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Environmental Reporting Series

Metz Farms 2 Ltd.

Surface Water & Groundwater Monitoring Results 2000 - 2001

Sciences and Reporting Branch - Sciences and Planning Division
New Brunswick Department of Environment and Local Government

ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

The New Brunswick Department of the Environment and Local Government conducted a monitoring program of surface and well water quality in the vicinity of Sainte-Marie-de-Kent, New Brunswick, between April and October, 2000 and between May and November, 2001. The purpose of this program was to assess the possible effects of land application of liquid manure generated at Metz Farms II on local surface and well water quality. This report presents data from both the 2000 and 2001 monitoring seasons. The first report entitled "Metz Farms 2 Ltd. Surface Water & Groundwater Monitoring Results April to October, 2000" presented the findings of only fecal coliform bacteria between April and October 2000. Copies of this report can be obtained from Sciences and Reporting Branch, Department of Environment and Local Government, Fredericton, New Brunswick.

Results from sampling of surface water stations and domestic wells are presented, including the concentrations of total phosphorus, total nitrogen, nitrate/nitrite, potassium, copper, and fecal coliforms, total coliforms and E. coli. Difficulty in distinguishing between various sources of the chemical and biological components, plus the temporal variability of surface water quality during rainfall events, presented obstacles to the interpretation. However, a correlation of increasing concentration of all parameters after major rain events was apparent. This correlation existed in all areas regardless of whether or not Metz manure was applied. This suggests other factors can have an affect on the water quality. There is no clear evidence that the Metz program alone is having a measurable adverse affect on water quality in the study area.

1.0 INTRODUCTION

On August 30, 1999, Metz Farms 2 Ltd. was issued a license (#LO-0006) to operate a piggery at Saint-Marie-de-Kent (Figure 1) under Section 5(1) of the New Brunswick Livestock Operations Act administered by the New Brunswick Department of Agriculture, Fisheries and Aquaculture. Manure management involved applying stored liquid manure on nearby farm fields in the spring and fall of 2000, and the spring, summer and fall of 2001. The license required certain restrictions on manure application to minimize impacts on water quality including: timing of application, setbacks near water courses, restrictions on slope and soil characteristics where spreading was to take place, and specified application rates established through an approved manure management plan.

The New Brunswick Department of Environment and Local Government (NBDELG) conducted a monitoring program in 2000 and 2001 to determine the effects of manure management on both surface water and groundwater. Results have been compiled for surface water and groundwater samples taken between April and October, 2000 and between May and November, 2001. For surface water, this report includes the concentrations of total phosphorus (TP), potassium (K), nitrate + nitrite (NOX) and copper (Cu) for the year 2000, and total phosphorus (TP), potassium (K), total nitrogen (TN), copper (Cu) and fecal coliform (FC) bacteria for the year 2001. The concentrations of fecal coliform (FC) bacteria for the year 2000 were published in a previous report in April 2001. For groundwater, this report presents data on total coliform and E. coli bacteria for the sampling year 2001.

1.1 Background

The Ministerial Monitoring Committee for Metz Farms 2 Ltd. was formed in the fall of 1999 and made up of staff from the New Brunswick departments of: Environment and Local Government; Agriculture, Fisheries and Aquaculture; Natural Resources and Energy; and Health and Wellness. Other organizations represented included Fisheries and Oceans Canada, the Local Service District, the Cooperative des Huîtres de Bouctouche, the Agri-Conservation Club, Sustainable Development at Northumberland Strait and the Southeastern Angler's Association.

The mandate of this committee was to develop a surface and groundwater quality monitoring plan. Ultimately, the plan would help to determine if, and to what extent, manure applications affected surface and groundwater quality in the area. The surface water sampling stations were chosen by this committee, and the monitoring plan called for sites to be sampled routinely, as well as after a rainfall of 25 mm or greater within a 24 hour period. It should be noted that some sampling stations were added or removed between the 2000 sampling program and the 2001 sampling program. In part, this reflects the location of fields used for spreading. In particular, new sampling stations were added for the 2001 sampling in the northwestern part of the map area (Figures 2 and 3).

2.0 METHODOLOGY

2.1 Surface Water

The sampling stations were established to monitor the quality of water originating from the land areas as presented in Figures 2 and 3. Samples were taken upstream and downstream in the areas where Metz manure spreading occurred. For

comparison, several other areas were sampled where no Metz manure spreading occurred, however in some cases these areas were utiized by local farmers for spreading of manure from their operations. NBDELG staff (Moncton Regional Office) collected samples at each station in accordance with established protocols. Samples were submitted to the NBDELG laboratory and analyzed for 34 variables including major ions, metals, nutrients, physical characteristics, and bacteria. Analyses were conducted using standard methodologies.

Graphs were constructed for each parameter using common dates along the bottom axis. Water quality results from upstream and downstream sampling stations located in the same local area have been kept on the same graph. Points on the graphs designate that a sample was collected on that date. Where there is no point on the graph, a sample has not been collected. This is typically due to dry conditions (not enough water could be collected) or that the station was not a priority based on the location of manure spreading.

2.2 Groundwater

A survey of water quality was conducted by collecting groundwater samples in domestic water wells in the vicinity of the fields where spreading of liquid manure (generated at Metz Farms) was expected to occur. Local residents were contacted in person, or when not available, by letter to explain the sampling program, and who to contact if interested. During the year 2001, three sampling events were undertaken: Winter 2001, Spring 2001 and Summer 2001. For the Winter 2001 sampling event, of the 85 homeowners surveyed, 71 agreed to participate in the sampling program, 12 did not respond to the survey and 2 declined to participate. For the Spring 2001 sampling event, of the 88 homeowners surveyed, 78 agreed to participate and 10 did not respond to the survey. For the Summer 2001 sampling event, of the 92 homeowners surveyed, 88 agreed to participate, 3 did not respond to the survey and 1 declined to participate.

Samples were taken in accordance with accepted techniques at all wells and analyzed for bacteria only at the NBDELG laboratory in Fredericton using standard techniques. Results were mailed or hand-delivered to the homeowner. If the water tested positive for bacteria, the Department of Health and Wellness was also contacted and homeowners were advised on procedures to follow.

2.3 Additional Data

Details of liquid manure spreading (volumes, dates, and field identification) were kindly provided by the Department of Agriculture, Fisheries and Aquaculture, Moncton Regional Office.

Rainfall data for the Moncton airport between the months of March and November (year 2000 and 2001), as well as rainfall data from Bouctouche between March and November (year 2001) were extracted from NBDELG files. Bouctouche rainfall data was added for the year 2001 because it is likely to be more representative of the spreading areas than Moncton airport data. Bouctouche rainfall data were not available for the year 2000.

Figure 1: Location of Metz Farms 2 Ltd. in eastern NB

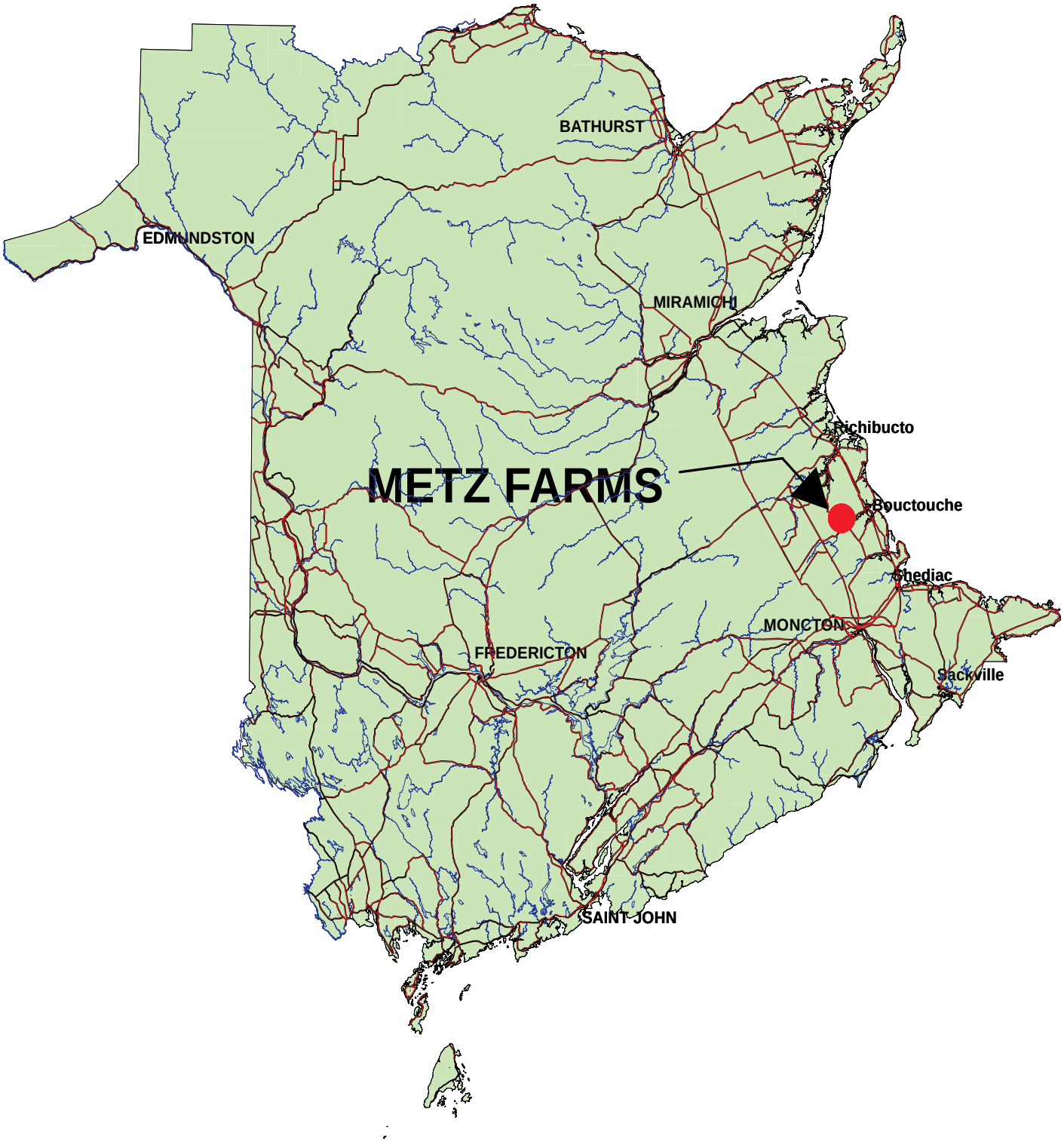


Figure 2: Year 2000 Sampling Stations

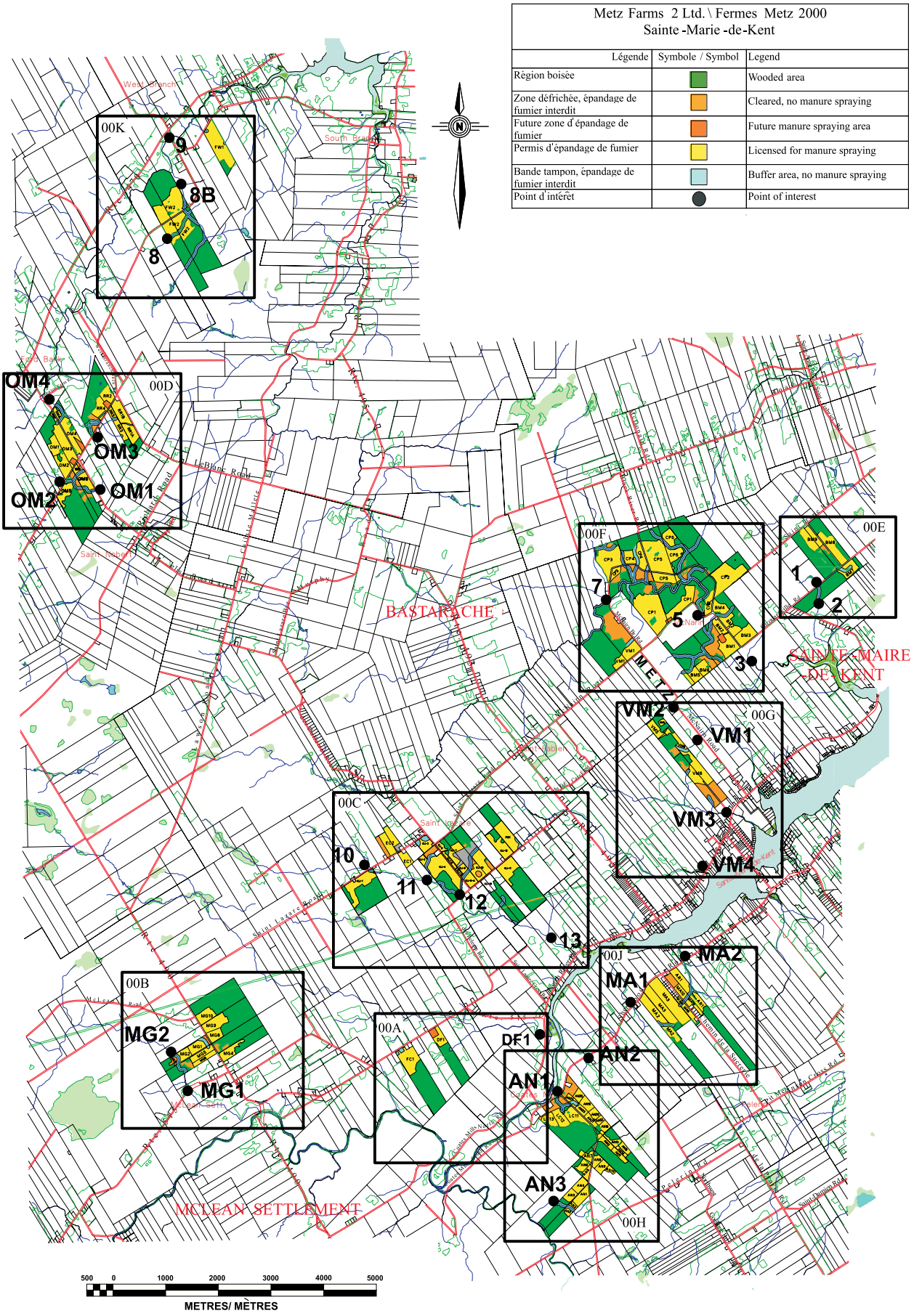
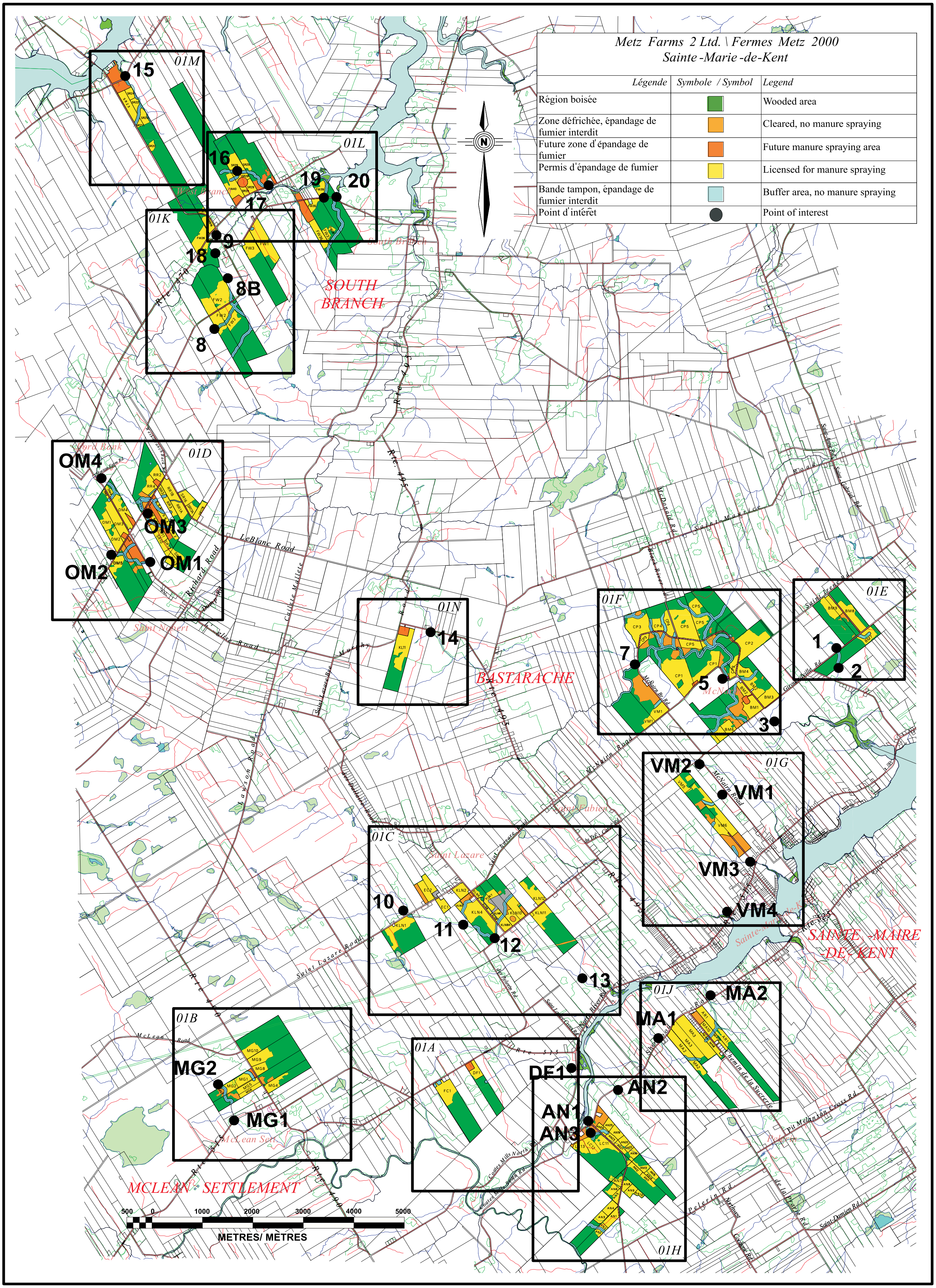


Figure 3: Year 2001 Sampling Stations



3.0 RESULTS

3.1 Manure Spreading Information

Spreading of liquid manure was performed in the spring and fall of 2000, and the spring, summer, and fall of 2001. Field identification, volume of spreading, and the dates of spreading are presented in Tables 1 and 2. Department of Agriculture, Fisheries and Aquaculture staff were on hand to witness most of the spreading activity to ensure that the application adhered to the manure management plan.

3.2 Rainfall

Graphs of daily rainfall for the year 2000 sampling period (Moncton airport) and the year 2001 sampling period (Moncton airport and Bouctouche) are presented in Figures 4, 5, and 6. In year 2000 (Moncton airport), total rainfall amounts prior to each surface water sampling event were:

15 mm	April 25
0 mm	May 23
27 mm	June 8
6 mm	June 27-28
0 mm	July 31- August 1
9 mm	August 21
25 mm	September 16
41 mm	October 19
58 mm	October 29

(see Figure 7a).

In year 2001 (Bouctouche), total rainfall amounts prior to each surface water sampling events were:

0 mm	May 2
0.6 mm	May 10
26.3 mm	June 4
9.4 mm	June 18
0 mm	July 5
1.2 mm	July 9
1.2 mm	July 16
0.8 mm	July 17
0 mm	August 16
0 mm	August 21
16.4 mm	August 28
12 mm	September 23
1.5 mm	October 15
13.2 mm	October 16
34.4 mm	October 17
3.2 mm	October 25
53.1 mm	November 7
1.6 mm	November 21
1.6 mm	November 22

(see Figure 7b).

Table 1: Manure Spreading Information, Metz Farms, 2000

Field Identification	# of Loads [Estimated maximum volume is 3750 Imperial gallons per load]	Dates spread (Year 2000)
Part of CP3	6	June 1
FW2	83	June 6
BM8, BM9, part of BM7	62	June 13
Part of BM5, BM6	15	June 13 (night)
Last of BM7, BM3, north side of BM2	64	June 14
Section of CP3	25	June 14 (night)
CP2	53	June 15
BM4	7	June 15
VM1	24	October 12, 23, 24, 25
VM5	6	October 24
VM6	38	October 23
CP1	80	October 11
MA2, MA3, MA8	86	October 13, 14, 18, 23
MA10	12	October 13
AN1, AN2, AN3, AN4	40	October 26
LC11, LC12, LC13	29	October 25
AN 20, AN21, AN22	16	October 25
AN19, AN23	10	October 25
AN16	7	October 26
AN8, AN9, AN10	6	October 27

Table 2: Manure Spreading Information, Metz Farms, 2001

Field Identification	# of Loads [Estimated maximum volume is 3750 Imperial gallons per load]	Dates spread (Year 2001)
BM-8, BM-9, BM-2, BM-3	48	June 11
BM-1, BM-2, BM-4, BM-3, EC-2	64	June 13
KLN-4, KLN-8, KLN-9, KLN-6, KLN-5, KLN-8A	73	June 14
KLN-8A, KLN-11, KLN-1	54	June 15
MG-8, MG-9	35	June 19
MG-10, MG-1, MG-9, KL-11	62	June 20
KL-11, BM-5, BM-6	58	June 21
FW-2	45	July 16
FW-2, FW-1	44	July 17
FW-1, FW-3, FW-26	53	July 18
FW-26, FW-25	25	July 19
FW-25, FW-14, FW-26, SR-29	25	July 20
SR-29, FW-40	50	July 23
SR–21A, SR-21B, SR-22, SR-23, SR-24, SR-20, FW-12 FW-13	51	July 24
FW-12, FW-13, FW-3, FW-35	47	July 25
RR-14, RR-3, RR-2, RR-4, RR-1B	73	July 26
OM-4, OM- 3, OM-1, OM-2	74	July 27
OM - 3	29	July 30
OM - 5, SR-16, SR-17A, SR-17B	53	July 31
SR - 13, SR-14, SR-12, SR-10, SR-8, SR-11	54	August 1
VM-1, VM-6	49	September 25
VM-6, VM-5, LC-13	35	September 26
LC-12, LC-11	16	September 27
AN-11, AN-12, AN-13, AN-14, AN-15, LC-11	40	September 28
AN-8, AN- 9, AN-10, AN-1, AN-2, AN-3, AN-4	43	October 1
AN-1, AN-2, AN-3, AN-4, AN-5, AN-6 AN-7, AR-1	37	October 2
AR-1, CP-1	23	October 3
CP-1	29	October 4
CP-1	31	October 5
CP-3	28	October 9
CP-3, CP-4	30	October 10
CP-4, CP-5	21	October 11
CP-5	20	October 19
BM-5, BM-6, CP-2	30	October 22
CP-2	35	October 23
CP-2, CP-5	18	October 24

Figure 4: Daily Rainfall at Moncton, N.B., April to October 2000

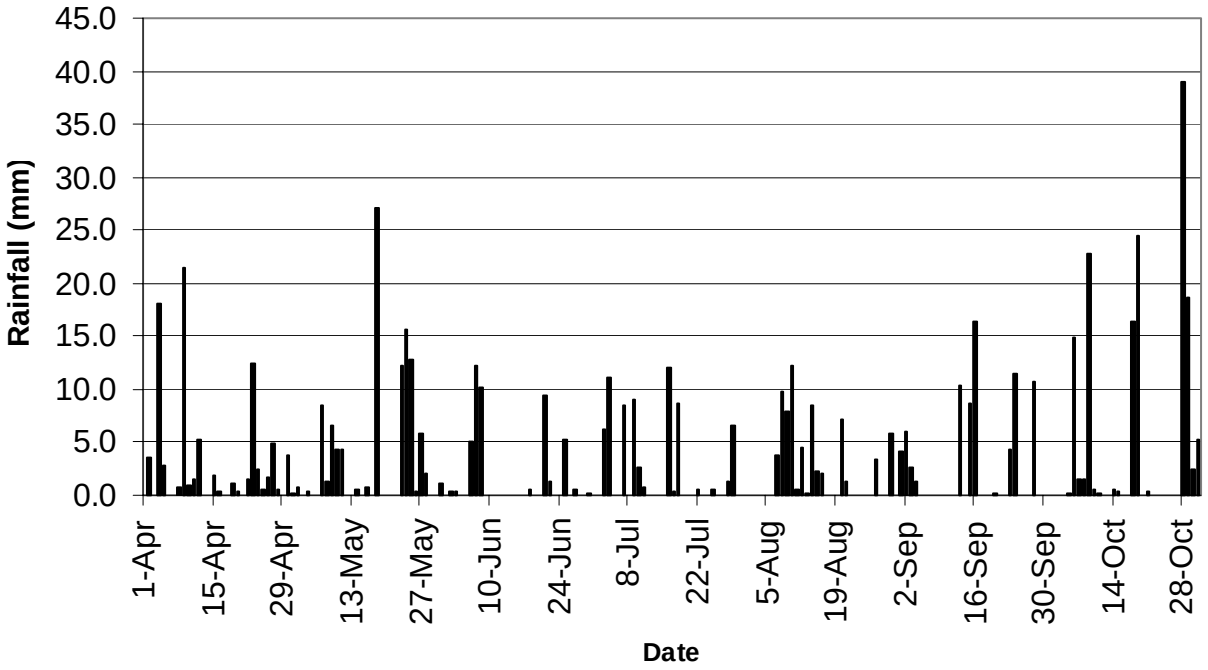


Figure 5: Daily Rainfall at Moncton, N.B., April to October 2001

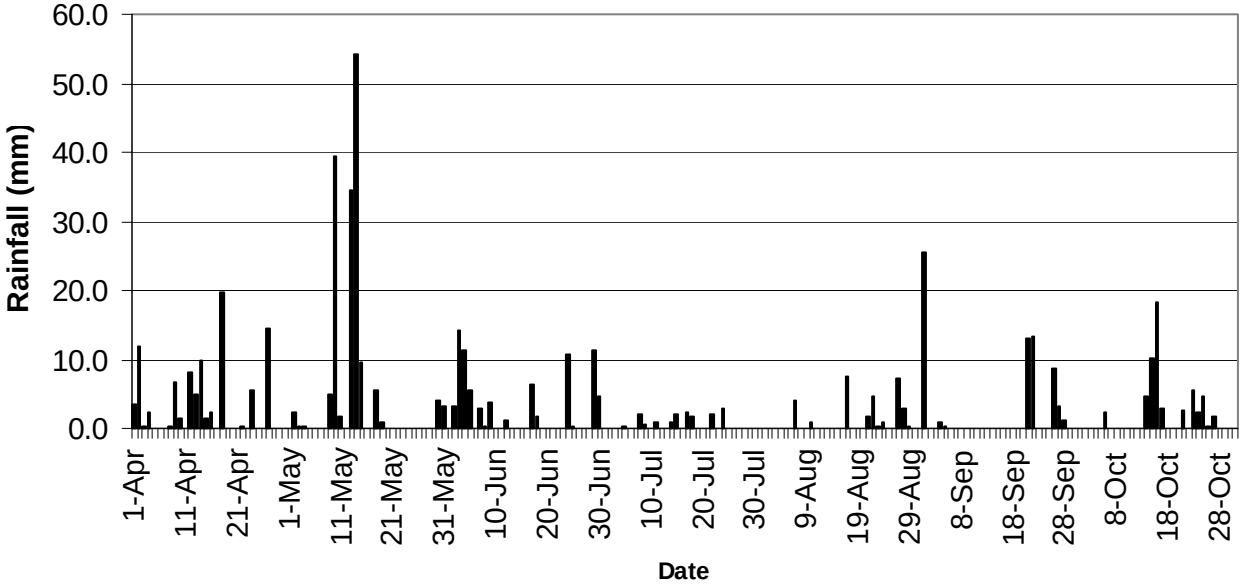


Figure 6: Daily Rainfall at Bouctouche, N.B., April to November 2001

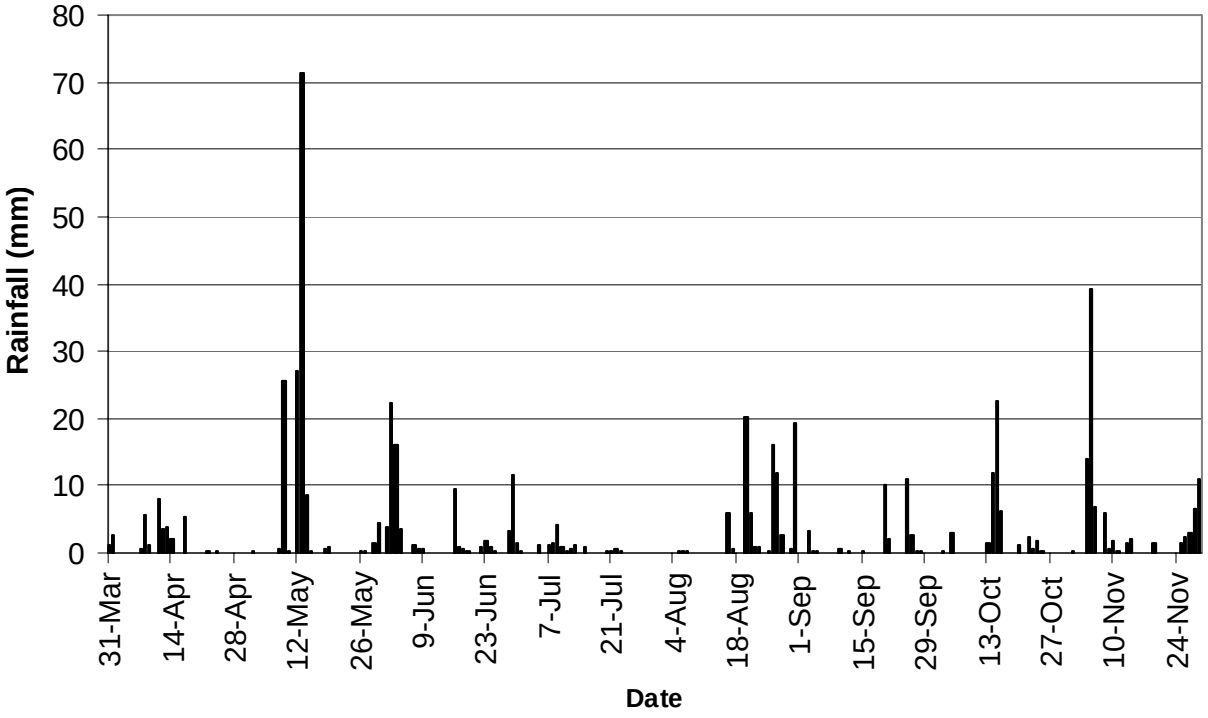


Figure 7a: Total Rainfall (2000) for the 48 hour period before sampling (Moncton Airport)

