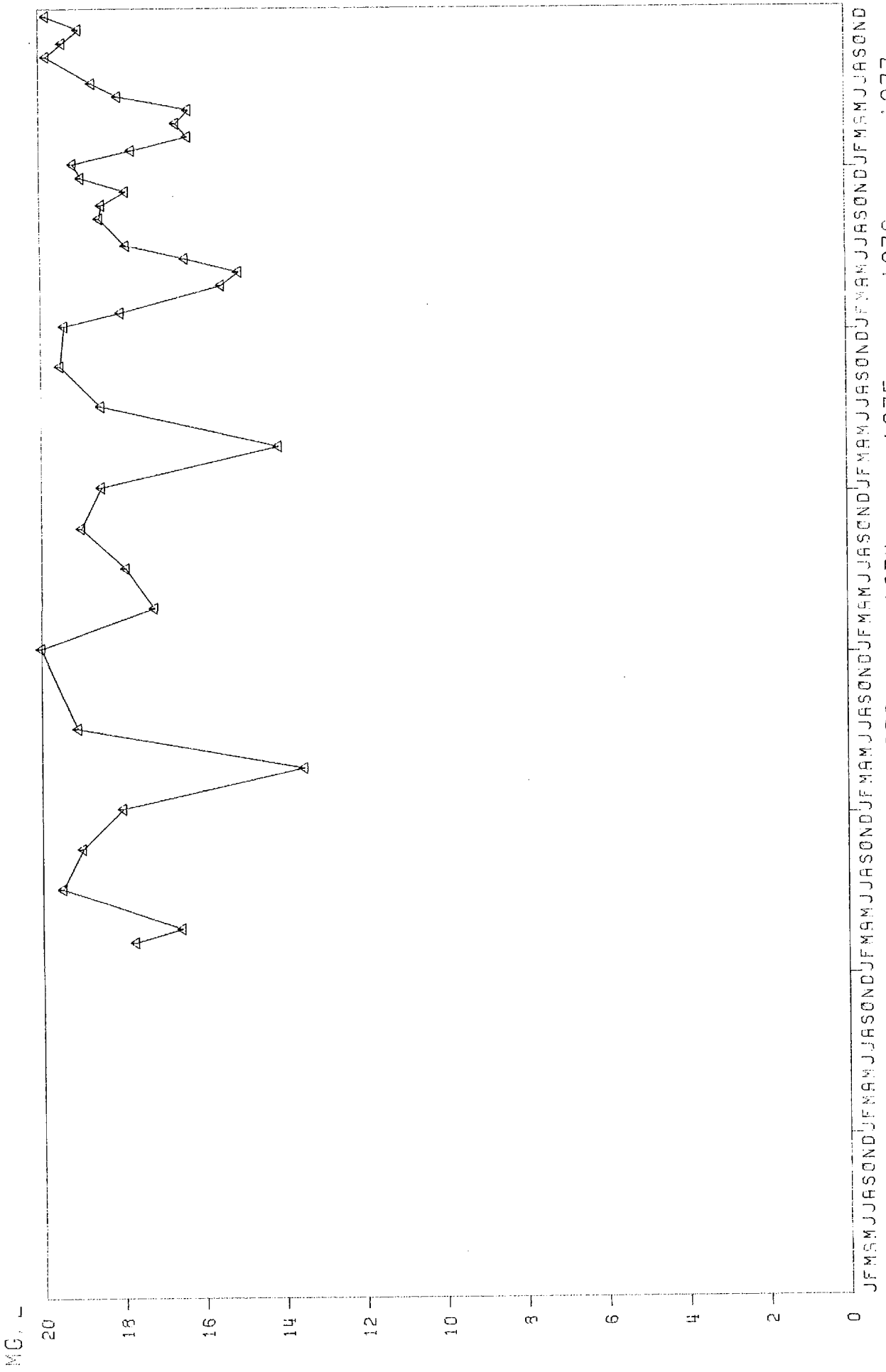

Figure A39. Mean monthly concentrations of silica (reactive) in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.