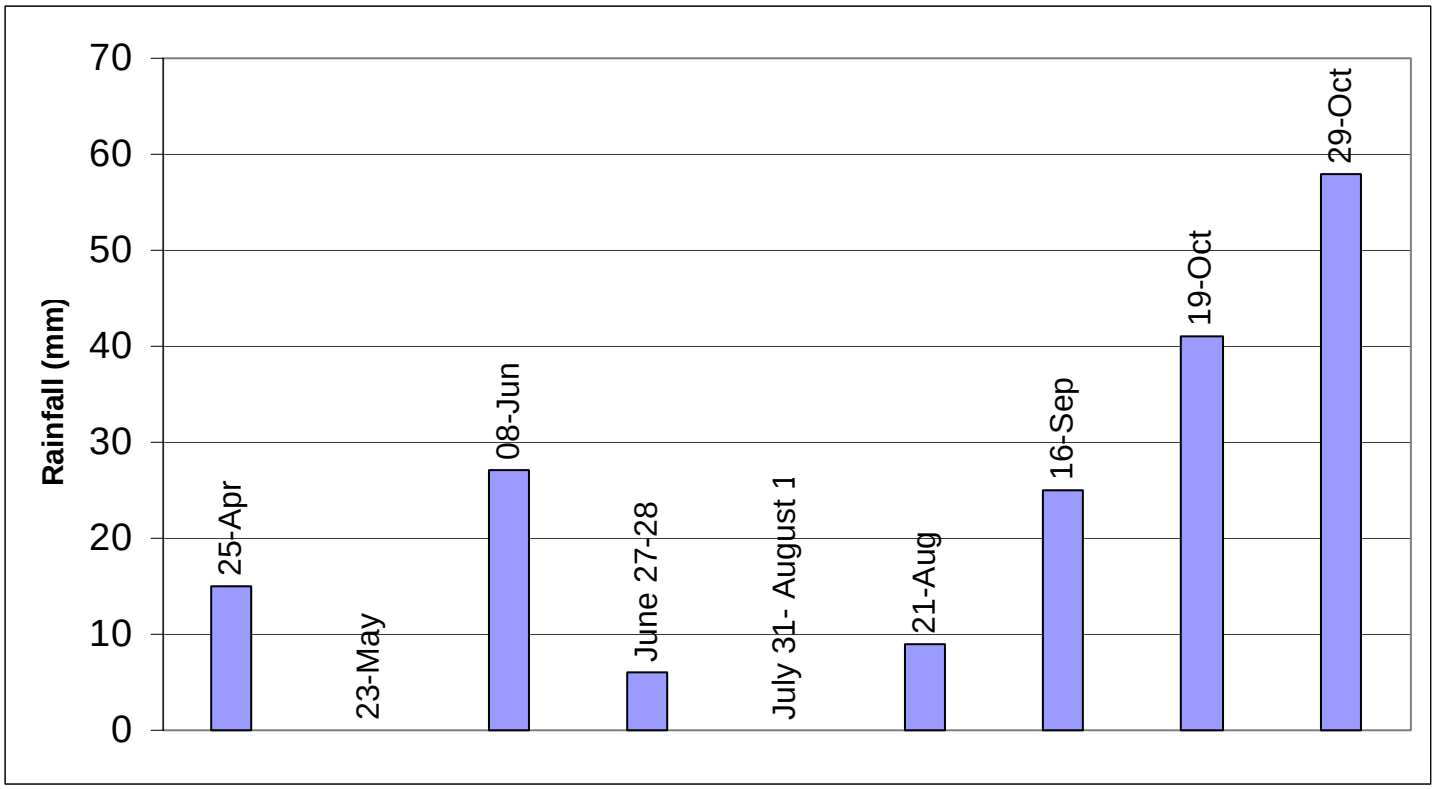


Figure 7b: Total Rainfall (2001) for the 48 hour period before sampling (Bouctouche)

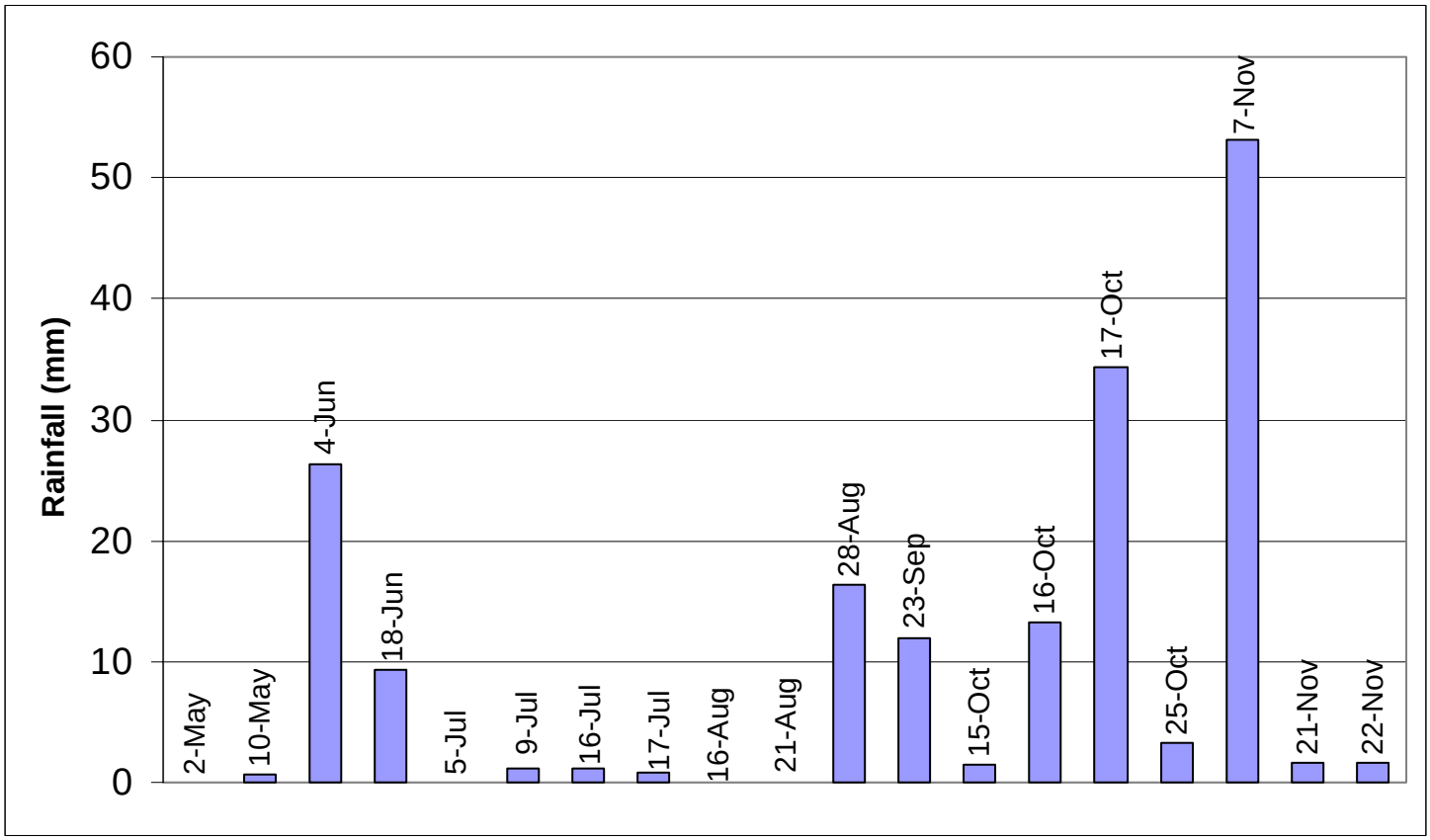
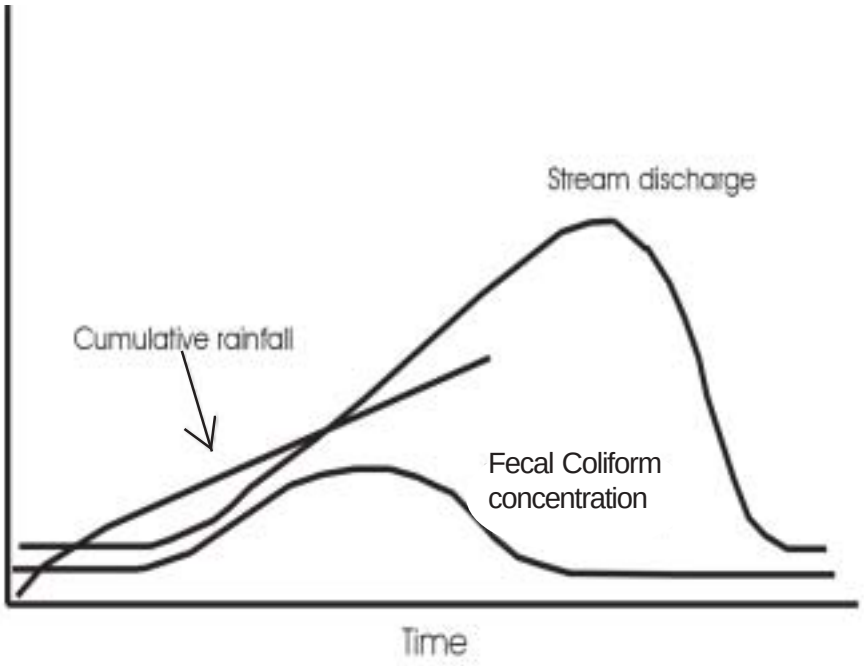


Figure 8: Hypothetical Relationship Between Stream Discharge, Rainfall and Bacteria Concentration in a stream



3.3 Surface Water Quality

In this report, results are presented for total phosphorus (TP), potassium (K), nitrate + nitrite (NOX), and copper (Cu) for the sampling year 2000, and total phosphorus (TP), potassium (K), total nitrogen (TN), copper (Cu), and fecal coliform (FC) for the sampling year 2001. In general, TP, TN, and K are the three most abundant chemical parameters in swine manure, and FC is an abundant biological component. Cu is included for both sampling years because it is a micronutrient that is added to feed. In year 2000, TN was not a standard parameter in the general water chemistry package so the inorganic form of nitrogen (NOX) was used as an indication of possible surface runoff. The concentrations of TN and NOX are not directly comparable but their overall trends are expected to be similar. Note that for all parameters where the concentration is less than or greater than the detection limit, the detection limit value has been used.

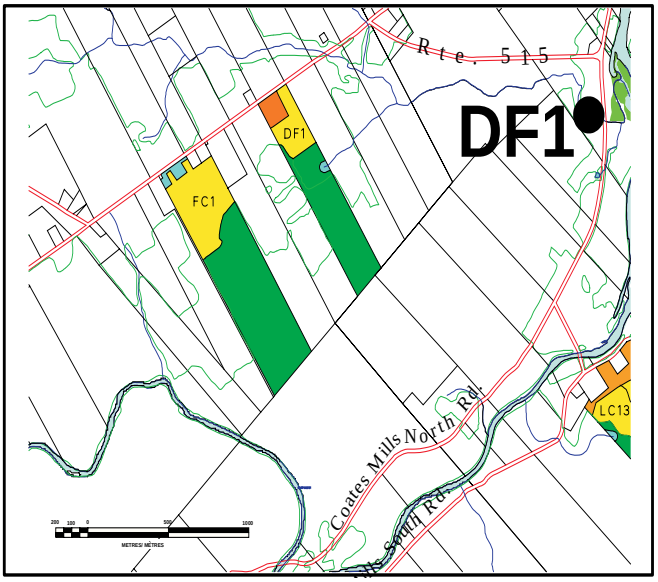
In the following section, the results for each parameter are organized according to area,as well as livestock usage or non-usage and manure spreading history. It must be remembered that water quality may change a great deal over the course of a rainfall event (Figure 8), and field personnel had no way of knowing at precisely what point in the runoff cycle samples were collected. Therefore, caution must be exercised when interpreting results, particularly when comparing results for specific stations and/or dates. Thus, conclusions drawn from the data must be tempered by the fact that results obtained during an event could be as much related to the timing of sample collections as to the effects of manure application.

A further complicating factor was the fact that livestock were pastured on some of the spreading areas. When FC and other parameters were detected in drainage from these areas, the portion originating from the Metz manure and that from the pastured livestock or other sources (e.g. birds or wild animals) could not be determined.

AREAS DF1 AND FC1

Year 2000

Local Map: 00A



Livestock: none known to be pastured within the area.

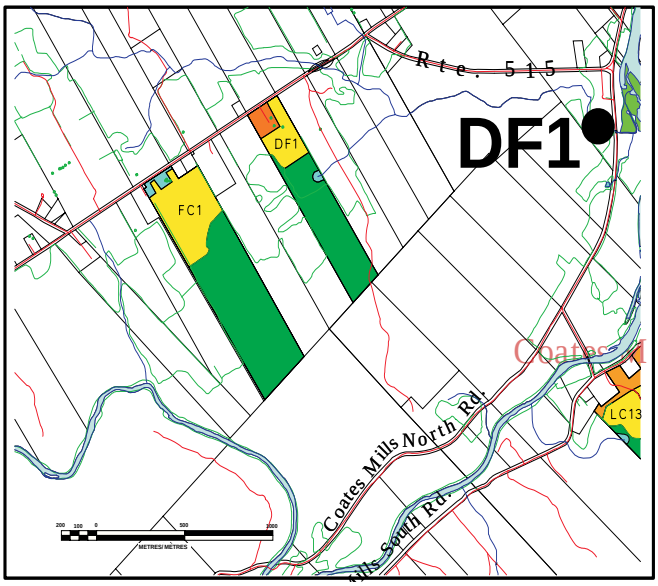
Manure application: no manure applied.

Results: see Figures 9, 10, 11 and 12.

Comments:
An increase in K and TP was measured after a small rainfall event in the middle of September. NOX decreased slightly for the same rain event. Cu remained at less than 0.5 micrograms/L for all three samples. Note the station was not sampled when heavy rainfall occurred in October as no manure was applied to the site.

Year 2001

Local Map: 01A



Livestock: none known to be pastured within the area.

Manure application: no manure applied.

Results: see Figures 13, 14, 15, 16 and 17.

Comments:
K showed an apparent overall increase between spring and fall. For the most part, TN was below detection at less than 0.3 mg/ L. However, both TN and TP increased during the major rain event of November 7. Cu concentrations were highest during the June 4 and November 7 rain event. Fecal coliform values were less than 10 CFU/ 100 ml on May 2 and November 22, and less than 100 CFU/100 ml on September 23. Values increased during three rain events of June 4, August 28, and November 7 with the highest value of 300 CFU/100 ml during the August 28 rain event.

2000

Figure 9

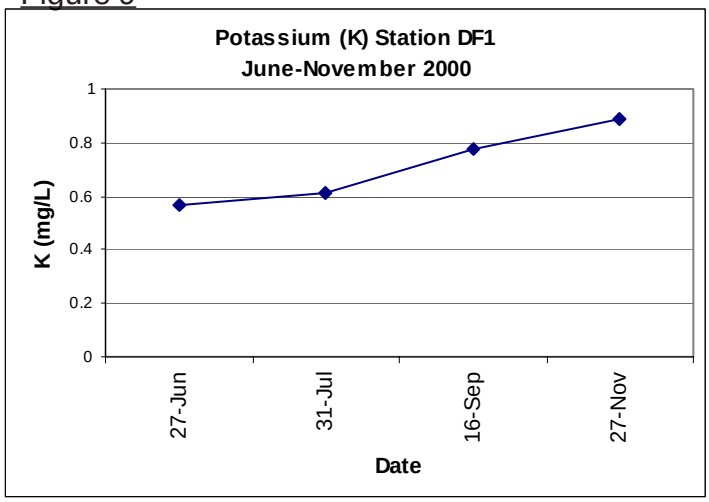


Figure 12

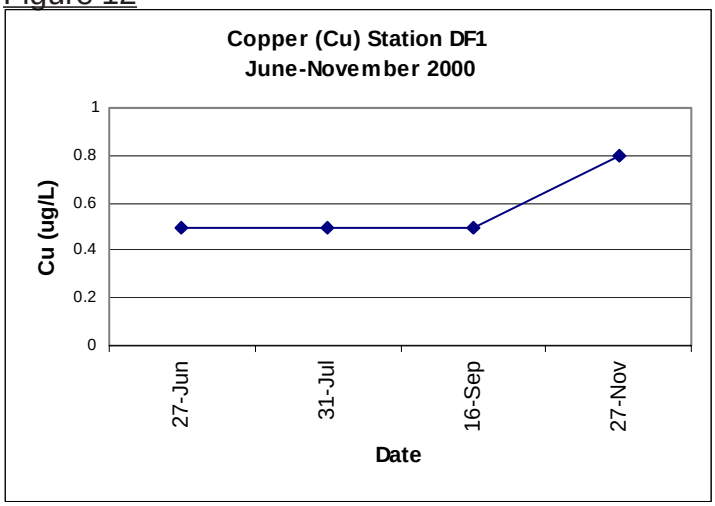


Figure 10

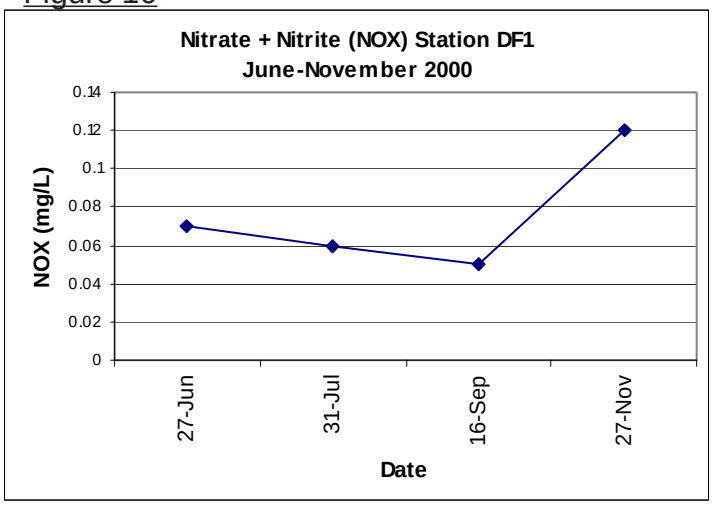
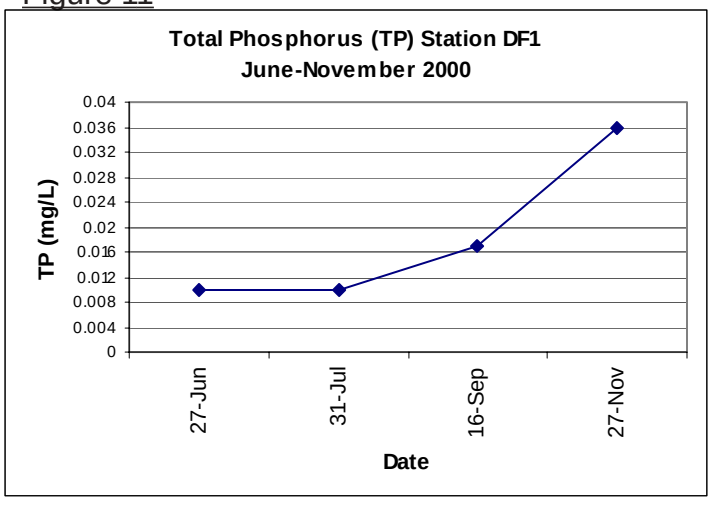


Figure 11



2001

Figure 13

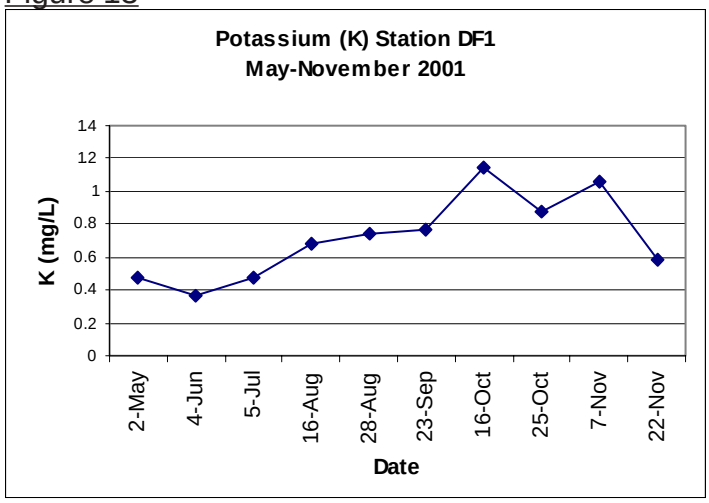


Figure 14

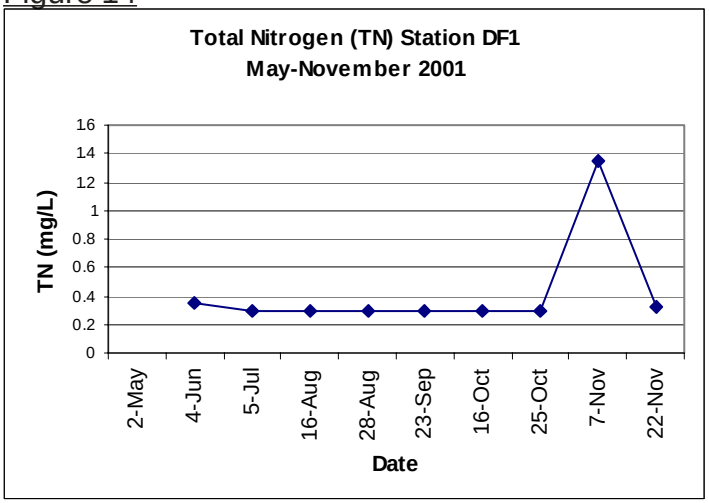


Figure 15

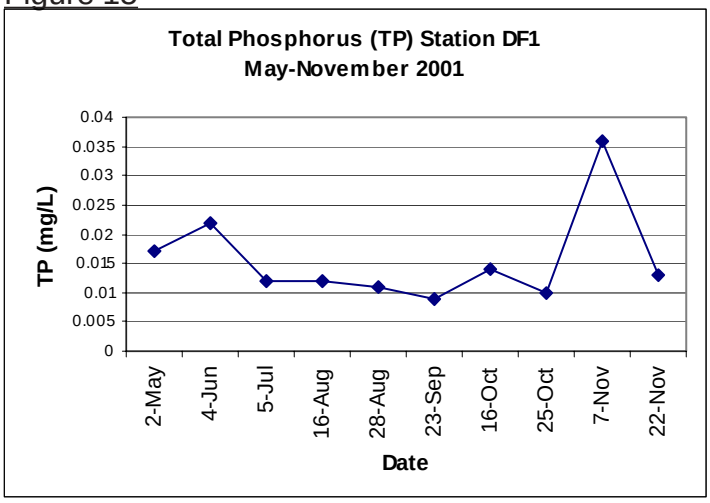


Figure 16

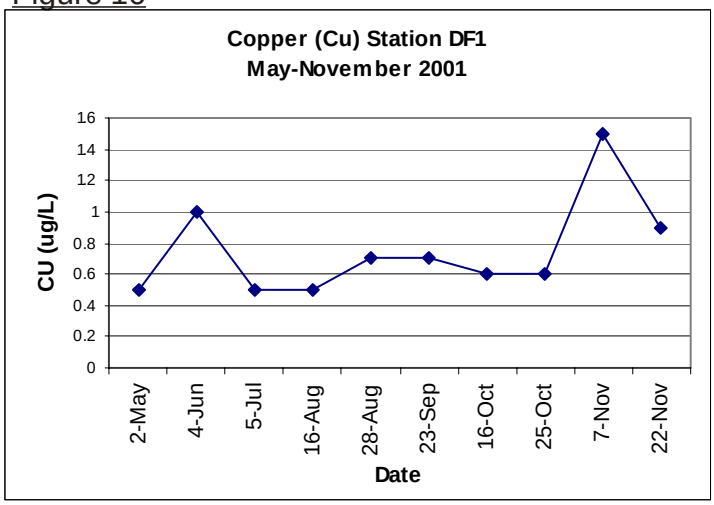
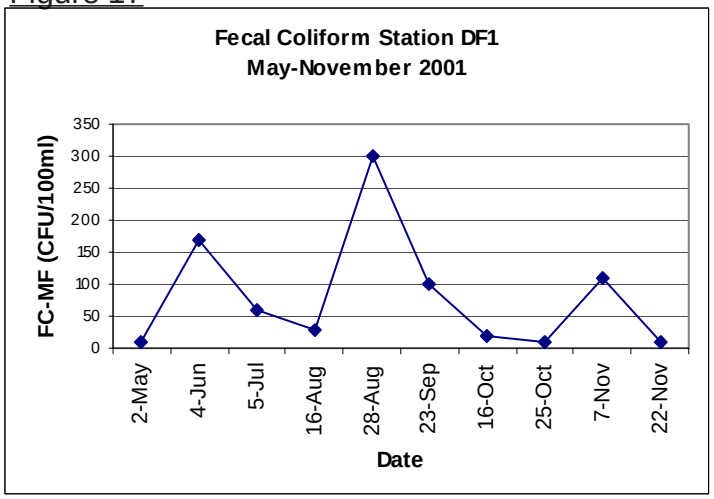


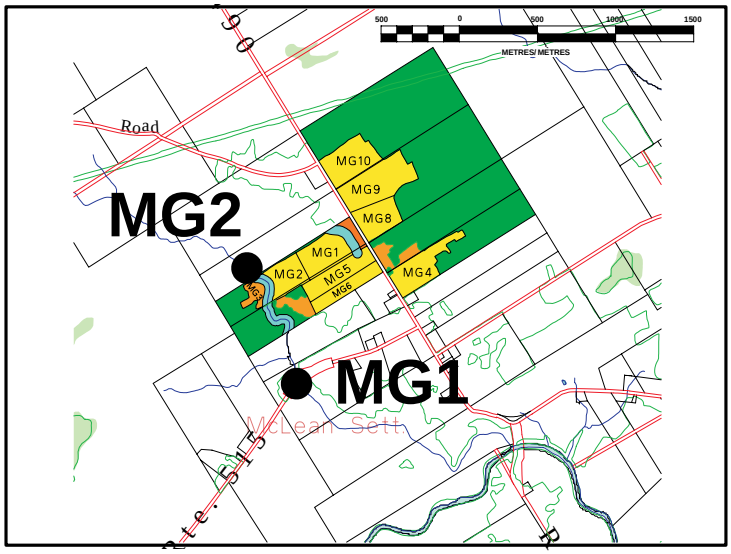
Figure 17



AREA MG

Year 2000

Local Map: 00B



Livestock: none known to be pastured in the area.

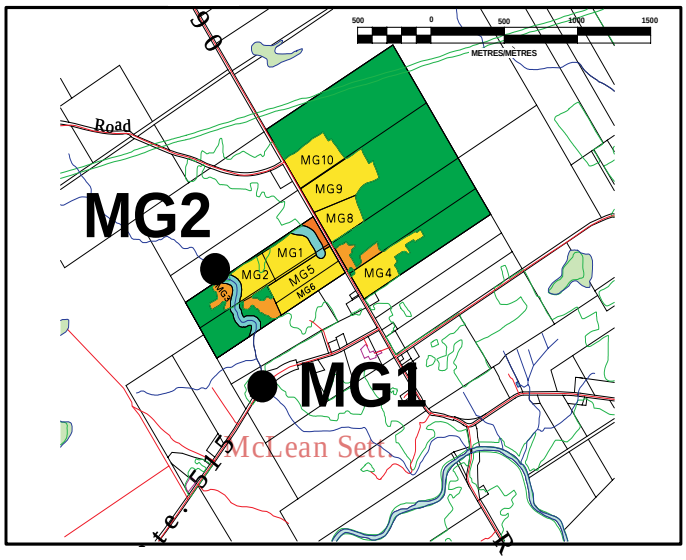
Manure application: none

Results: see Figures 18, 19, 20 and 21.

Comments:
Stations were not sampled during the rainfall events of October because no manure had been applied to the sites. K increased after the rain event of September 16. TP showed an increase during the same rain event but only at station MG1. NOX increased during the September 16 rain event only at station MG2.

Year 2001

Local Map: 01B



Livestock: none known to be pastured in the area.

Manure application: MG1, MG8, MG9, MG10 June 19, 20

Results: see Figures 22, 23, 24, 25 and 26.

Comments:
Overall increase in FC, K, TN, TP, and Cu during the November 7 rain event, which was long after spreading occurred in June.

Figure 18

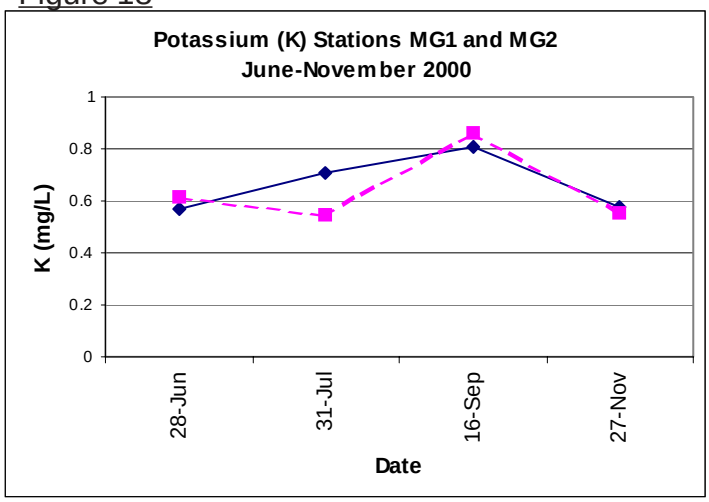


Figure 21

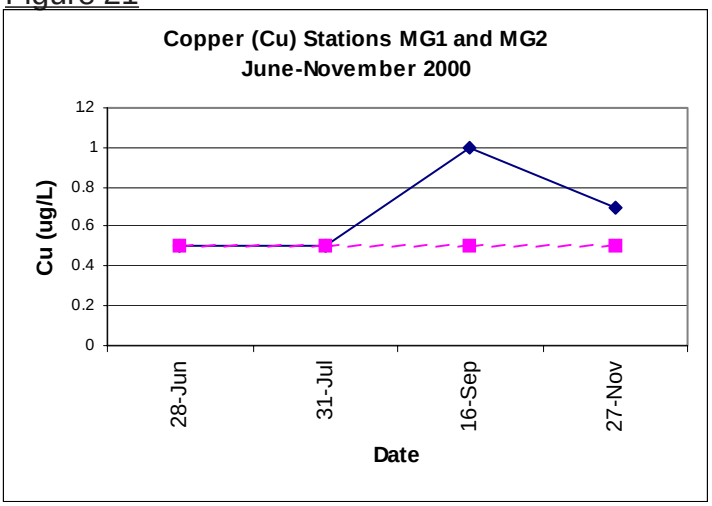


Figure 19

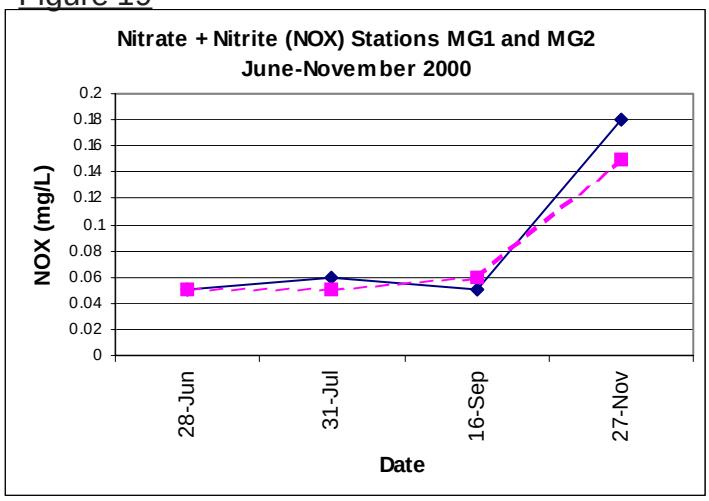
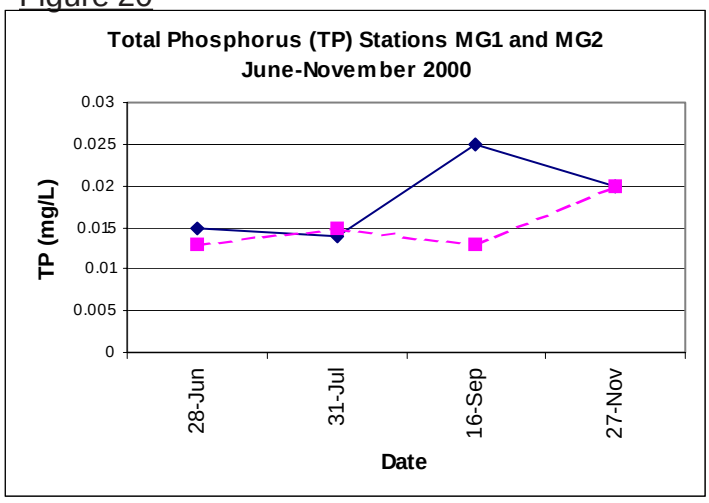


Figure 20



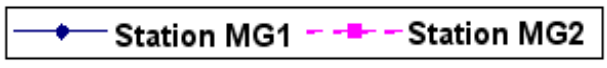


Figure 22

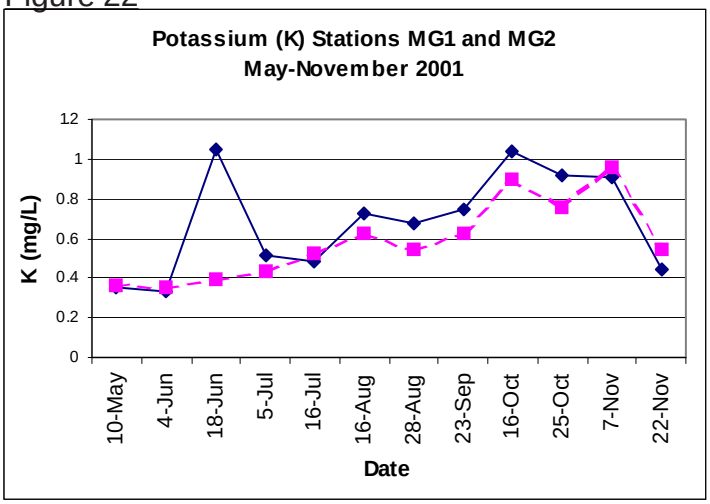


Figure 25

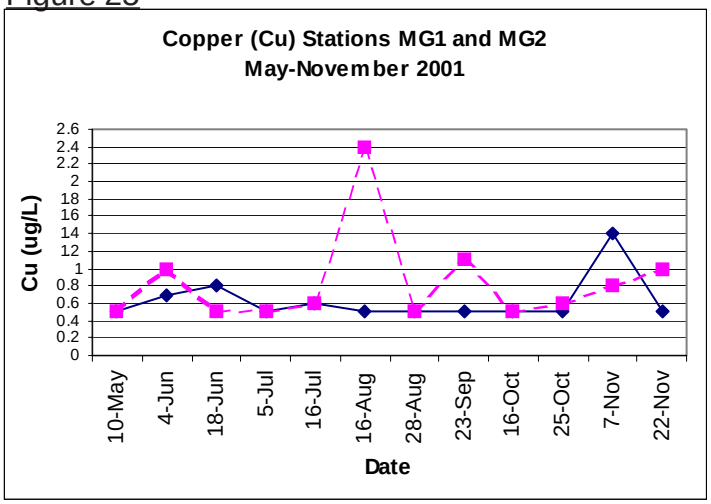


Figure 23

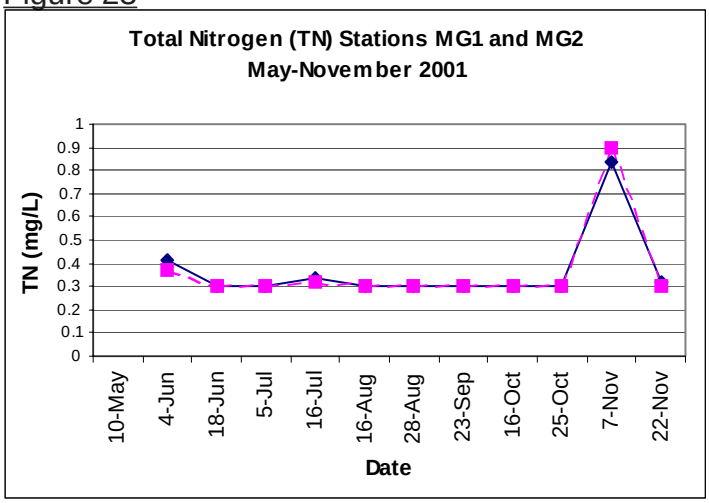


Figure 26

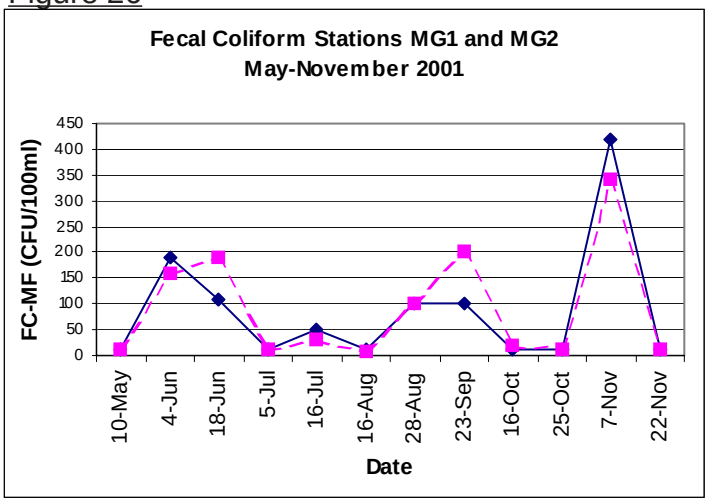
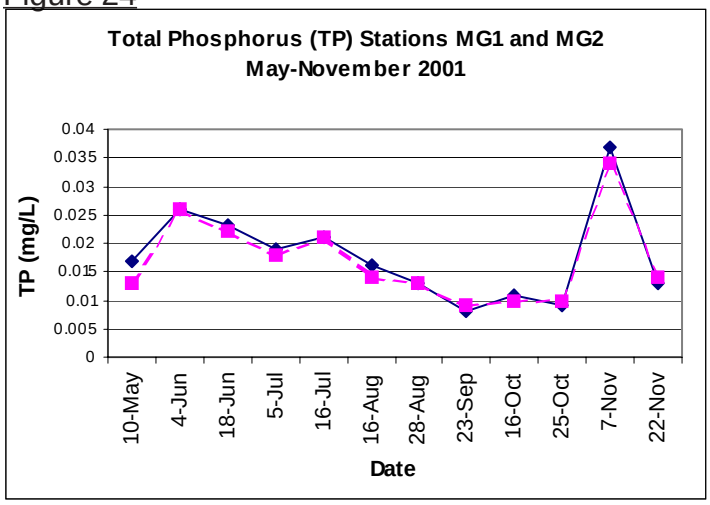
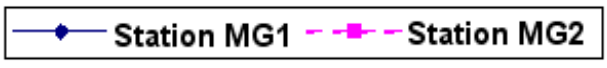


Figure 24



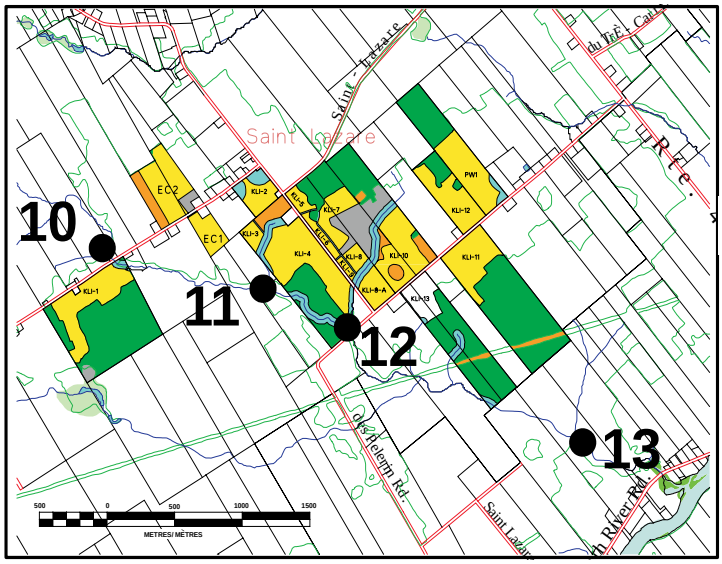


AREAS EC, KL AND PW

Station 10 is an upstream station. Station 11 is downstream of station 10, but upstream of most of the fields proposed for treatment. Station 12 is downstream of most of the fields proposed for manure application. Station 13 is downstream of all fields proposed for treatment, near the confluence with the Bouctouche River.

Year 2000

Local Map: 00C



Livestock: 50 cows on Area EC

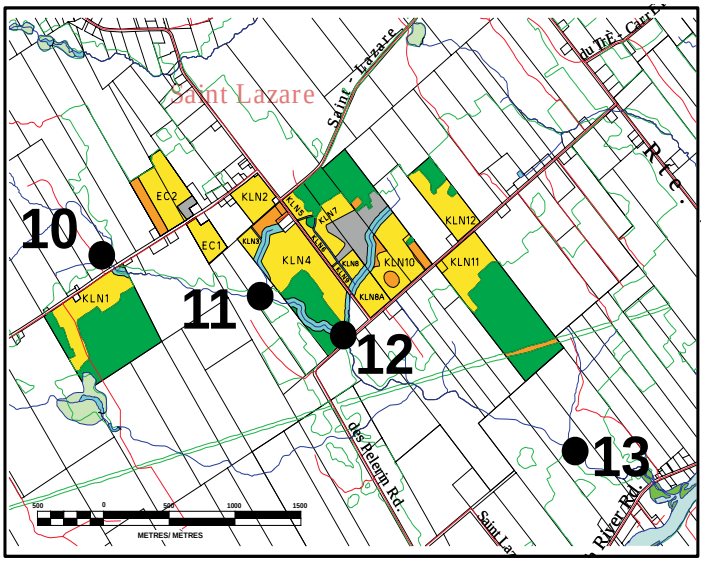
Manure application: none

Results: see Figures 27, 28, 29 and 30.

Comments:
Overall, values for all parameters were lowest in May and June and increased to highest concentrations after the heavy rain in late October. One exception to this was a Cu value of 10 micrograms/L obtained at Station 10 on May 9.

Year 2001

Local Map: 01C



Livestock: 30 cows on Area EC

Manure application: KL4, KL5, KL6, KL8, KL8A, KL9, KL11 June 14, 15, 20.

Results: see Figures 31, 32, 33, 34 and 35.

Comments:
The highest FC values were located at station 11 during the August 28 and November 7 rain events. In general the other parameters increased during the November 7 rain event. These values were obtained long after spreading occurred in June.

2000

Figure 27

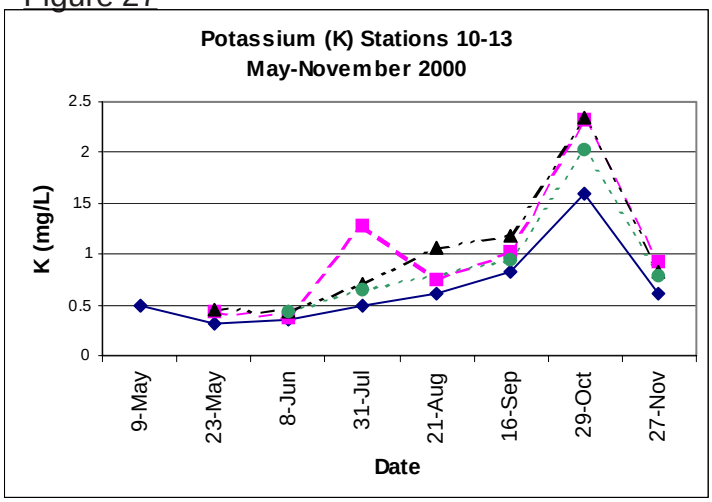


Figure 30

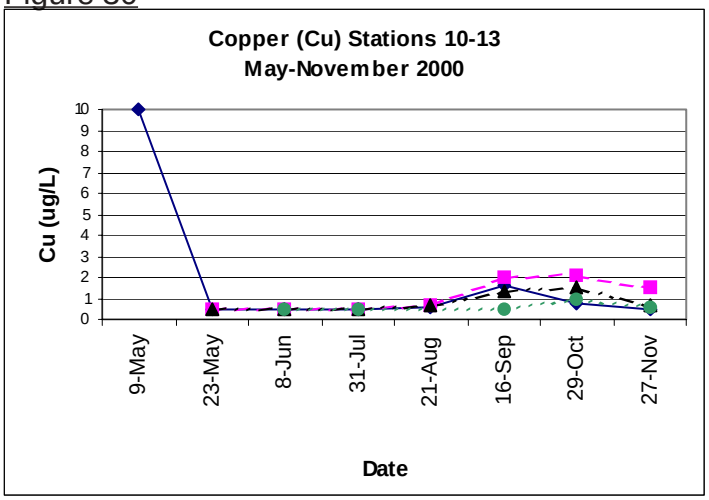


Figure 28

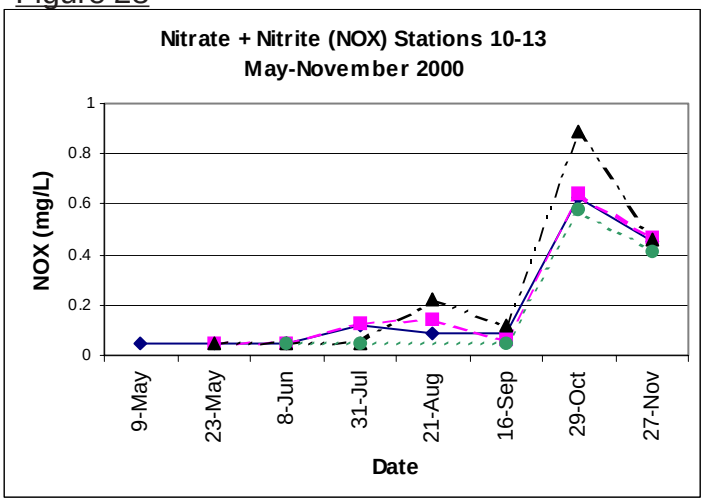
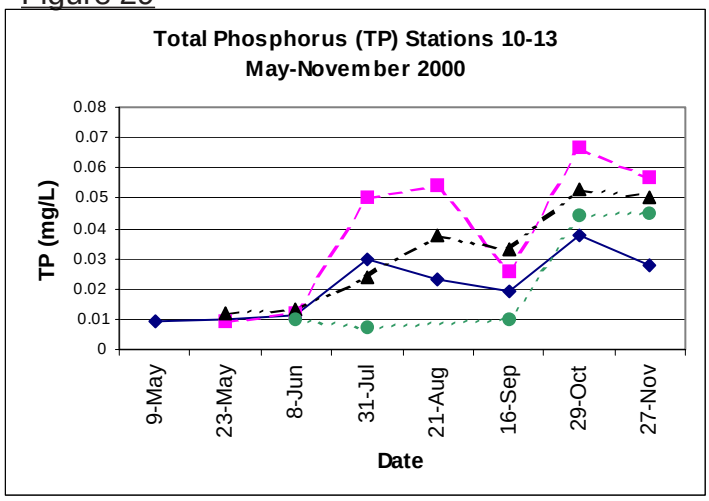
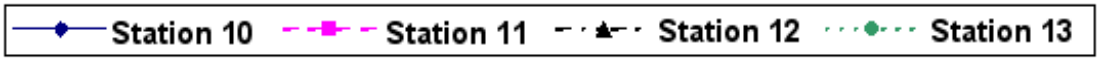


Figure 29





2001

Figure 31

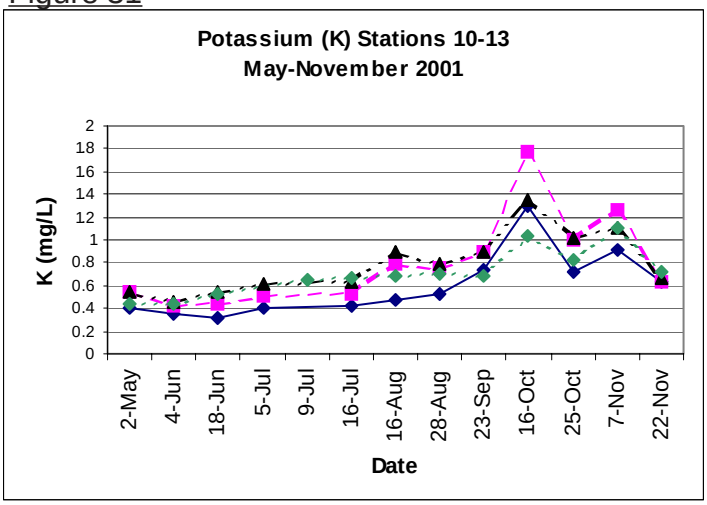


Figure 34

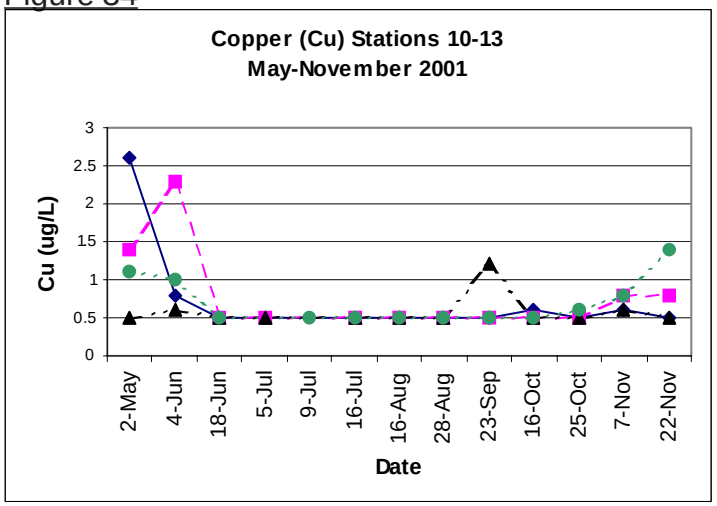


Figure 32

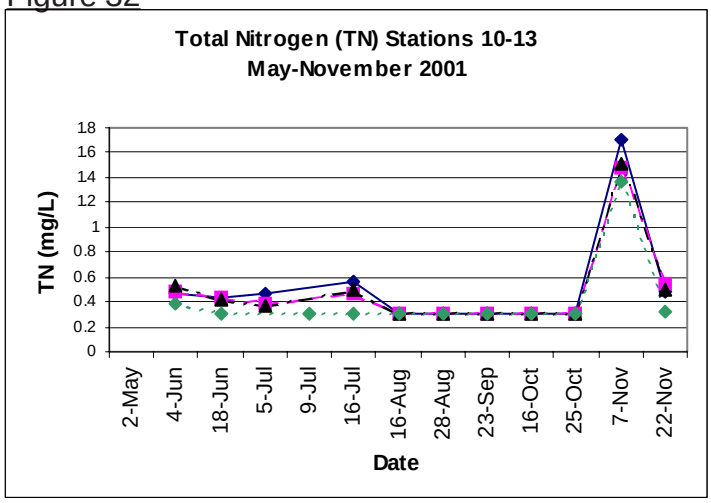


Figure 35

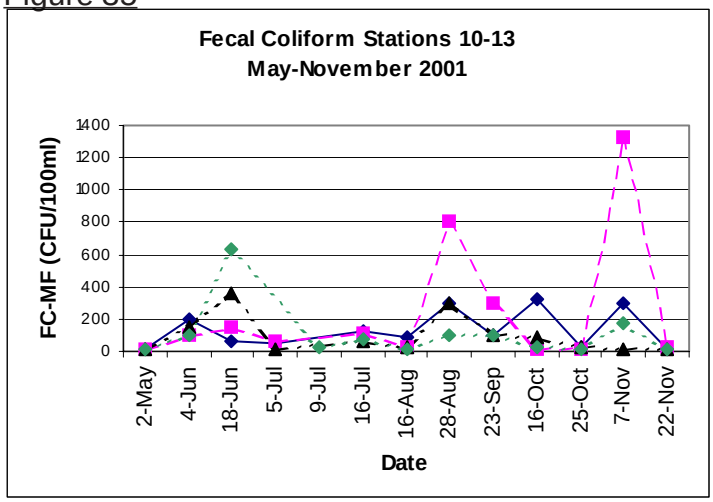
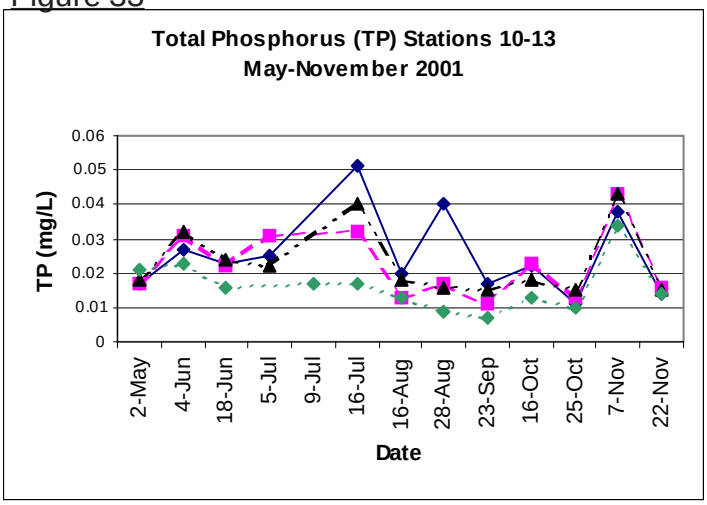
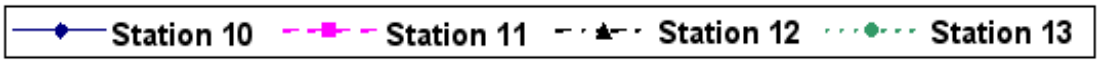


Figure 33



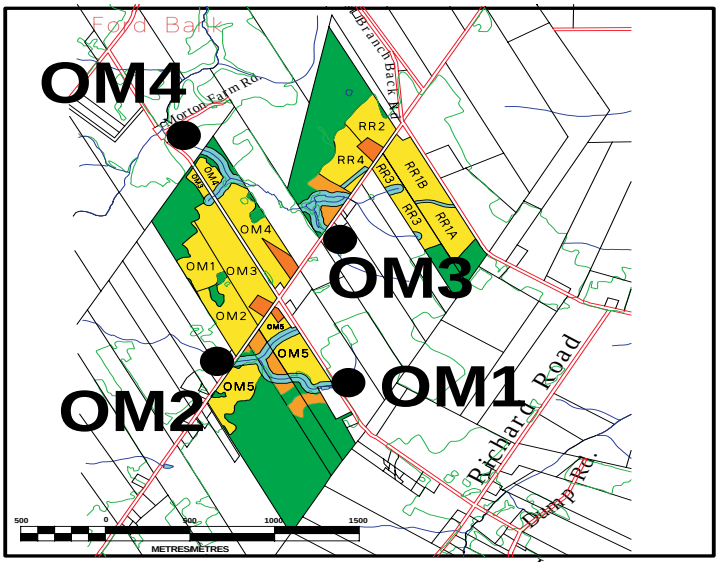


AREAS OM AND RR

Station OM1 is upstream of OM fields. Station OM2 is located downstream of fields designated OM5. Station OM3 is located on the upstream portion of a tributary draining portions of areas RR and OM. Station OM4 is downstream of RR and OM.