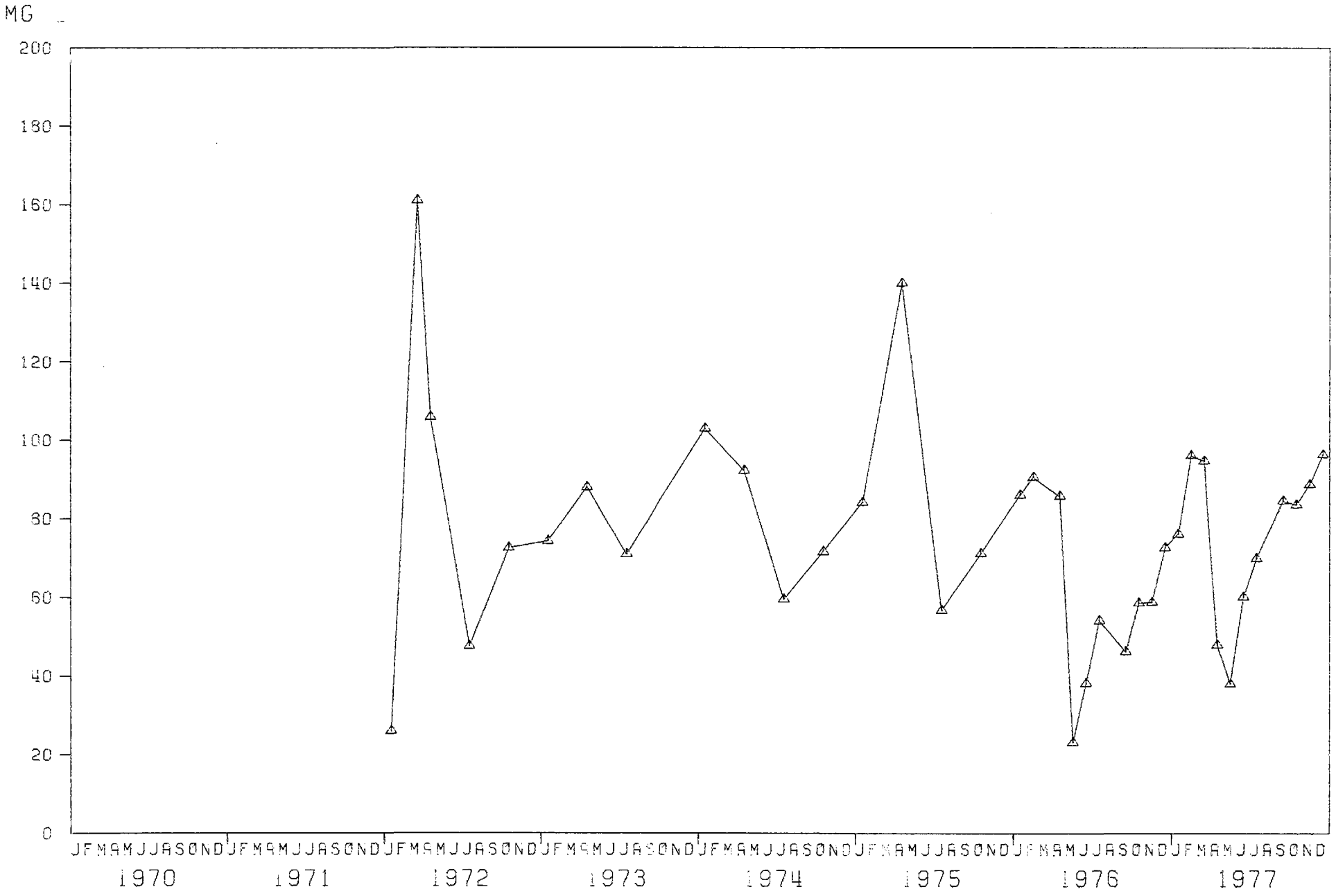

Figure A40. Mean monthly concentrations of sulphate in Coldstream Creek at Kirkland Drive from the first observation by Pollution Control Branch through 1977.