Year 2000

Local Map: 00D



Livestock: 40 cows on OM

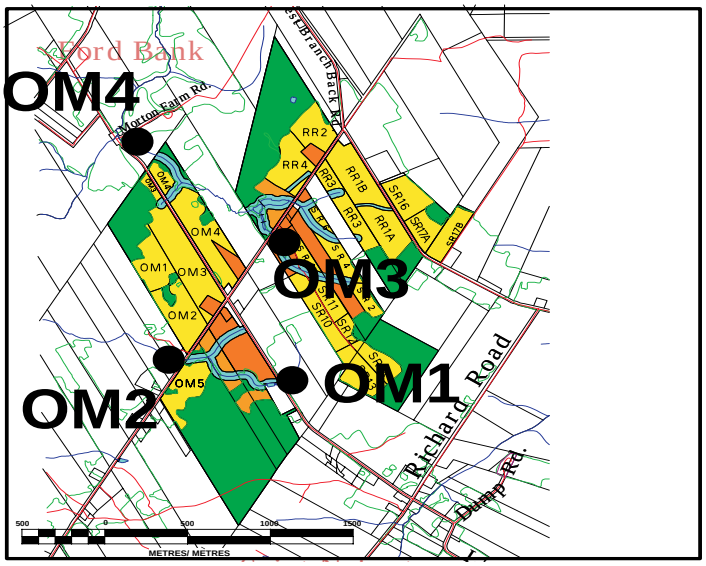
Manure application: none.

Results: See Figures 36, 37, 38 and 39.

Comments:
Station OM3 showed the highest values for K, NOX, TP, and Cu during the September 16 rain event. Stations were not sampled during the rain events in October.

Year 2001

Local Map: 01D



Livestock: 50 cows on OM

Manure application: OM1, OM2, OM3, OM4, OM5 July 27, 30, 31.

Results: See Figures 40, 41, 42, 43 and 44.

Comments:
All parameters including FC, K, TN, TP, and Cu showed an increase in concentration during the rain event of November 7. Cu and TP also showed increased values during the June 4 rain event. Highest values for nearly all parameters occurred long after spreading took place at the end of July.

2000

Figure 36

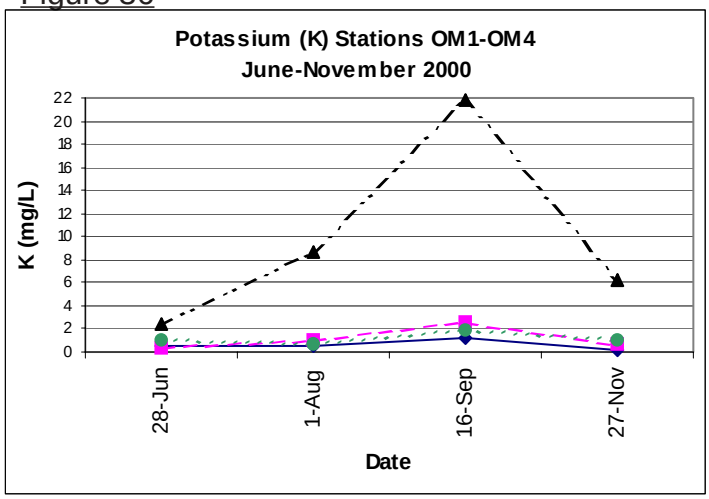


Figure 39

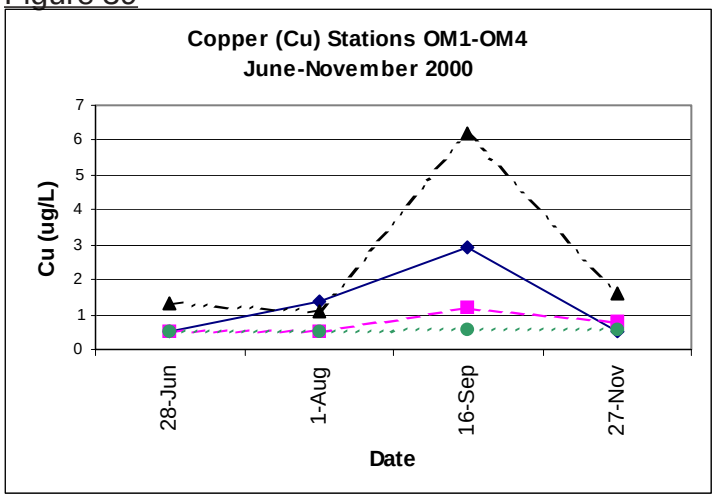


Figure 37

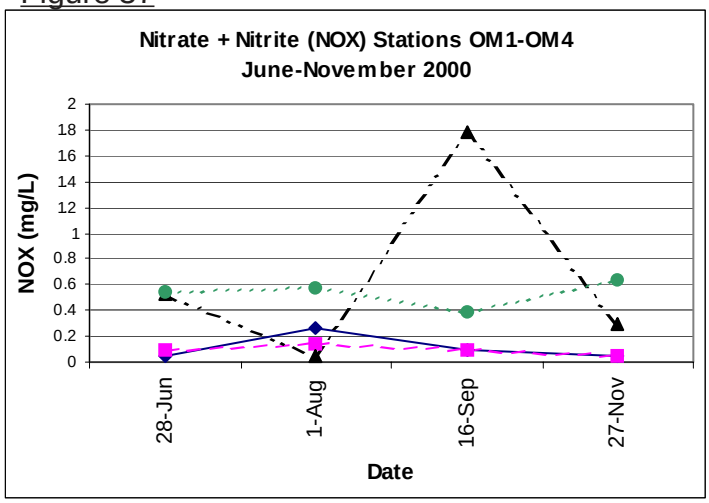
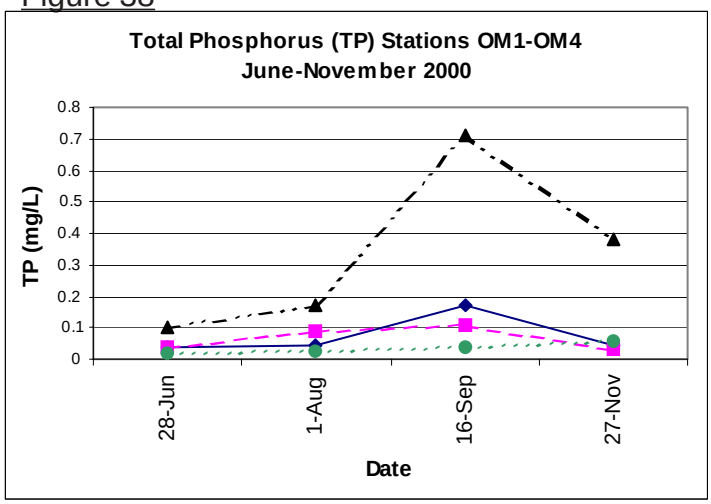
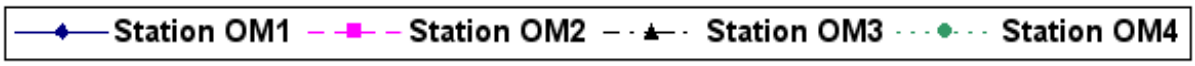


Figure 38





2001

Figure 40

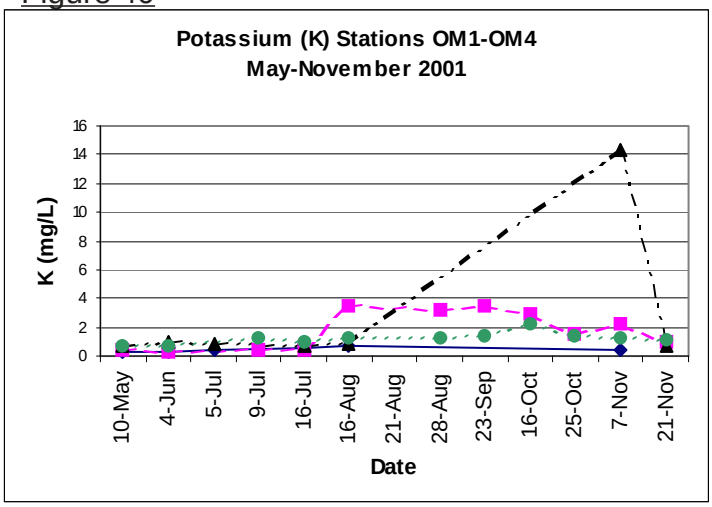


Figure 41

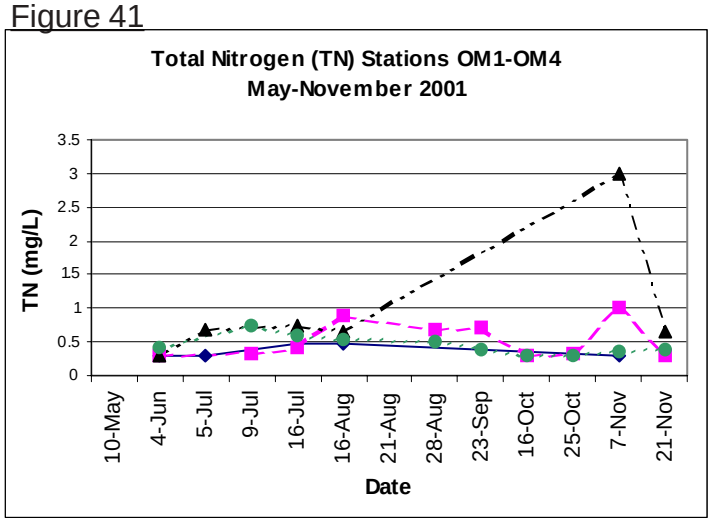


Figure 42

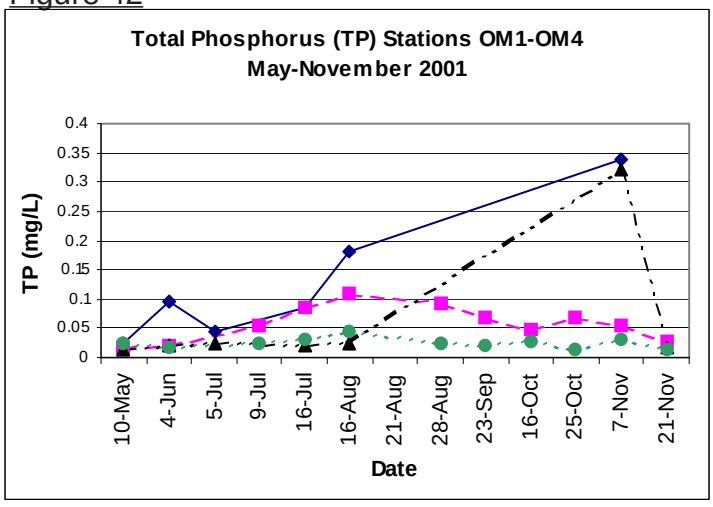


Figure 43

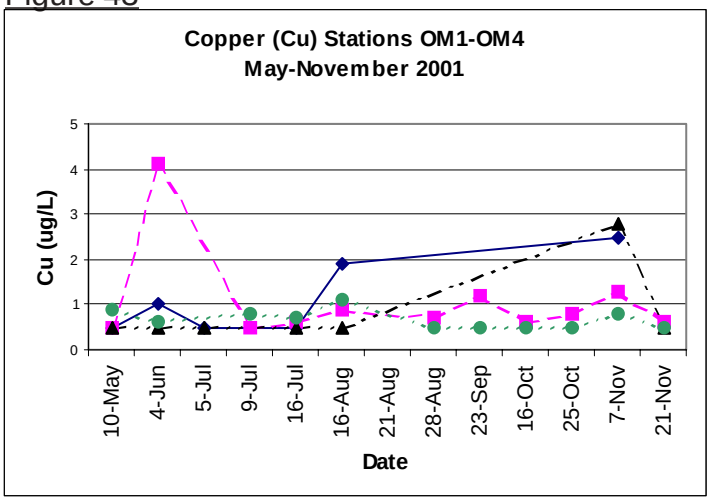
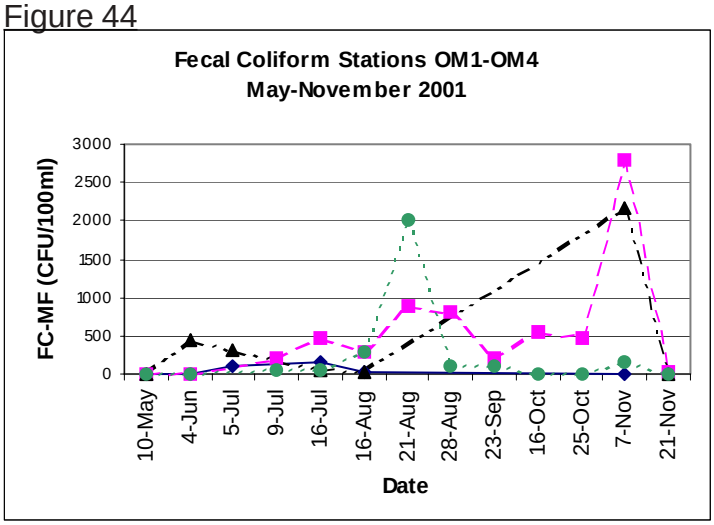
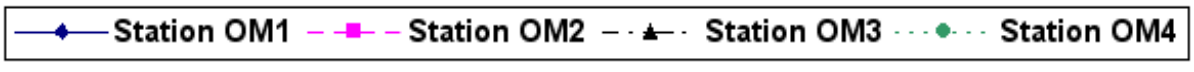


Figure 44



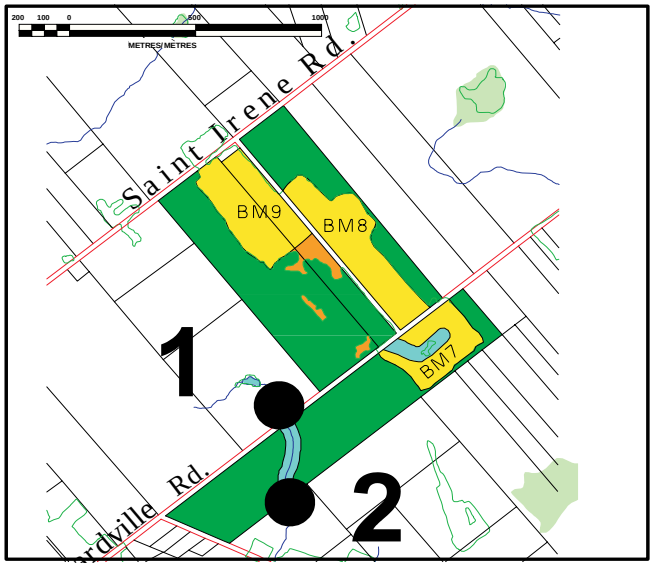


AREAS BM 7, 8, AND 9

Station 1 is an upstream site on a stream draining a wooded area. The stream is a considerable distance from the treated areas. Station 2 is a downstream site. Stations 1 and 2 likely do not represent sites where all drainage from fields BM 7, 8, and 9 enters because the fields are in a watershed divide area. In other words, the sample stations represent only partial drainage from the fields where manure was spread.

Year 2000

Local Map: 00E



Livestock: none

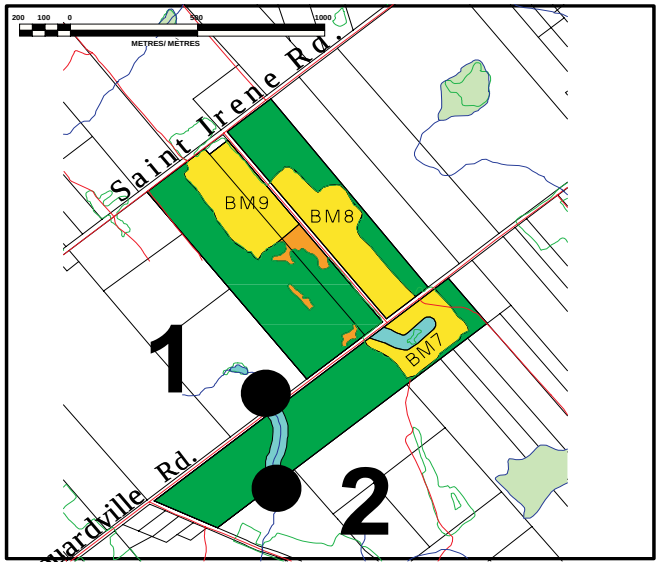
Manure application: BM 7, 8, 9 June 13
BM 7 June 14

Results: See Figures 45, 46, 47 and 48.

Comments:
Concentrations of K, NOX, TP, and Cu all increased after the October 19 rain event. The highest concentration of NOX occurred after the October 29 rain event. Concentrations of all parameters remained relatively low during the summer months. Stations were not sampled immediately after spreading in the middle of June.

Year 2001

Local Map: 01E



Livestock: none

Manure application: BM 8, 9 June 11

Results: See Figures 49, 50, 51, 52 and 53.

Comments:
The highest concentration of FC was obtained after the June 4 rain event. Increased concentrations were also obtained in the middle of October, also related to rain events. Increased concentrations of K occurred after the rain event of October 16 and 17. The highest values of TN and TP were obtained on November 7.

2000

Figure 45

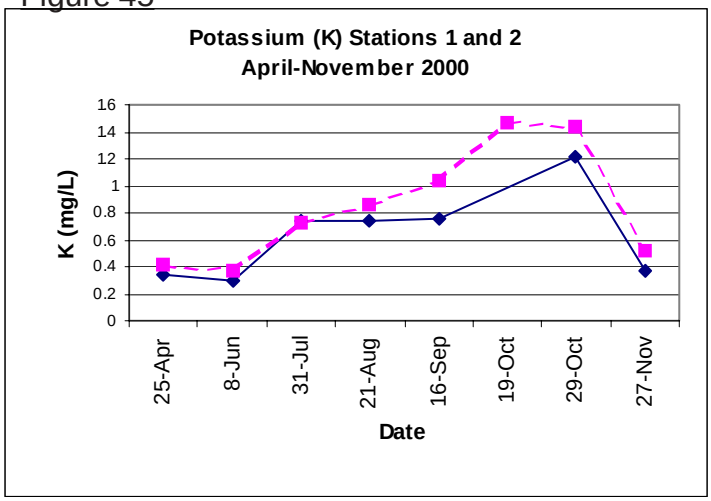


Figure 48

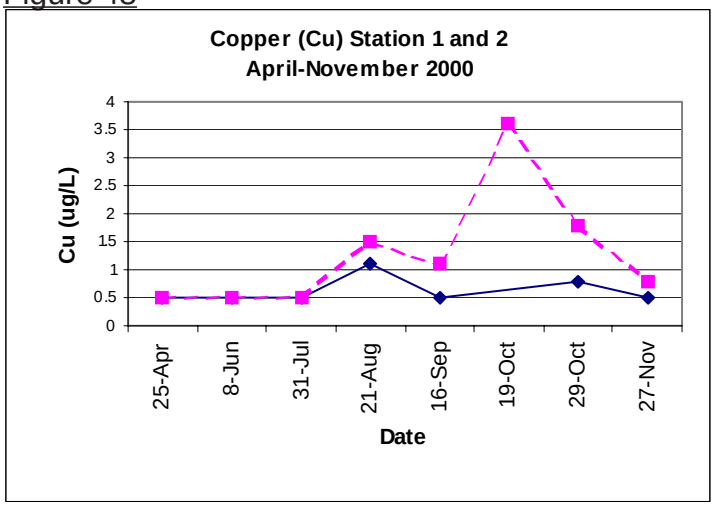


Figure 46

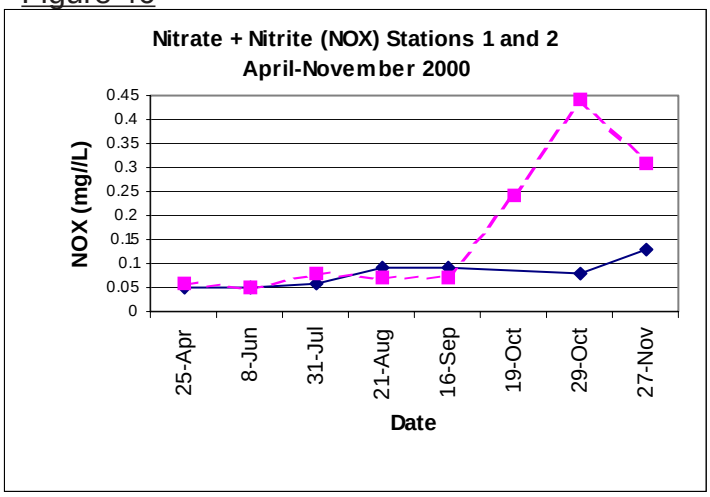
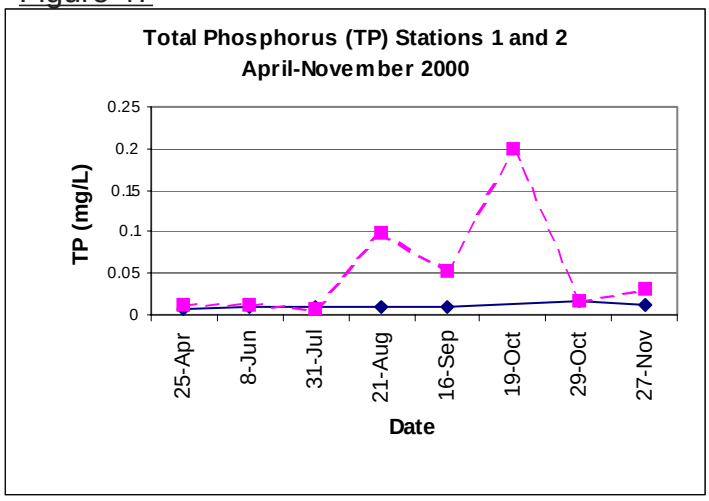
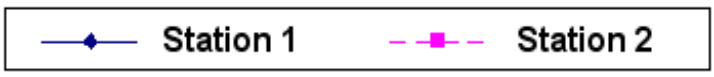


Figure 47





2001

Figure 49

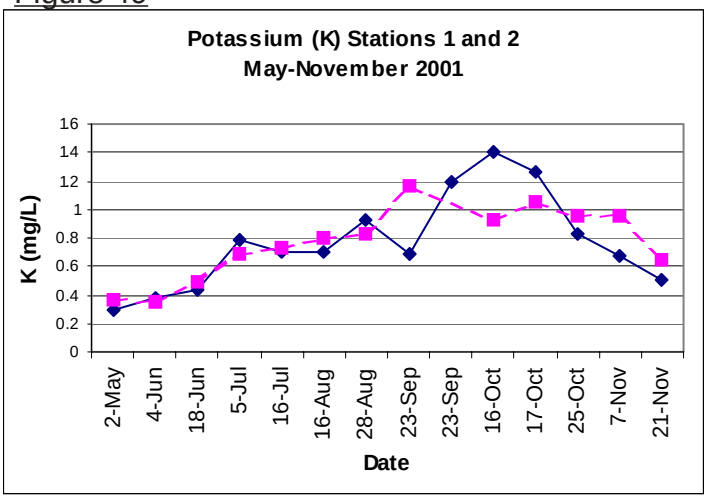


Figure 52

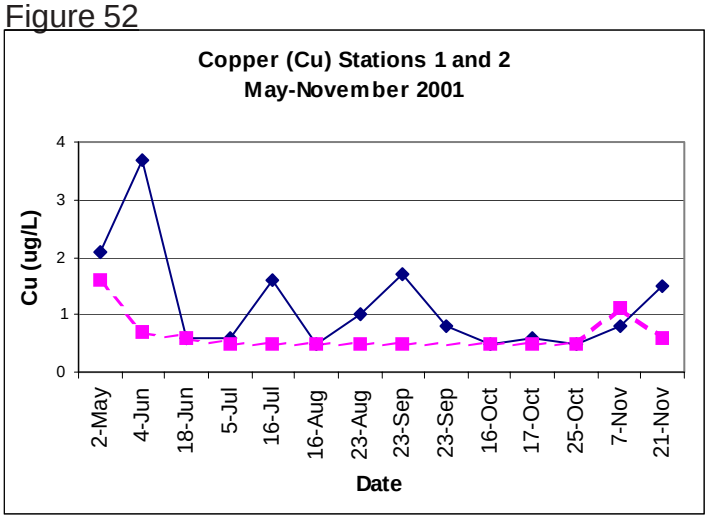


Figure 50

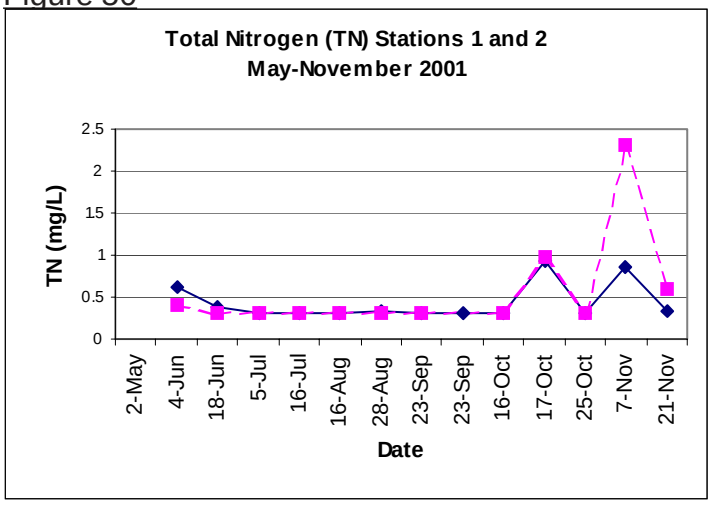


Figure 53

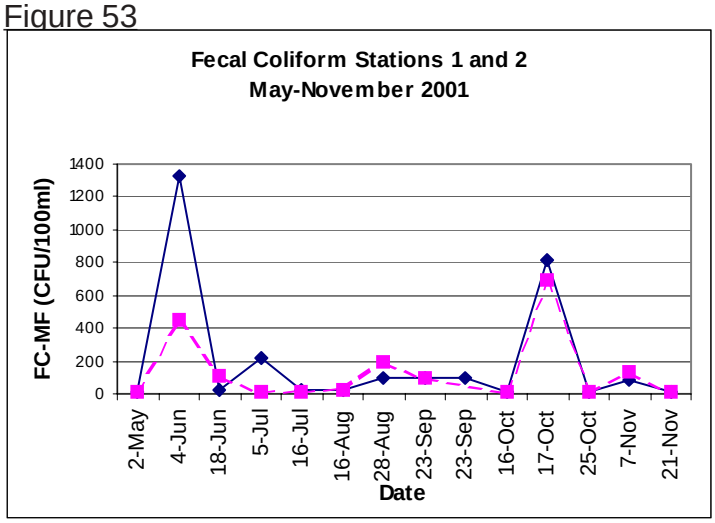
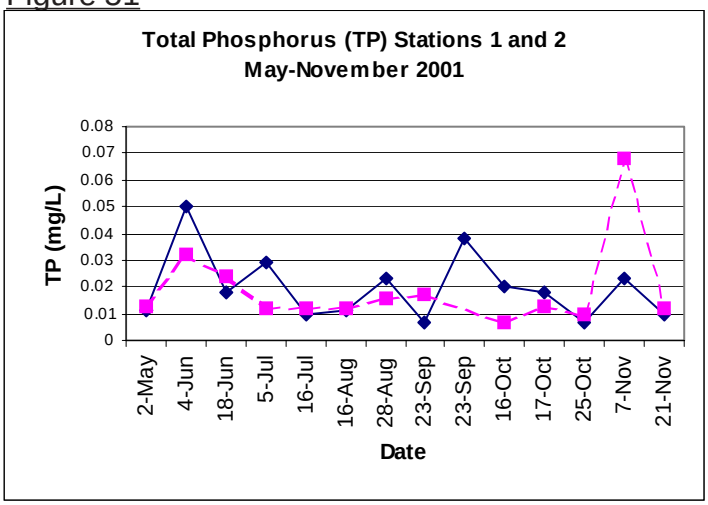
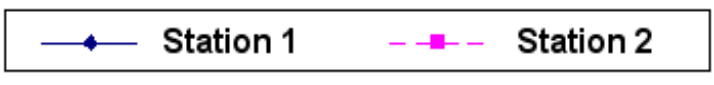


Figure 51



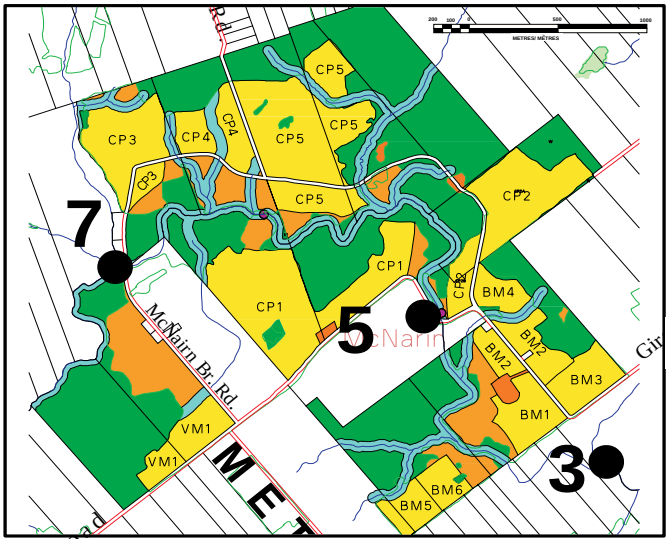


AREAS CP AND BM

Station 7 is upstream of the treated areas. Station 5 is located about two thirds the distance down the drainage from Station 7. A large portion of the treated area, as well as community pasture are upstream of this site. Station 3 is located downstream of areas where Metz manure was applied.

Year 2000

Local Map: 00F



Livestock: CP 350 cows; BM 80 cows, 20 heifers, 20 horses

Manure Application:

CP 1	October 11 and 12
CP 2	June 15
CP 3	June 1, 14
BM 2, 3	June 14
BM 4	June 15
BM 5, 6	June 13
VM1	October 12, 23, 24, 25

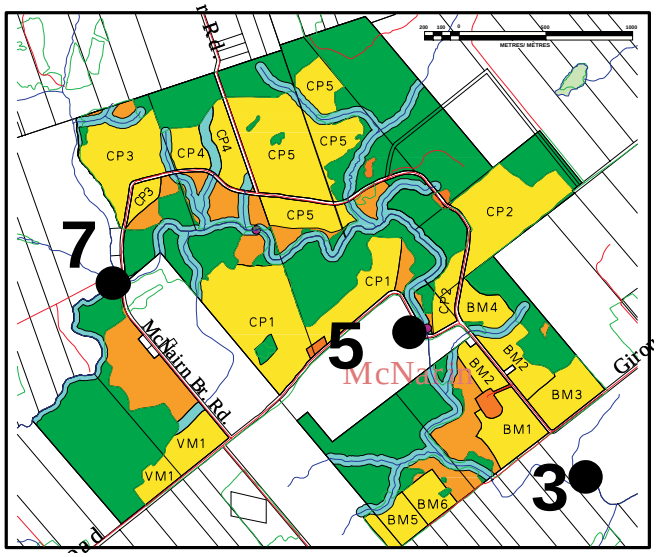
Results: See Figures 54, 55, 56 and 57.

Comments:
In summary, the heavy rains of September and October appeared to have resulted in overall increases of K, NOX, TP, and Cu. NOX shows a pattern of increasing concentration downstream from station 7 to station 3 for nearly all sampling events. TP concentrations decreased between the rain

Year 2000 Continued on Page 46

Year 2001

Local Map: 01F



Livestock: CP 280 cows; BM 70 cows, some horses

Manure Application:

BM1, BM2, BM3, and BM4	June 11, 13
BM5, BM6	October 22
VM1	September 25
CP1, CP2, CP3, CP4, and CP5	October 29

Results: See Figures 58, 59, 60, 61 and 62.

Comments:
Highest FC concentrations occurred after the August 28, October 17, and November 7 rain events. TN and TP concentrations remained low throughout the summer months and were highest after the rain event on November 7.

Year 2000 Continued from page 45

events of October 19 and October 29 for all three sample stations. This could indicate that much of the available phosphorus was removed via runoff after the first rain events in the fall.

2000

Figure 54

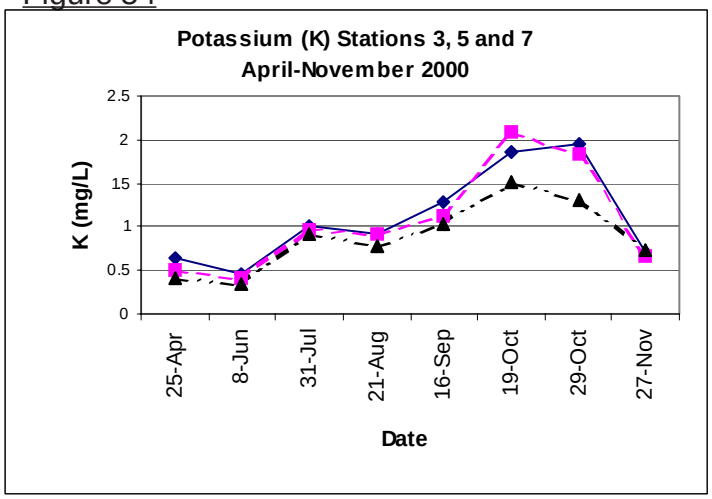


Figure 57

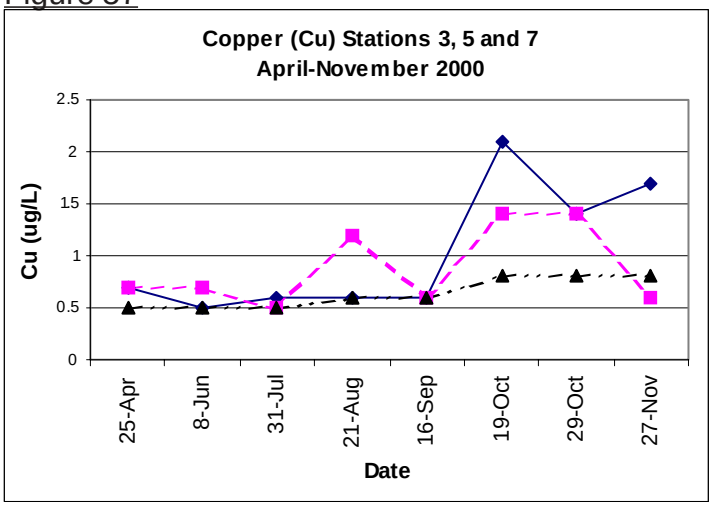


Figure 55

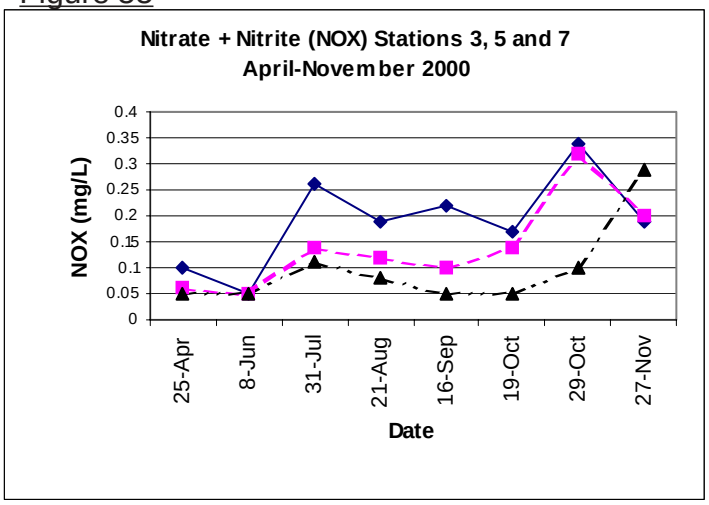
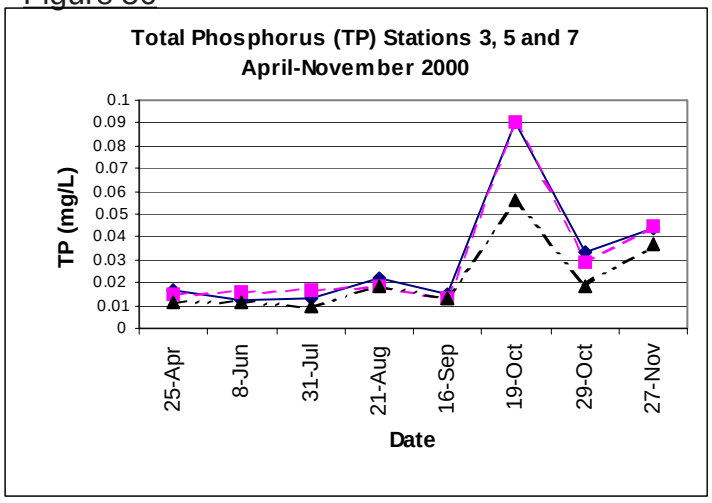
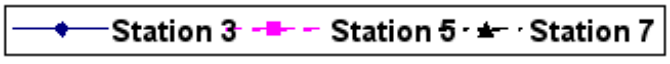


Figure 56





2001

Figure 58

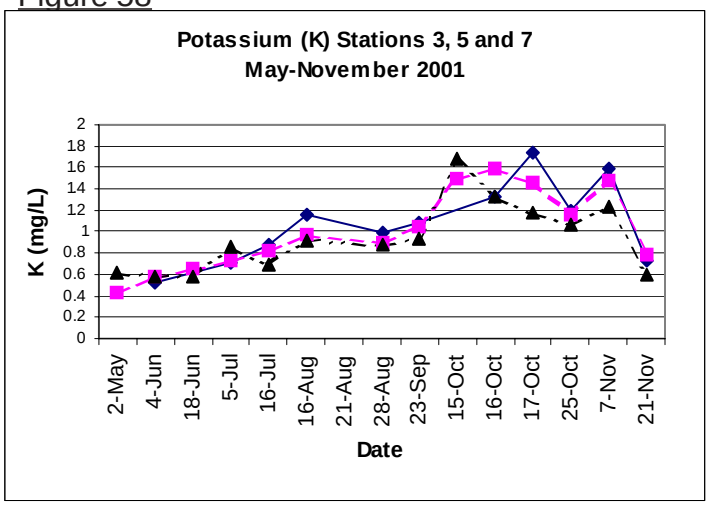


Figure 61

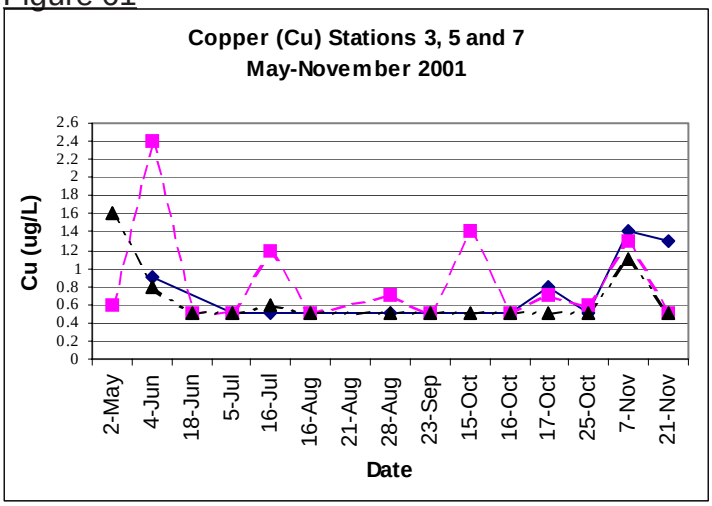


Figure 59

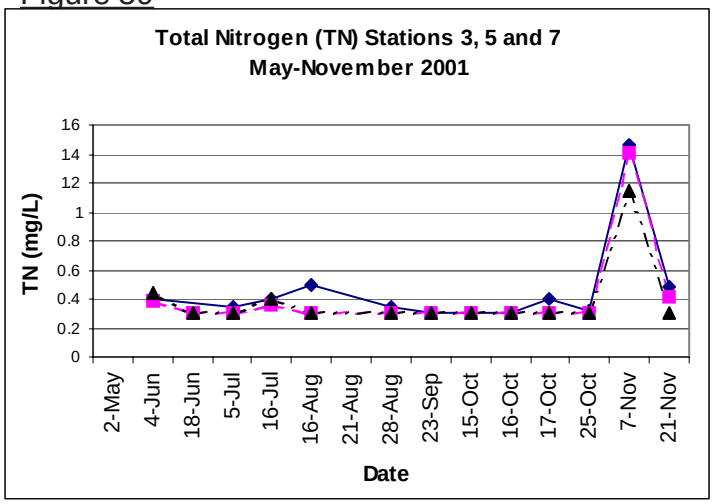


Figure 62

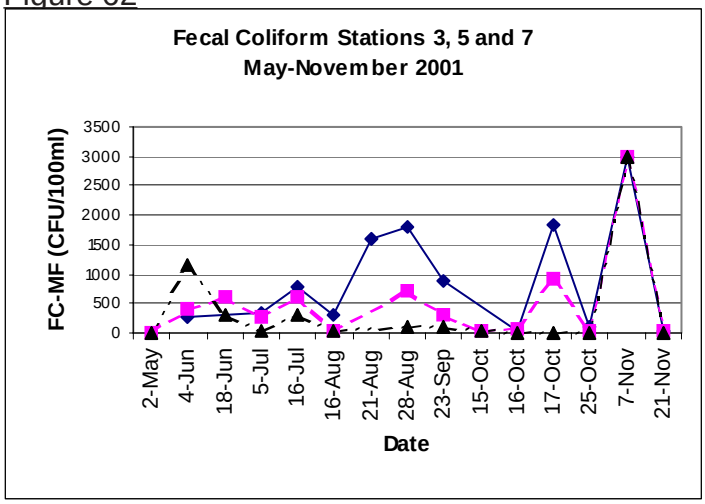
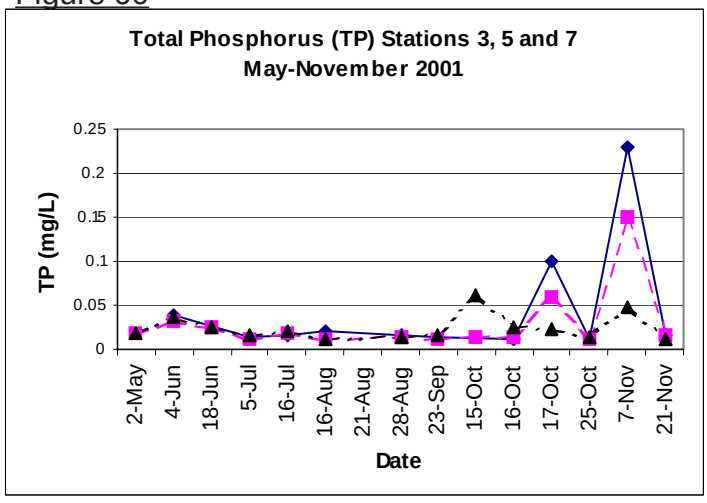


Figure 60



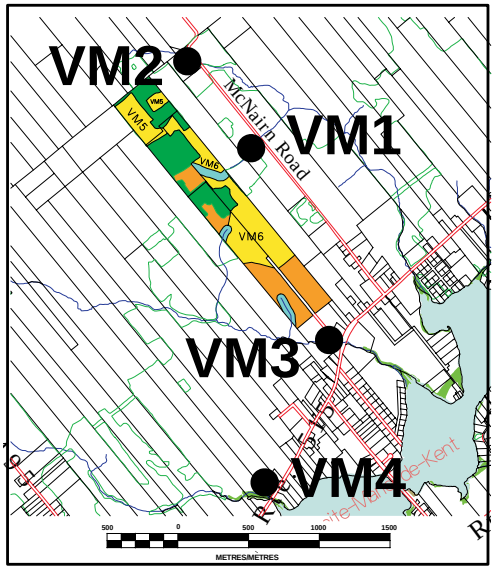
Station 3 Station 5 Station 7

AREA VM

Station VM 1 drains a portion of field VM 6. Station VM 2 drains field VM 5 and a surrounding area. Station VM 3 drains mostly hay fields, however, a small tributary of the main stream drains a portion of Field VM 6. Station VM 4 drains an area that was not treated. Land use in the drainage is considered to be typical of that throughout the area, mostly hay fields and some cattle. Note that in year 2001, several samples from station VM4 were probably of ocean water (taken at high tide) and have not been included.

Year 2000

Local Map: 00G



Livestock: 40 cows

Manure Application:

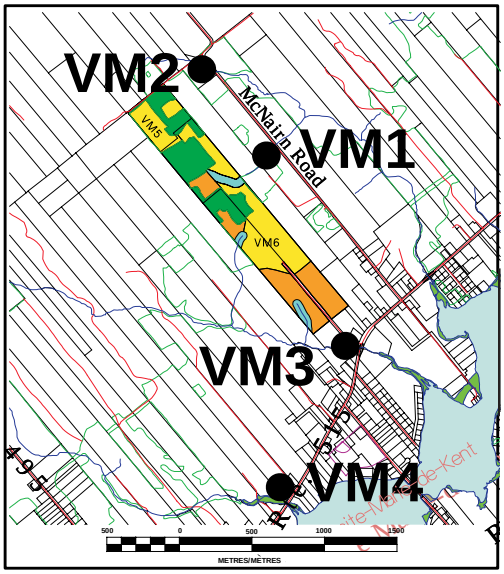
VM5 October 24
VM6 October 23, 24

Results: See Figures 63, 64, 65 and 66

Comments:
NOX concentrations were highest after the rain event on October 29. TP was highest after the October 19 rain event and dropped considerably after the October 29 rain event. Cu values peaked after the rain event of September 16.

Year 2001

Local Map: 01G



Livestock: none

Manure Application:

VM5, VM6 October 24, 25

Results: See Figures 67, 68, 69, 70 and 71.

Comments:
FC concentrations were very high (10,200 CFU/100 ml) at station VM3 after the September 23 rain event. This station drains only a minor portion of spreading area VM6. Also, the area did not receive manure until October. Therefore, it is not possible that the Metz spreading resulted in this high value. TN was highest for three out of the four sampling stations after the rain event on November 7. TP peaked at station VM2 after the September 23 rain event.

2000

Figure 63

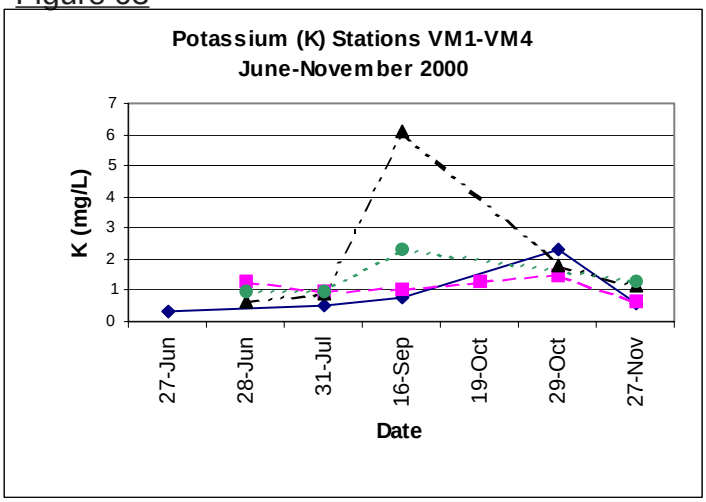


Figure 66

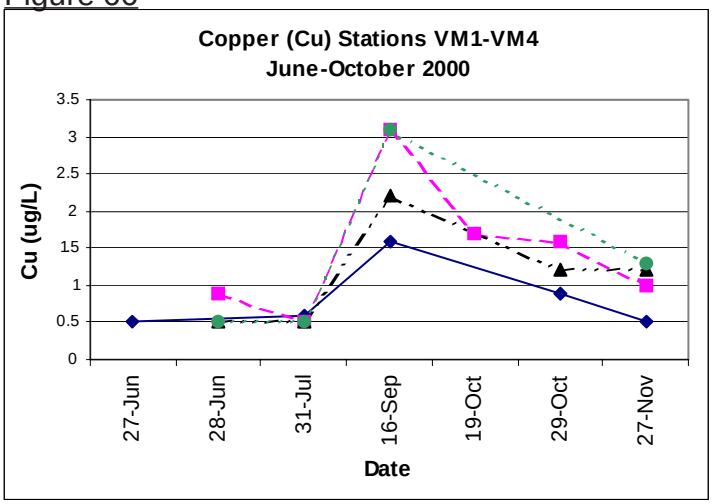


Figure 64

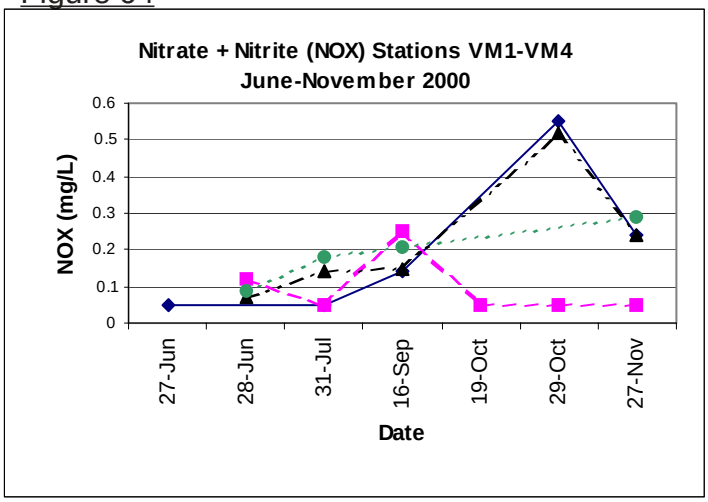
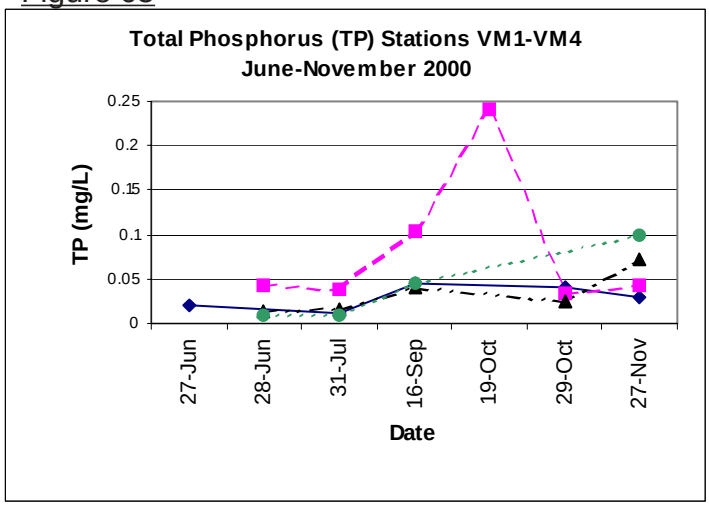
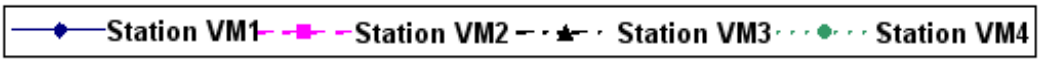


Figure 65





2001

Figure 67

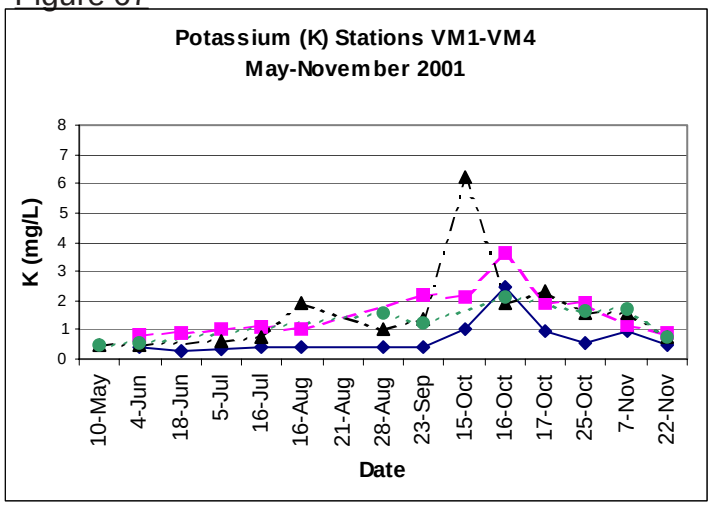


Figure 68

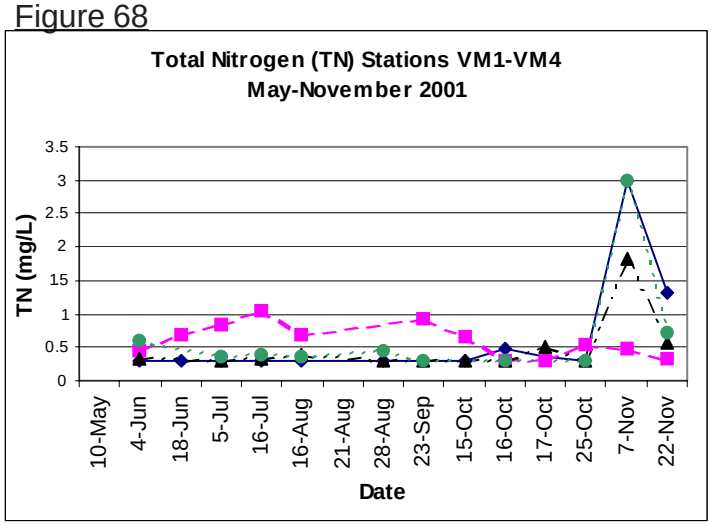


Figure 69

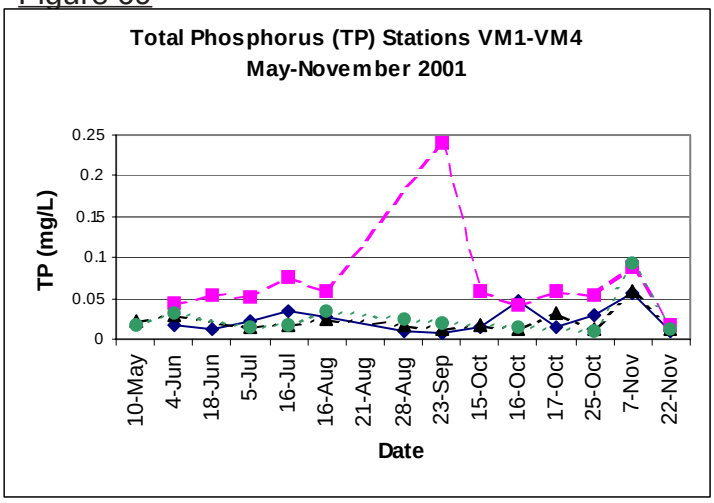


Figure 70

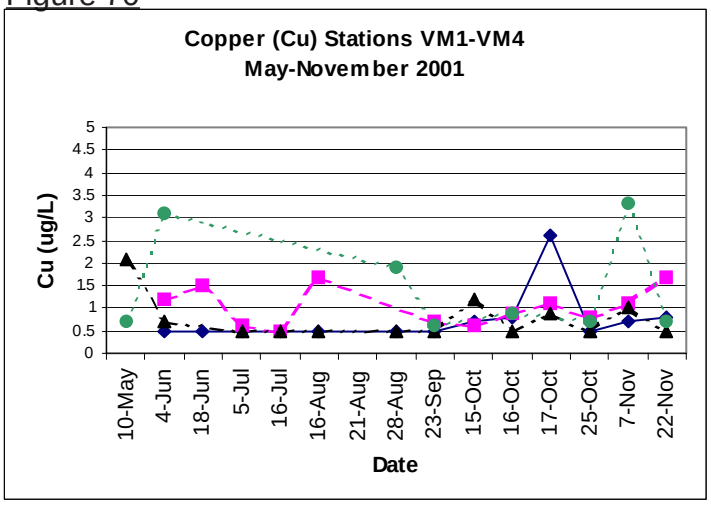
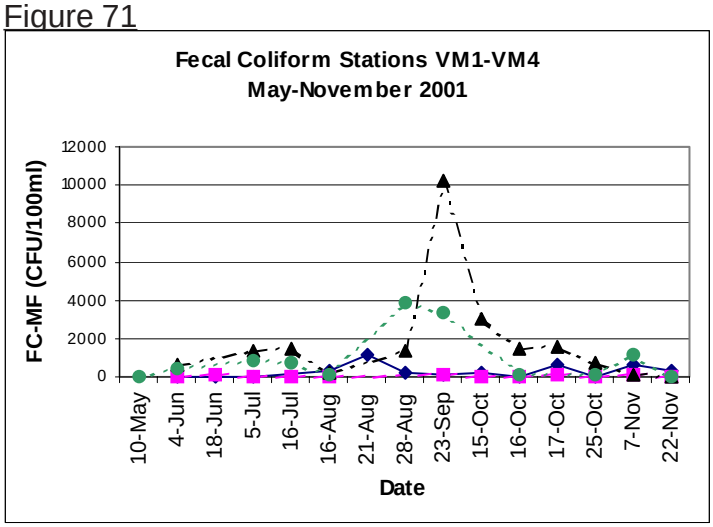
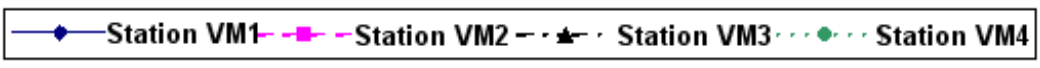


Figure 71



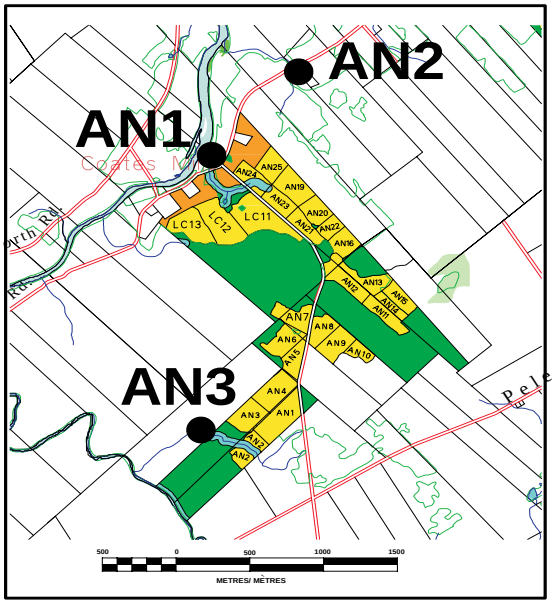


AREAS AN AND LC

Station AN1 is located downstream of treated area. Station AN3 is located upstream of station AN1 (note this station was moved in Year 2001 because the first location generally did not have enough water during dry periods). Station AN2 is located on a small tributary of the Bouctouche River and represents drainage from fields with the AN designation, but also drained considerable area outside of the AN fields.

Year 2000

Local Map: 00H



Livestock: 100 cows, 75 calves (AN)

Manure application:

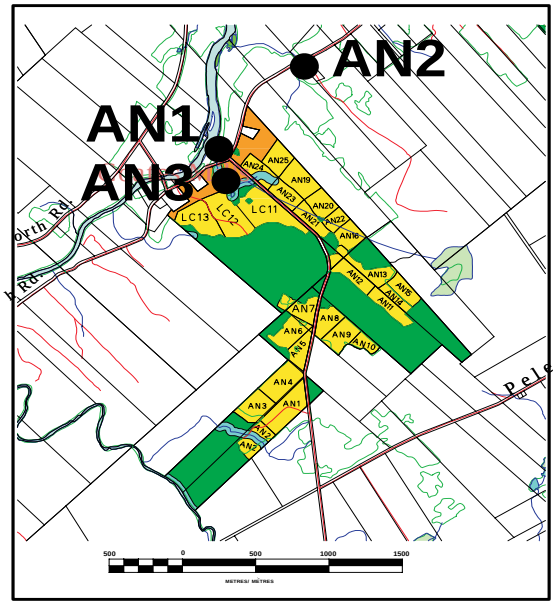
AN 1,2,3,4	October 26, 27
AN 20,21,22	October 25, 26
AN 19,23	October 25, 26
AN 16	October 26
AN 8,9,10	October 27
LC 11,12,13	October 25, 26

Results: See Figures 72, 73, 74 and 75.

Comments:
K, NOX, TP, and Cu all increased after the October 29 rain event. K, TP, and Cu increased to a lesser degree after the September 16 rain event compared to the lower concentrations in June and July.

Year 2001

Local Map: 01H



Livestock: 55 cows (AN 11 to 23)

Manure application:

AN11, AN12, AN13, AN14 and AN15	September 28
AN8, AN9, AN10	October 1
AN1, AN2, AN3, and AN4	October 1, 2
AN5, AN6, AN7	October 2

Results: See Figures 76, 77, 78, 79 and 80.

Comments:
FC concentrations were relatively high at station AN1 on July 5 as well as during the October rains and after the rains on November 7. K, TN, and TP were elevated on July 5. The elevated concentrations on July 5 were not related to a rain event.

2000

Figure 72

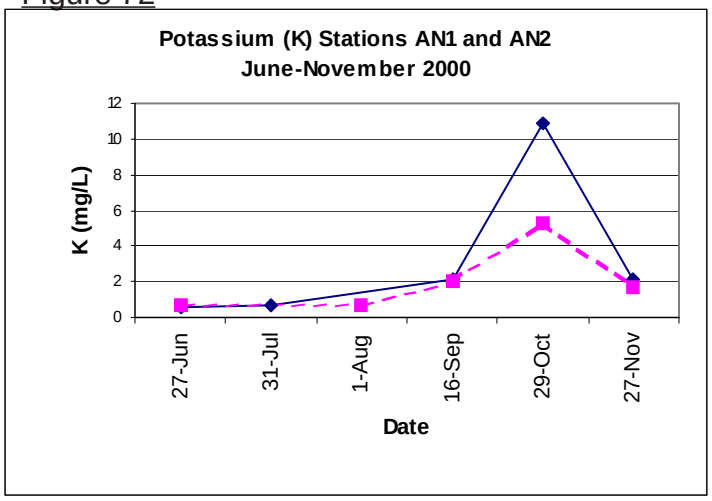


Figure 75

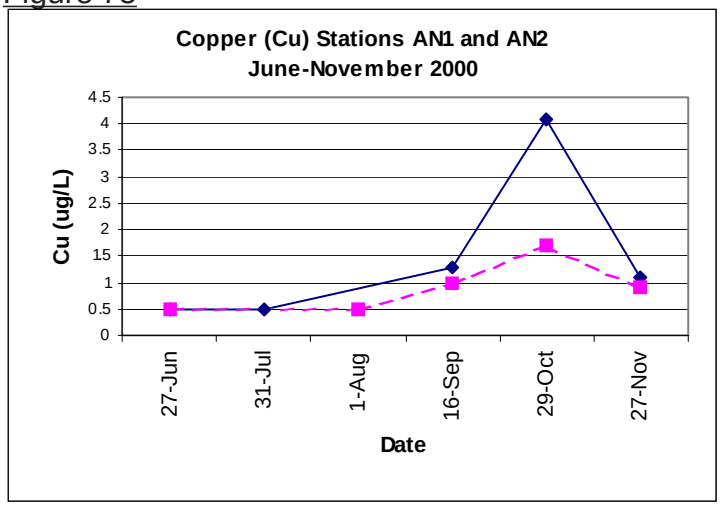


Figure 73

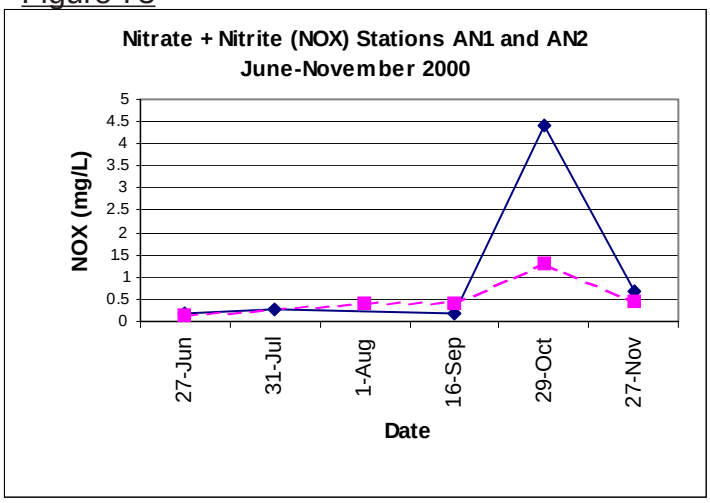
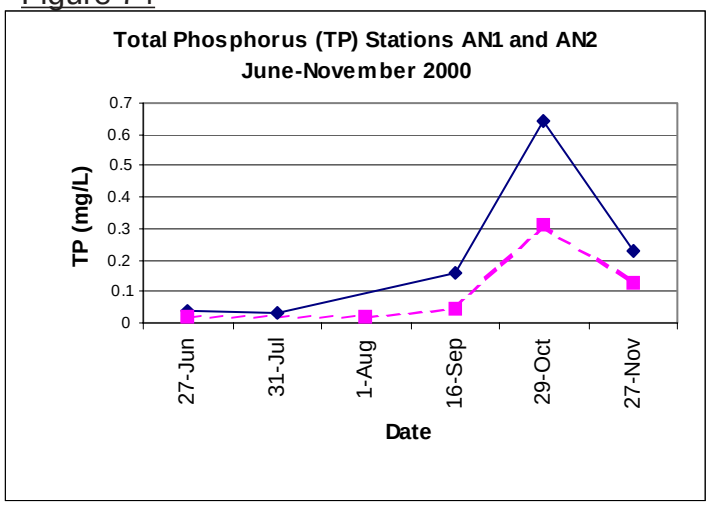
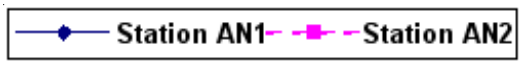


Figure 74





2001

Figure 76

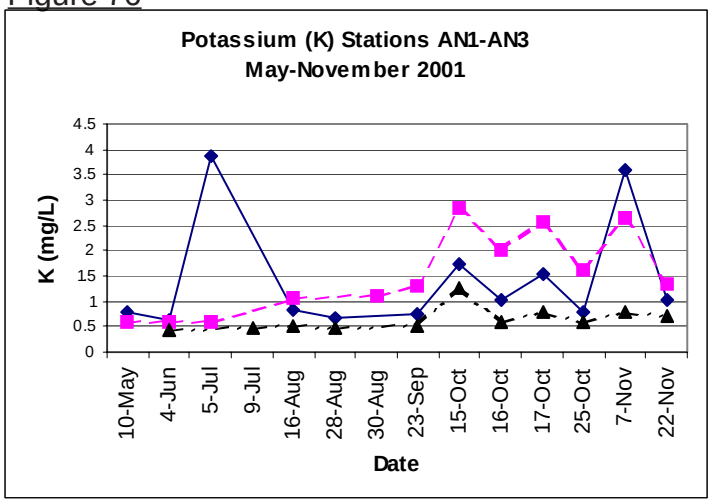


Figure 77

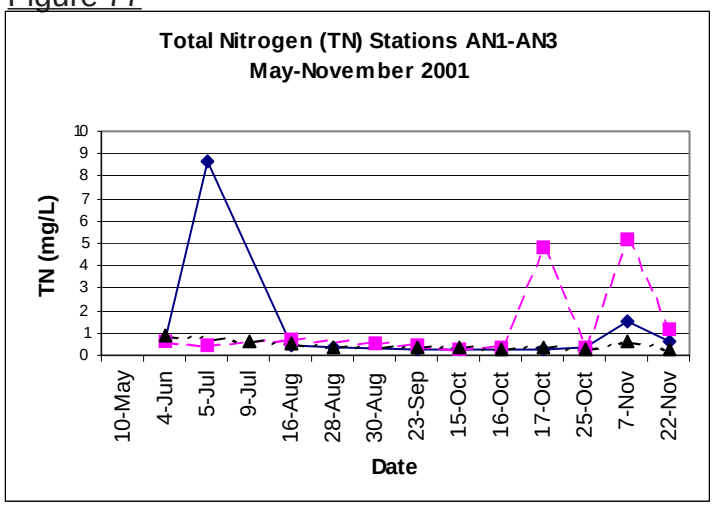


Figure 78

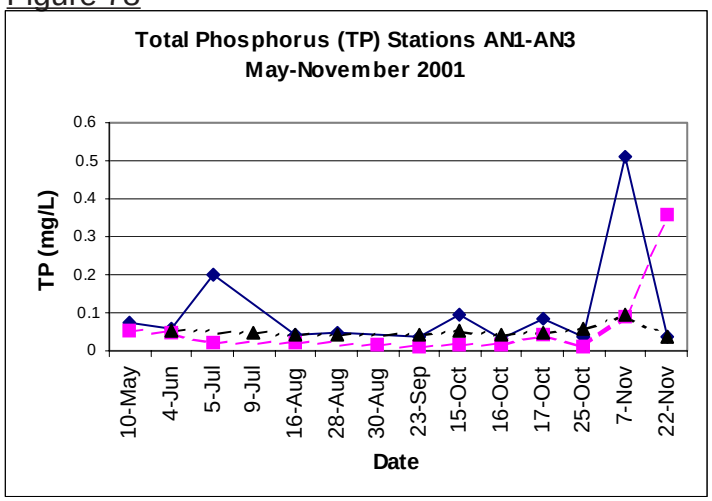


Figure 79

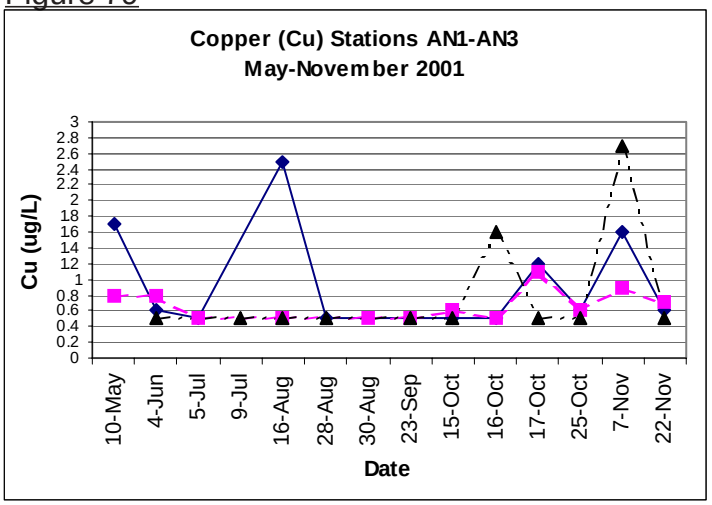
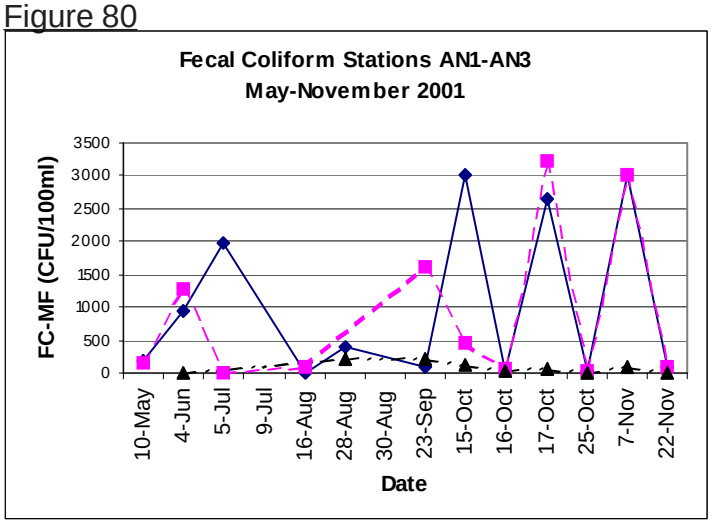
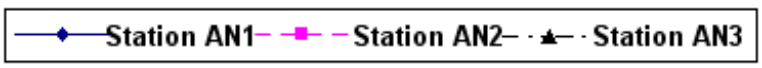


Figure 80



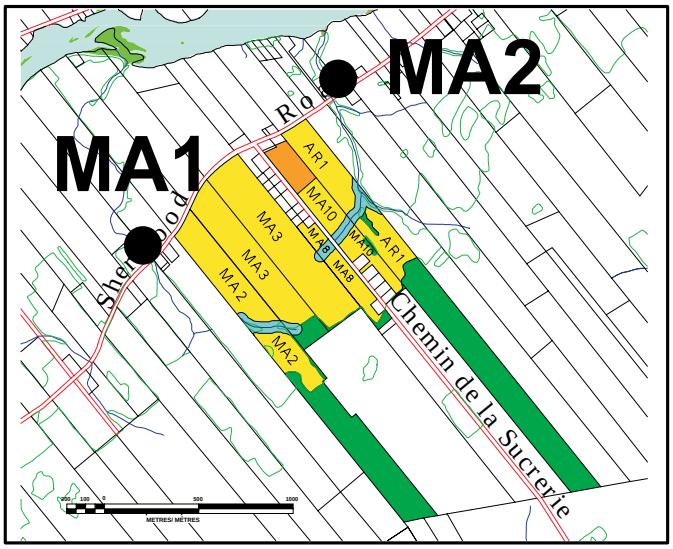


AREAS AR AND MA

Station MA1 is located downstream of manure application areas. The drainage includes a considerable area outside the treated fields and thus, results were subject to the effects of non-treated areas. Station MA2 is located on another stream which drains the MA and AR fields.

Year 2000

Local Map: 00J



Livestock: 30 cows
80 sheep (neither cows or sheep were pastured in the treated area)

Manure application:

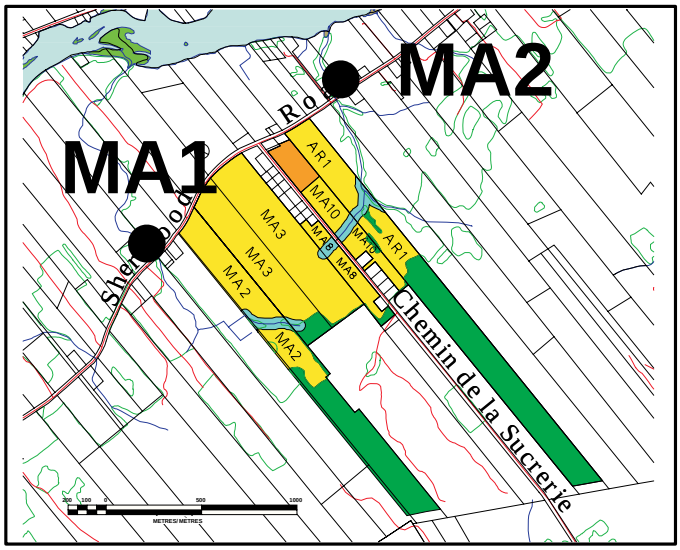
MA 2,3,8	October 13,14,18,23
MA 10	October 13

Results: See Figures 81, 82, 83 and 84.

Comments:
K, TP, and Cu increased after the October 19 rain event. Manure spreading took place only days before this rain event. NOX was highest at station MA1 during the June and July sampling times and dropped off after the rain events on September 16, October 19, and October 29.

Year 2001

Local Map: 01J



Livestock: none

Manure application: none

Results: See Figures 85, 86, 87, 88 and 89.

Comments:
FC concentration was highest at station MA2 on October 15. FC, K, TN, TP and Cu all had increased concentrations after the November 7 rain event compared to the previous sampling event on October 25.

2000

Figure 81

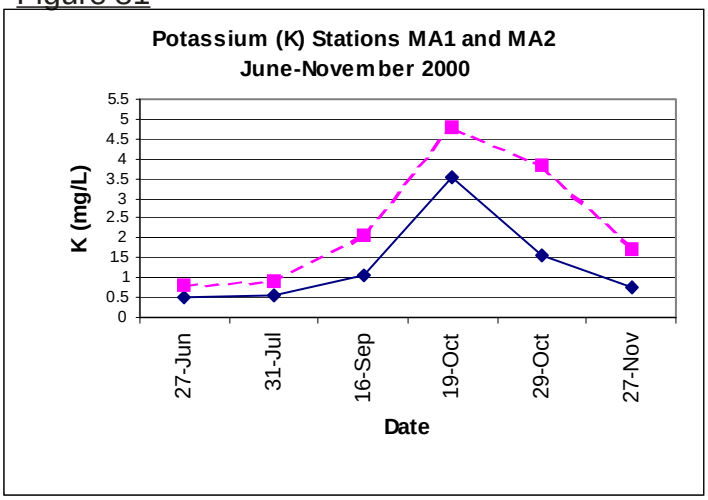


Figure 84

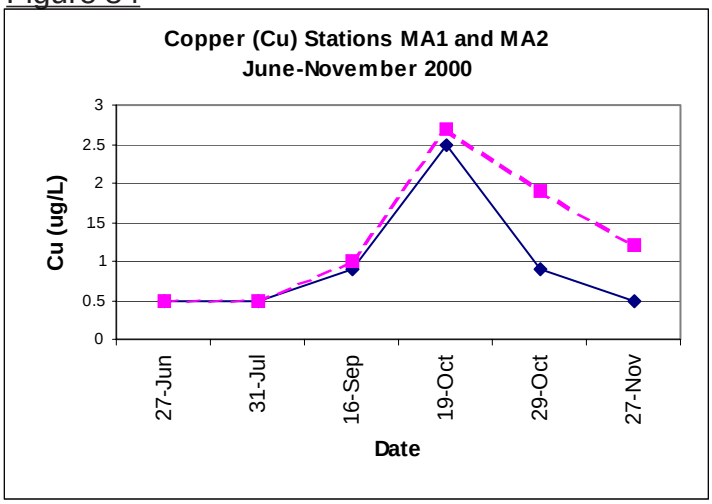


Figure 82

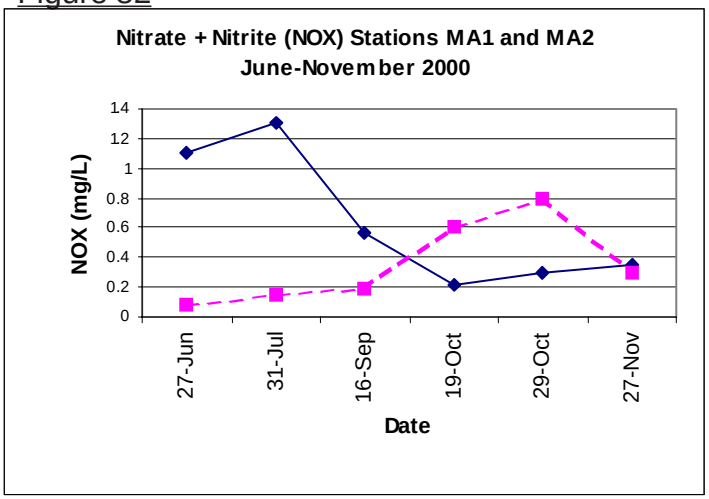
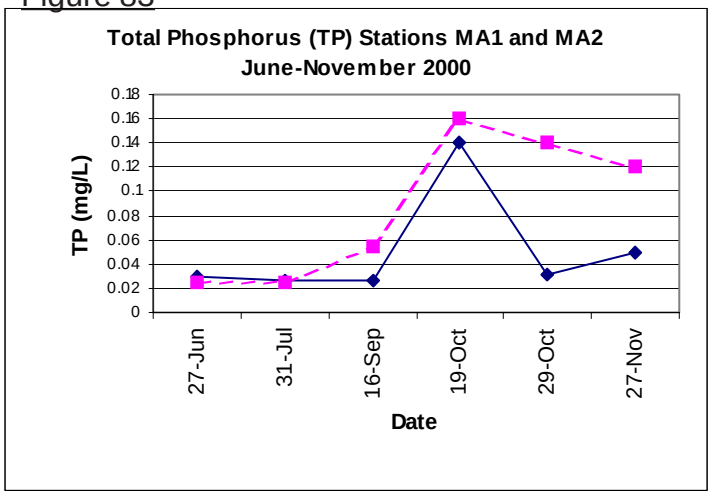


Figure 83



2001

Figure 85

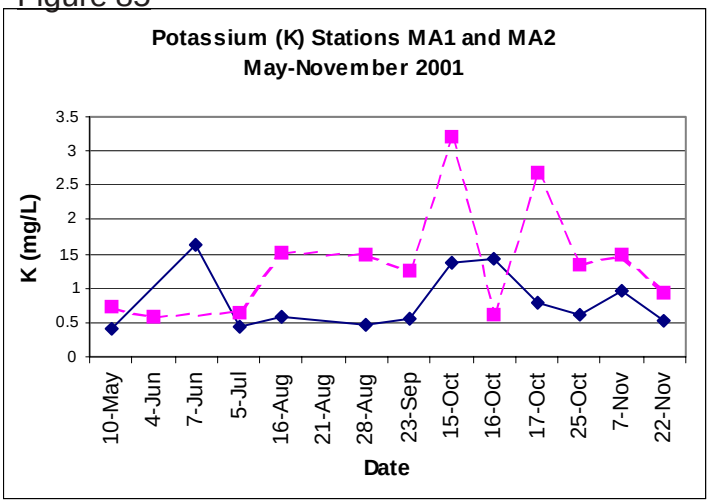


Figure 88

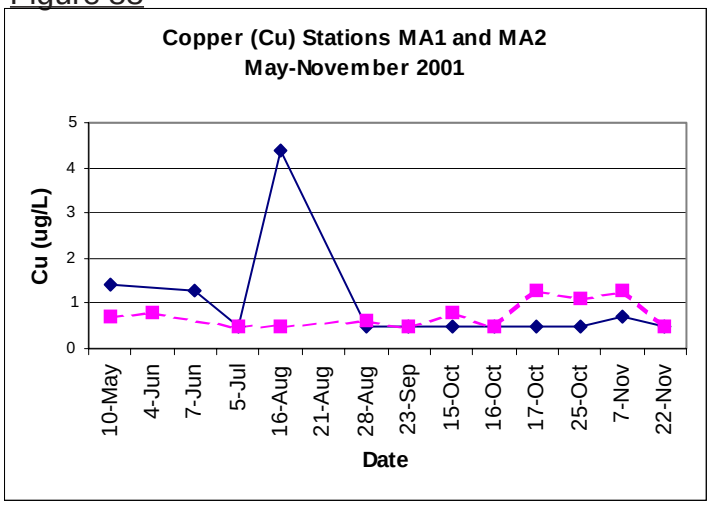


Figure 86

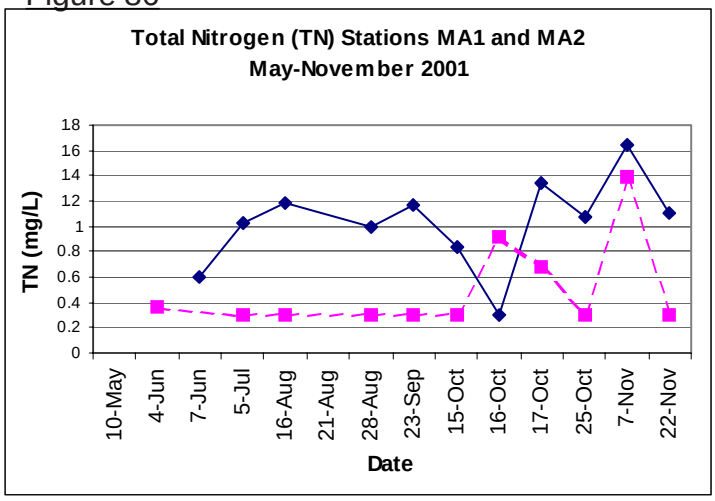


Figure 89

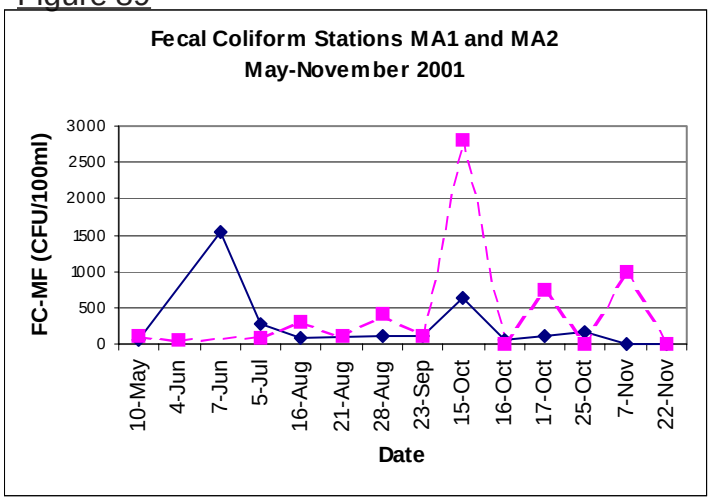
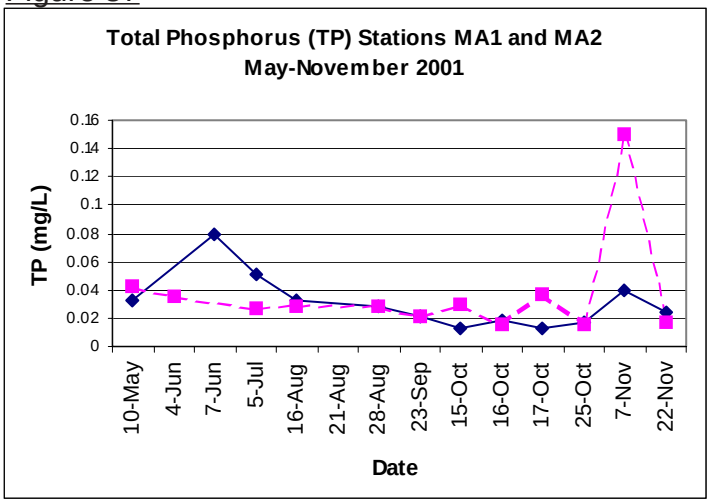


Figure 87

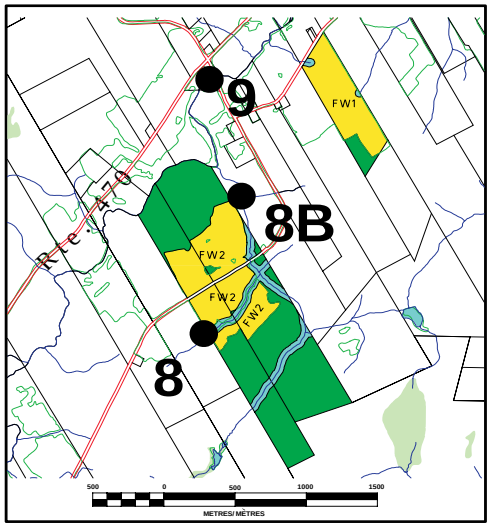


AREA FW 2

Station 8 is located upstream of the treated area. Station 8B is located a short distance downstream of the treated area. Station 9 is located downstream of station 8B and represents a larger drainage area than station 8B. Station 18 was added in 2001.

Year 2000

Local Map: 00K



Livestock: 45 cows, 50 sheep

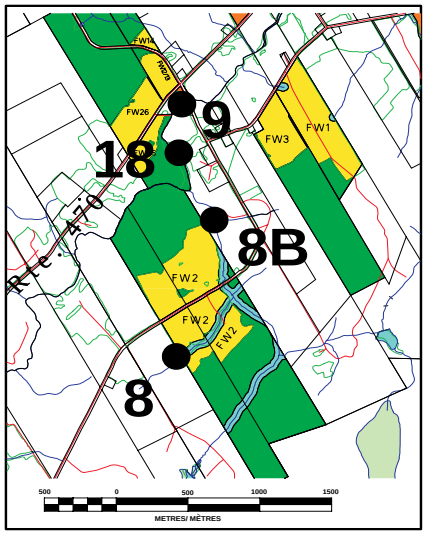
Manure application: June 6 and 12

Results: See Figures 90, 91, 92 and 93.

Comments:
The highest concentration of TP was obtained from station 8 after the rain event of September 16. K and Cu also increased at all three stations after the September 16 rain event.

Year 2001

Local Map: 01K



Livestock: 45 cows

Manure application: July 16 and 17

Results: See Figures 94, 95, 96, 97 and 98.

Comments:
All parameters increased in concentration after the rain event of November 7. The concentration of FC and TP were elevated on July 16, apparently not related to a rain event. The July increase in concentration occurred at the time of spreading of Metz manure.

2000

Figure 90

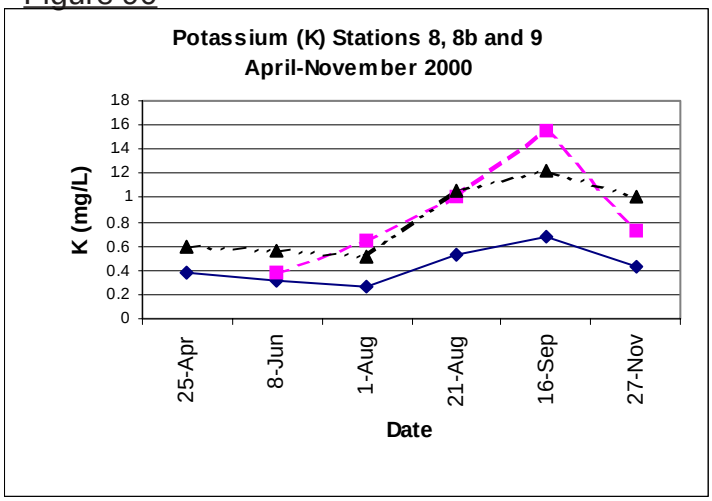


Figure 93

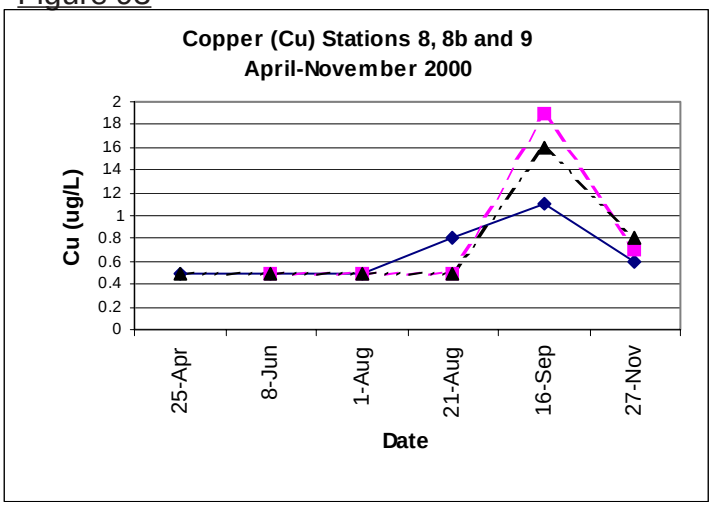


Figure 91

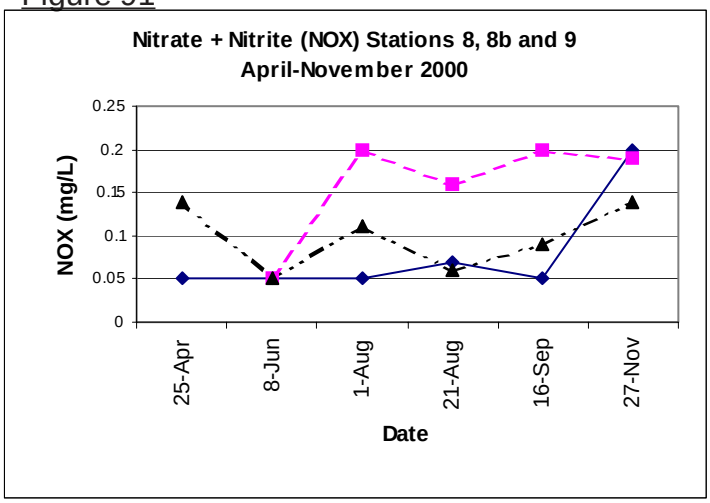
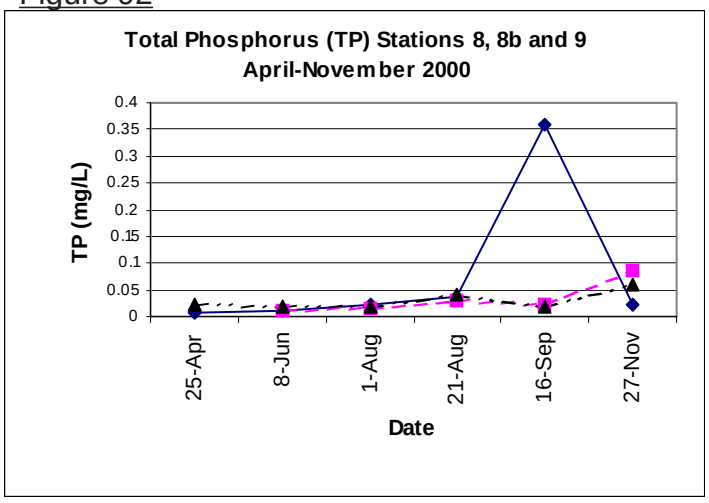
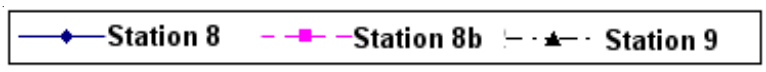


Figure 92





2001

Figure 94

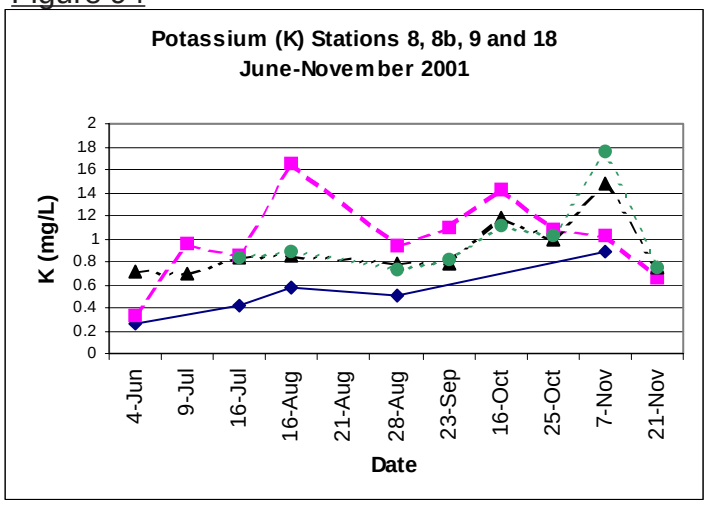


Figure 95

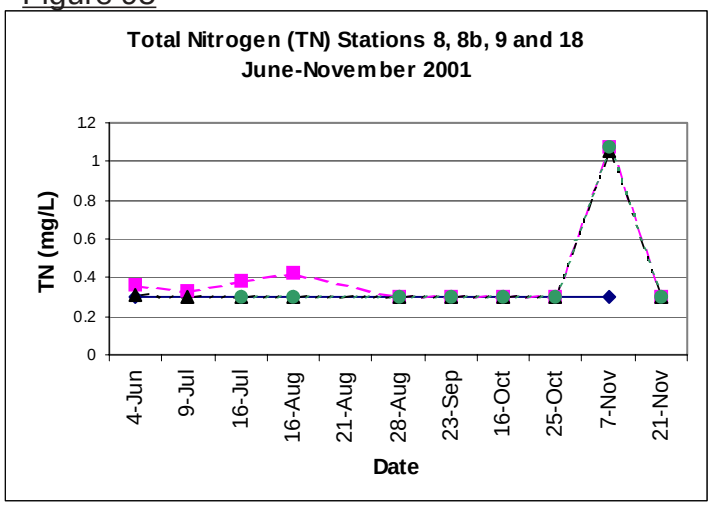


Figure 96

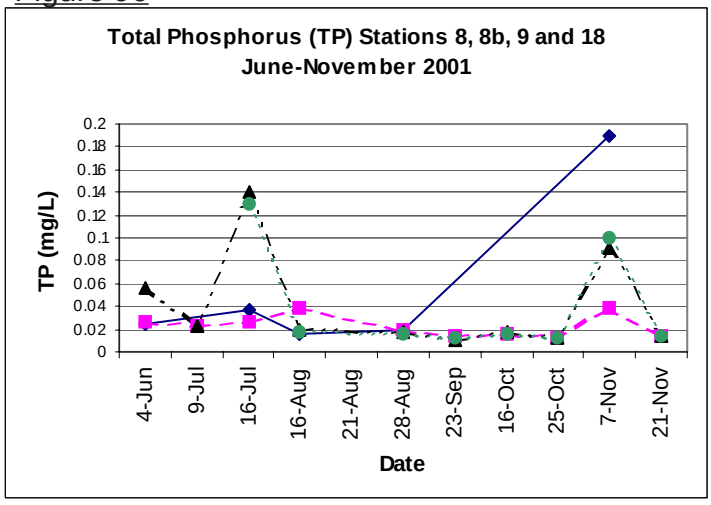


Figure 97

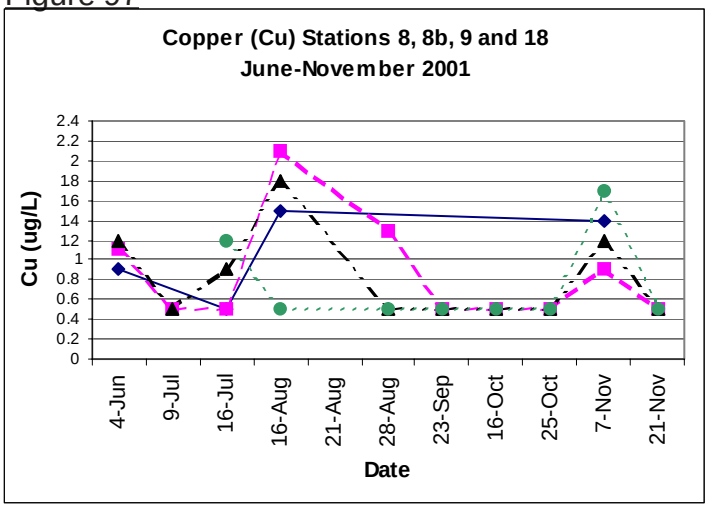
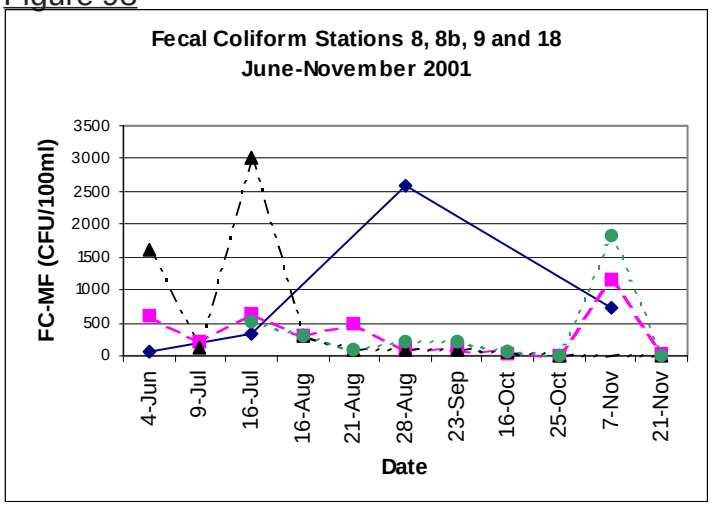
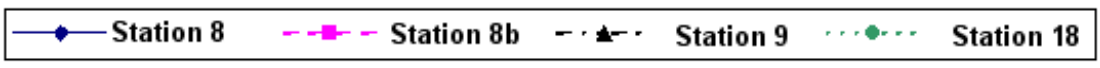


Figure 98





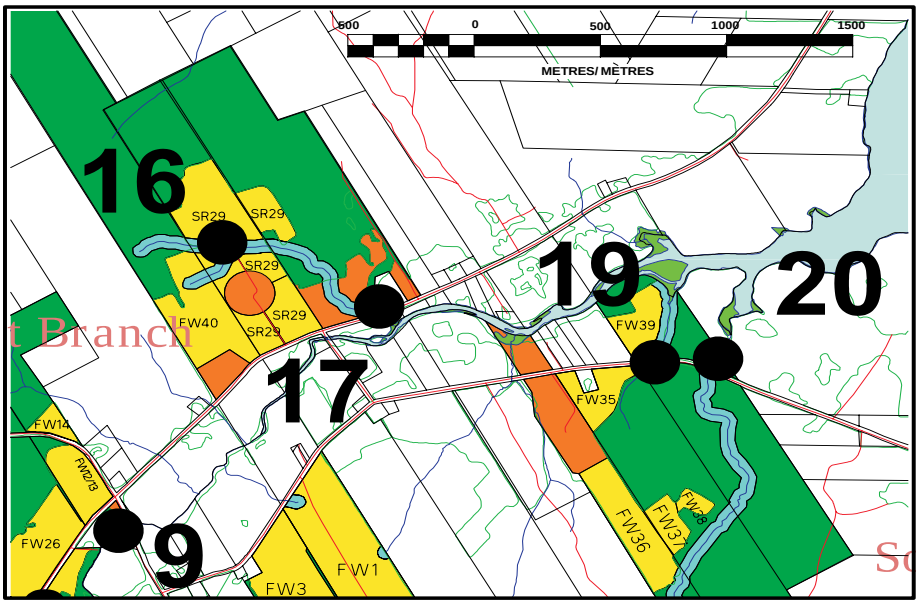
3.4 New Sample Areas for 2001

AREAS FW AND SR29

Station 16 is located within spreading areas SR29 and FW40 and station 17 is a downstream station. Stations 19 and 20 represent drainage from FW fields. These stations were new in year 2001.

Year 2001

Local Map: 01L



Livestock: 40 cows (Field SR 29)

Manure application:

SR29	July 20 and 23
FW40	July 23
FW35	July 25

Results: See Figures 99, 100, 101, 102 and 103.

Comments:
FC and TP concentrations were highest on July 16, before spreading occurred. Note that several samples from station 17 were possibly of ocean water (taken at high tide) and have not been included. The concentrations of sodium, potassium, sulphate, calcium, magnesium, and chloride were very high compared to samples typical in this report.

Figure 99

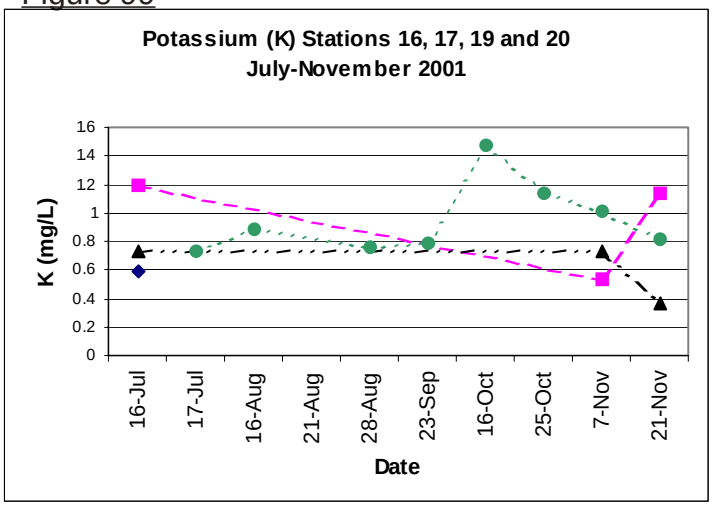


Figure 102

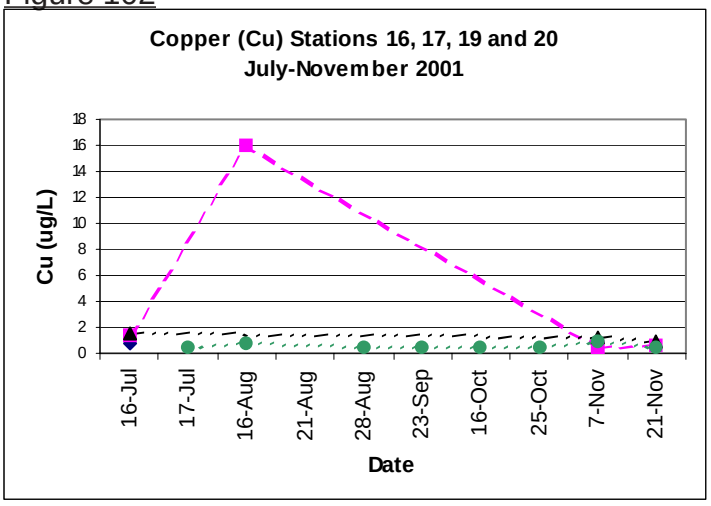


Figure 100

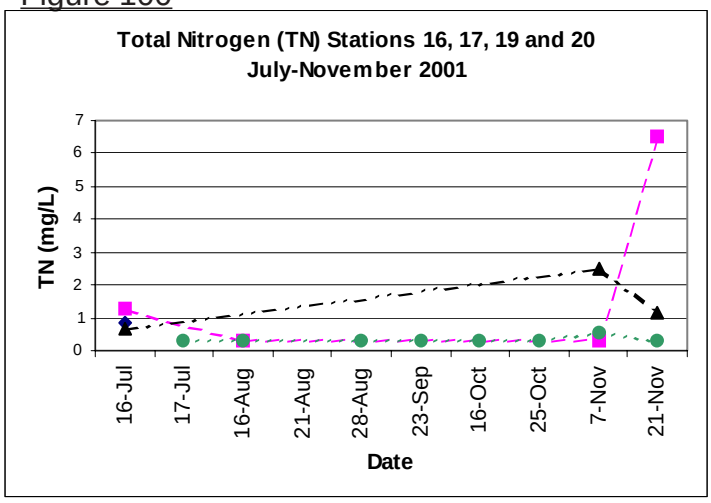


Figure 103

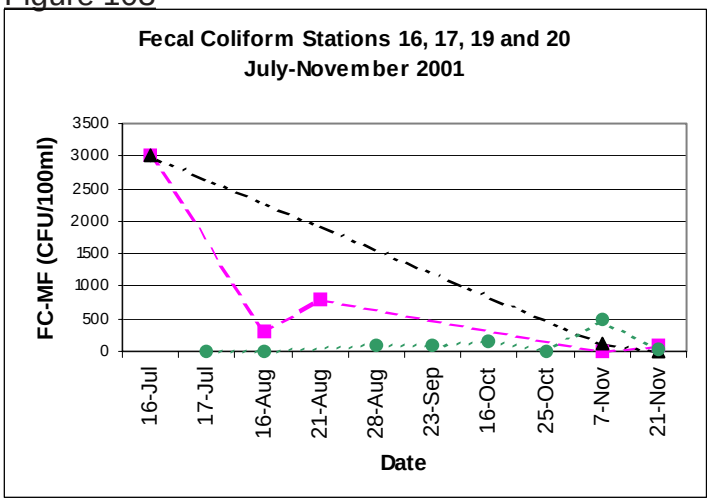
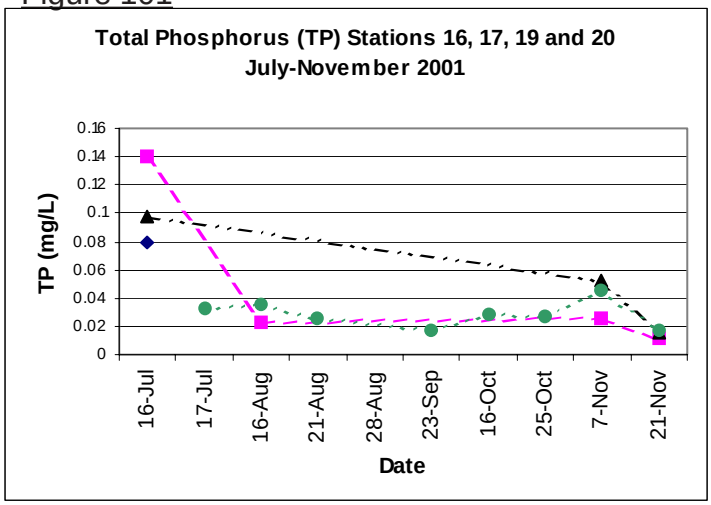
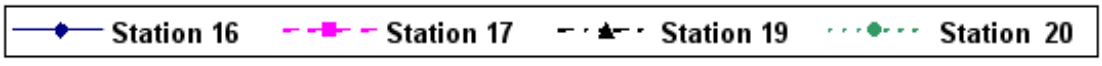


Figure 101



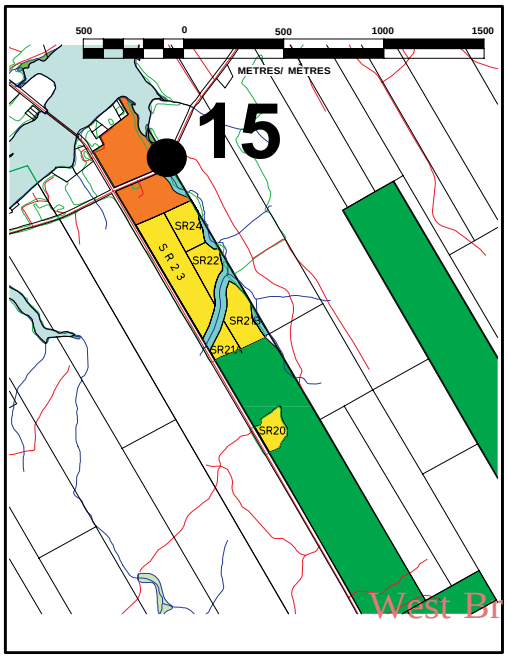


AREAS SR20 AND SR24

Station 15 is located downstream from the spreading areas. This station was new to year 2001.

Year 2001

Local Map: 01M



Livestock: 55 cows (moved between two places so animals were not located here for the entire summer)

Manure application:

SR20, SR21A, SR21B, SR22, SR23, SR24 July 24

Results: See Figures 104, 105, 106, 107 and 108.

Comments:

K, TN and TP all peaked after the November 7 rain event. Cu and FC concentrations peaked in August and apparently were not related to a rain event. Both of these high values were obtained weeks after spreading occurred in July.

Figure 104

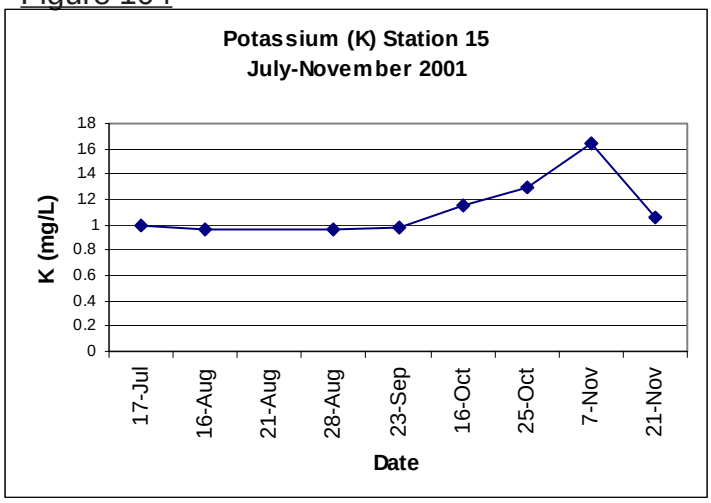


Figure 105

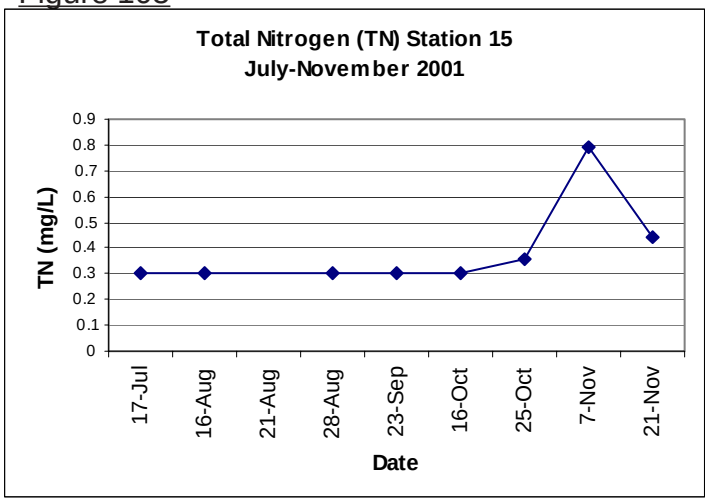


Figure 106

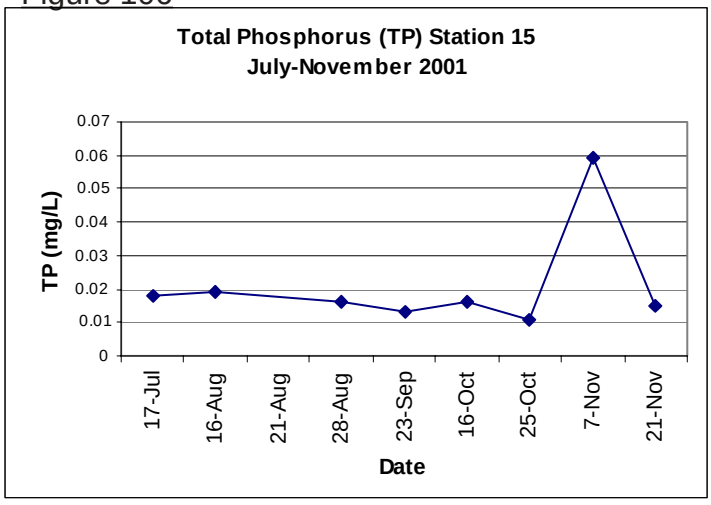


Figure 107

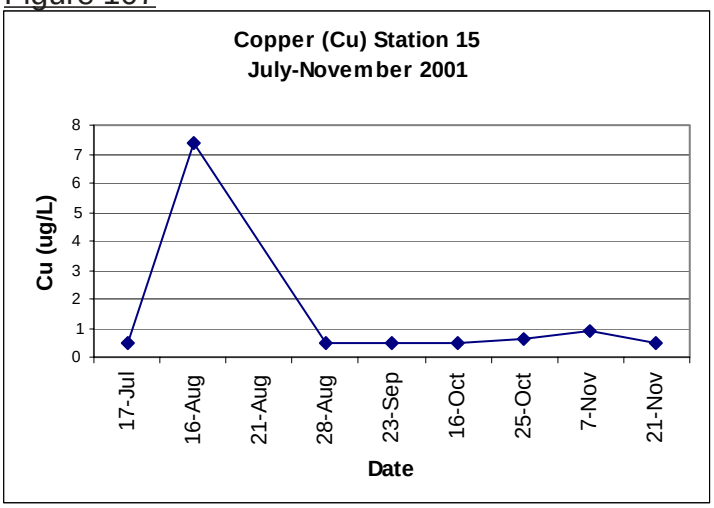
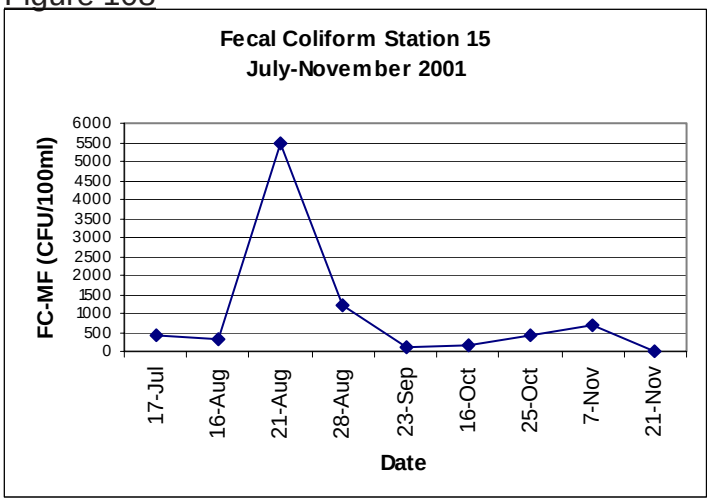


Figure 108

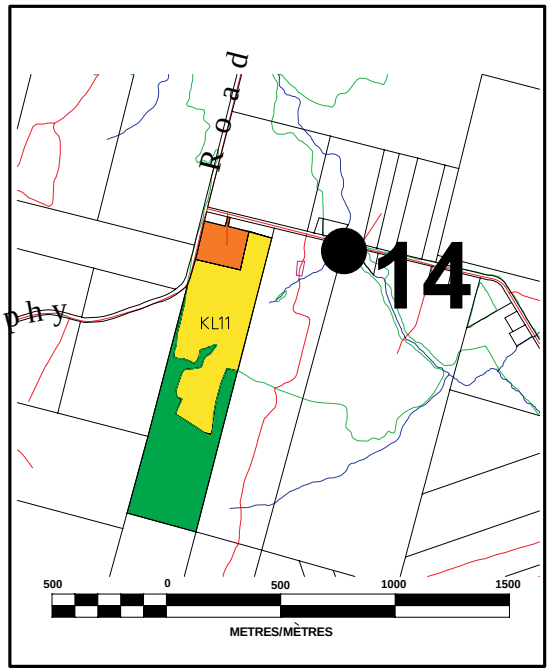


AREA KL11

Station 14 is located downstream from the spreading area. This station was new to year 2001.

Year 2001

Local Map: 01N



Livestock: none

Manure application:

KL11 June 21

Results: See Figures 109, 110, 111, 112 and 113.

Comments:

FC, K, TN and TP all peaked after the November 7 rain event. During the summer months, concentrations for all parameters were comparatively low.

Figure 109

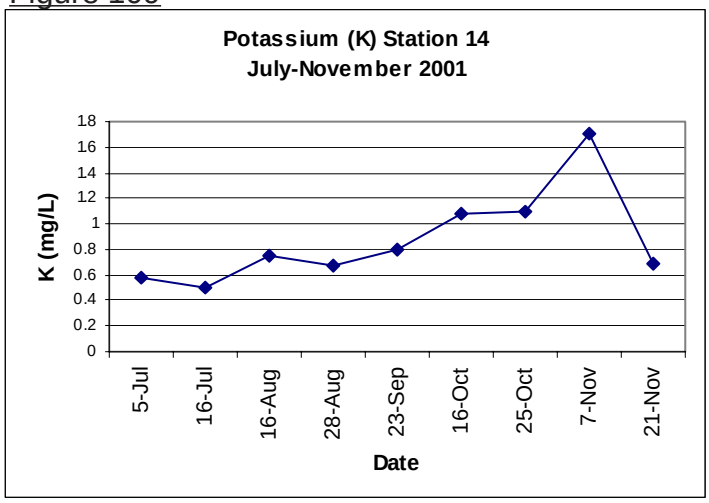


Figure 110

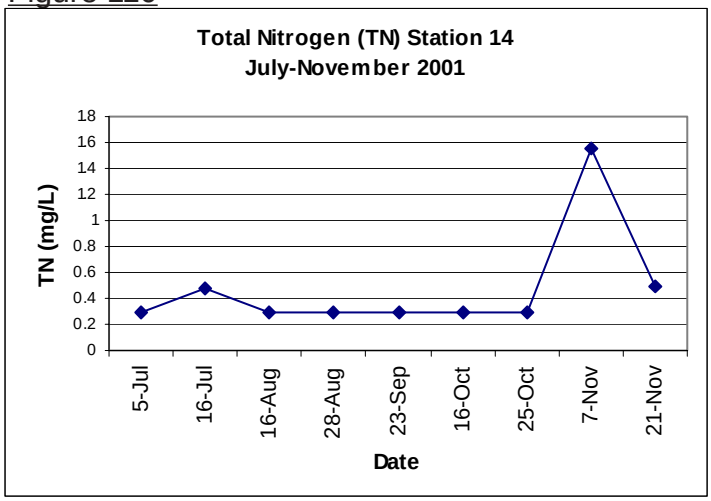


Figure 111

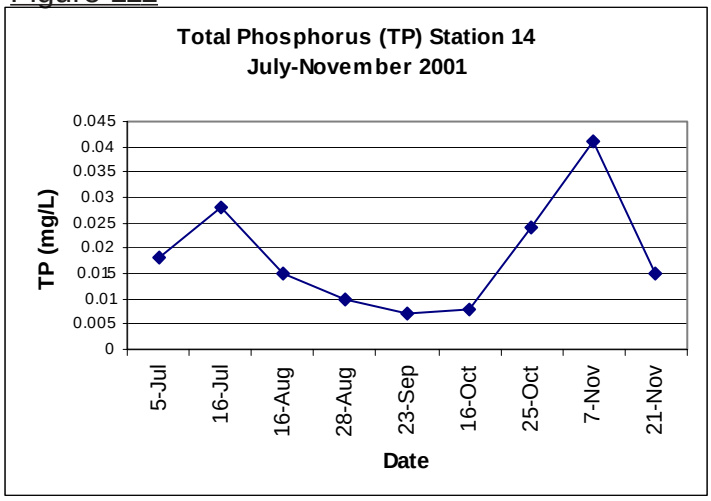


Figure 112

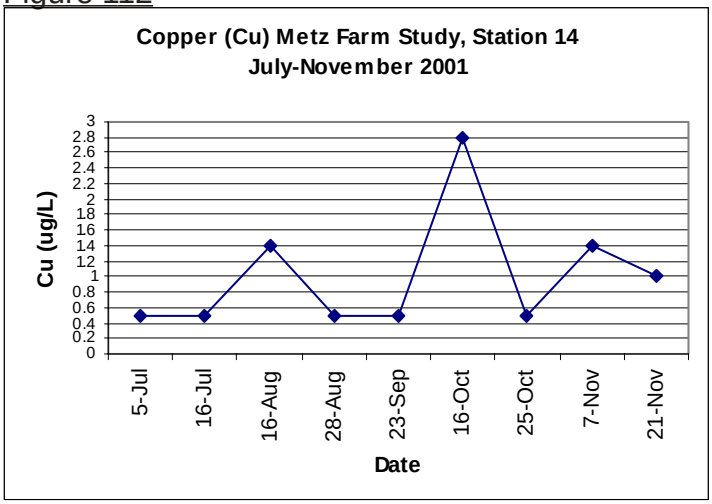
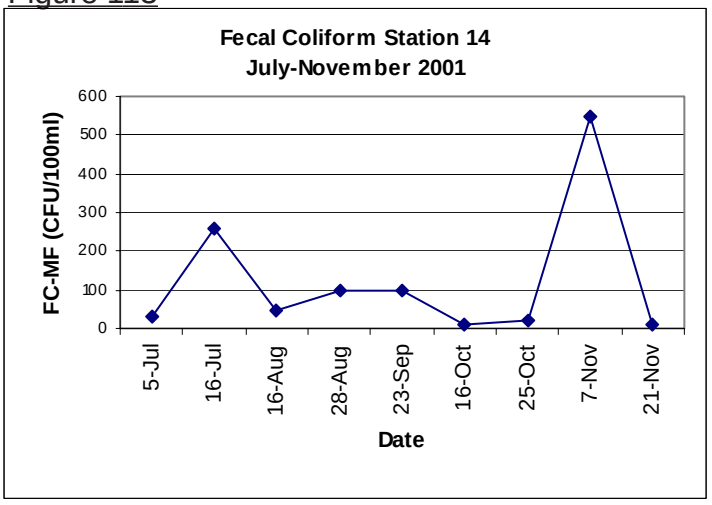


Figure 113



3.5 Groundwater Quality

Samples were taken from January through to October 2001. The results are shown in Tables 3, 4 and 5. Results by area are presented in Appendix II.

Table 3. Pre-spreading results for Winter 2001 sampling

Parameter	# of samples	Range of results	Guideline*	# exceeding guidelines
Total coliform	70	ND - > 200 counts/100 mL	<10 counts/100 mL on first sample, no two consecutive samples with presence detected	24 samples showed presence on first sample, of these samples 10 samples had counts > 10 counts/100 mL
E. coli	70	ND – 4 counts/100	0 counts/100 mL	2 samples

Table 4. Pre-spreading results for Spring 2001 sampling

Parameter	# of sample	Range of results	Guideline*	# exceeding guideline
Total coliform	78	ND - > 200 counts/100 mL	<10 counts/100 mL on first sample, no two consecutive samples with presence detected	33 samples showed presence on first sample, 21 samples had counts > 10 counts/100 mL
E. coli	78	ND – 18 counts/100	0 counts/100 mL	5 samples

Table 5. Pre-spreading results for Summer 2001 sampling

Parameter	# of sample	Range of results	Guideline*	# exceeding guideline
Total coliform	88	ND - > 200 counts/100 mL	<10 counts/100 mL on first sample, no two consecutive samples with presence detected	30 samples showed presence on first sample, 14 samples had counts > 10 counts/100 mL
E. coli	88	ND – 1 counts/100	0 counts/100 mL	4 samples

*****Note: Total coliform count greater than 10 counts/100 mL is unacceptable. If a result of 1 -10 is obtained re-sampling is recommended. To meet the guideline no two consecutive samples should show any presence of total coliforms.

Percentage results of total coliforms above the Health Advisory Limit (HAL) and the percentage results of *E. coli* counts above the HAL of 0 counts per 100 ml are shown in Table 6. Results ranged from non-detectable (ND) to >200 organisms per 100 ml. Previous studies in rural New Brunswick (Ecobichon et al, 1990) have shown total coliform counts exceeding the HAL in New Brunswick in the range of 18-23% of samples. This variation is possibly related to sediment type or due to the non-randomness of site selection.

Table 6. Percentage distribution of Total coliform and E. coli *counts*

Parameter	Winter 2001	Spring 2001	Summer 2001
Percentage of Total Coliform counts above the HAL (%)	34.3	42.3	34.1
Percentage of *E. coli* counts above HAL (%)	2.9	6.4	4.5

As can be seen from the data in Appendix II, most wells exhibited no change or a reduction of total coliform counts from previous sampling events. One well exhibited an increase in total coliform counts. A reduction could be attributed to chlorination of wells following previous positive tests results. Without information pertaining to an interim test on the wells with positive counts, it is difficult to comment on the possible effect of spreading on the well water, except to simply examine post-spreading results. Of the wells tested on August 23rd and September 4th, 80 % showed no detection of total coliforms. One well had nine total coliform colonies where previously there were four. This is not a statistically significant difference.

Samples taken after spreading showed no detection of *E. coli*. Should spreading of the liquid manure be a cause for concern, one would expect to see *E. coli* counts. Total coliform can be produced from a variety of sources and is widespread in the natural environment. *E. coli* is thought to be universally present in the feces of warm blooded animals. It is suggested therefore that *E. coli* would always be present in any fecal contamination event (Allen and Edberg, 1995). Thus, at this time there appears to be no relationship between the spreading of liquid manure (originating at Metz Farms) and well contamination. In any case where there is concern regarding bacteria in a homeowners well, the owner is contacted and advised as to procedures to follow.

4.0 CONCLUSIONS

4.1 Surface Water

At this stage there is no evidence that the Metz Farm manure application program has had an adverse effect on water quality in the vicinity covered by the present study.

In some areas, uncertainties exist with the timing of sampling and the rate of water quality changes during and after rain events, however in general there was a correlation of increased chemical and biological parameters with increased rainfall. This correlation exists even in areas where no Metz manure was applied. For example, at Station DF1 there was a relatively large increase in TP and TN on November 7, 2001 (heavy rains) and no Metz manure was applied and no livestock were pastured.

In areas where Metz manure was applied, there was no clear correlation with observed FC levels. For example, at Stations 1 and 2 (where no livestock were pastured but Metz manure was applied) fecal coliforms increased significantly in June and October, 2001. However, the water sample was collected before manure was applied, and the October increase was more than three months after application. Therefore it is unlikely that the Metz spreading had caused the increases in fecal coliforms.

4.2 Groundwater

1. Background water quality data consisting of 70, 78 and 88 samples were collected during the winter, spring and summer of 2001, respectively.

2. There appears to be no relationship between the spreading of liquid manure from Metz Farms and well contamination.

5.0 REFERENCES

Allen, M.J. and S.C. Edberg. 1995. The Public Health Significance of Bacterial Indicators in Drinking Water. Presented at International Conference - "Coliforms and E-coli: Problem or Solution?", Royal Society of Chemistry, University of Leeds, U.K., September 24-27, 1995.

Ecobichon, D.J., Hicks, R., Allen, M.C., and R. Albert. 1990. Groundwater Contamination in Rural New Brunswick. Environmental Health Review.

N.B. Department of the Environment and Local Government, Sciences and Reporting Branch. 2001. Metz Farms 2 Ltd. Surface Water & Groundwater Monitoring Results, April to October, 2000.

APPENDIX I

Example of Homeowner's Questionnaire

GROUND WATER MONITORING PLAN FOR METZ FARMS 2 LTD

HOME OWNERS QUESTIONNAIRE

Name: _____

Address: _____

1. What is your source of drinking water?

   - Drilled well _____ If yes, year drilled _____
     Drilling Company _____
     Is well tagged? _____
     Do you have driller's report? _____
     Tag no. _____

   - Dug _____
     Spring _____
     Surface water _____

2. How deep is your well? _____

   - Casing depth _____

3. Any other wells on your property? _____

   - Which type? _____
   - Are they being used? _____
   - Have they been filled in? How? _____

4. Is the well cap above or below ground level? If below ground level, how deep?

5. Do you have a water softener?

6. Do you have an outside tap where a sample can be taken?

7. Please describe the type of soils near your well.

8. Do you wish to participate in the water sampling survey?

9. Please make a sketch of your lot indicating your home and well location and septic system.

APPENDIX II

Results of Groundwater Sampling Events 2001

Results of Groundwater Sampling Events 2001

Sample #	well depth (ft)	casing depth (ft)	age of well	Winter 2001			Spring 2001			Summer 2001		
				date	T.C.	E.C.	date	T.C.	E.C.	date	T.C.	E.C.
1	95		1974	22-Jan-01	ND	ND	29-May-01	ND	ND	15-Aug-01	ND	ND
2	85-120	60	1994	19-Feb-01	ND	ND	29-May-01	ND	ND	14-Aug-01	2	ND
3	spring			22-Jan-01	27	ND	29-May-01	200	ND	14-Aug-01	74	ND
				22-Jan-01	ND	ND	29-May-01	ND	ND	14-Aug-01	ND	ND
4				19-Feb-01	ND	ND						
5	60			22-Jan-01	> 200	4	17-May-01	> 200	ND	14-Aug-01	ND	ND
6										23-Aug-01	165	1
7	80		1983	22-Jan-01	ND	ND	29-May-01	ND	ND	14-Aug-01	ND	ND
8	100	30	1978	24-Jan-01	ND	ND	07-Jun-01	ND	ND	15-Aug-01	ND	ND
9				24-Jan-01	ND	ND	30-May-01	6	ND	14-Aug-01	14	ND
10	110	87	1989	24-Jan-01	ND	ND	24-May-01	ND	ND	15-Aug-01	ND	ND
11	60		"old"				17-May-01	> 200	18	20-Aug-01	ND	ND
	60		"old"				13-Jun-01	94	6			
	60		"old"	24-Jan-01	3	ND	05-Jul-01	3	ND			
12				19-Feb-01	ND	ND	30-May-01	ND	ND	14-Aug-01	ND	ND
13			1975	25-Jan-01	ND	ND	30-May-01	ND	ND	20-Aug-01	ND	ND
14				25-Jan-01	ND	ND	24-May-01	ND	ND	14-Aug-01	ND	ND
15				25-Jan-01	15	ND				14-Aug-01	1	ND
16				25-Jan-01	ND	ND	24-May-01	ND	ND	14-Aug-01	ND	ND
17	64		1985	05-Feb-01	6	ND				14-Aug-01	4	ND
18				05-Feb-01	6	2	24-May-01	> 200	15	14-Aug-01	ND	ND
19	100		1957	19-Feb-01	ND	ND	24-May-01	3	ND	14-Aug-01	4	ND
20										17-Jul-01	ND	ND
										04-Sep-01	ND	ND
21										17-Jul-01	ND	ND
										04-Sep-01	ND	ND
22										17-Jul-01	4	ND
										23-Aug-01	9	ND
23										17-Jul-01	ND	ND
										23-Aug-01	ND	ND
24										17-Jul-01	109	ND
										23-Aug-01	ND	ND
25										08-Aug-01	1	ND
										30-Aug-01	ND	ND
26										23-Aug-01	ND	ND
27				23-Jan-01	1	ND	23-May-01	ND	ND	23-Aug-01	ND	ND
28	80	20	1942	22-Jan-01	ND	ND	08-May-01	3	ND	23-Aug-01	ND	ND
29				22-Jan-01	1	ND	08-May-01	101	ND	23-Aug-01	29	ND
										11-Oct-01	2	ND

T.C. = Total coliforms
E.C. = E. coli
N.D. = Not detected

Results of Groundwater Sampling Events 2001 continued.

Sample #	well depth (ft)	casing depth (ft)	age of well	Winter 2001			Spring 2001			Summer 2001		
				date	T.C.	E.C.	date	T.C.	E.C.	date	T.C.	E.C.
30				05-Feb-01	2	ND	10-May-01	4	ND	13-Aug-01	2	ND
31							10-May-01	1	ND	13-Aug-01	ND	ND
32	70	30	1984	23-Jan-01	ND	ND	10-May-01	ND	ND	13-Aug-01	ND	ND
33				24-Jan-01	ND	ND						
34			1970	23-Jan-01	ND	ND	23-May-01	ND	ND	13-Aug-01	200	ND
										30-Aug-01	1	ND
35	80	27-30	1953	23-Jan-01	1	ND	10-May-01	1	ND	13-Aug-01	ND	ND
36				23-Jan-01	ND	ND	10-May-01	ND	ND	13-Aug-01	ND	ND
37	70		1990	24-Jan-01	ND	ND	23-May-01	12	ND	13-Aug-01	ND	ND
38				24-Jan-01	ND	ND	10-May-01	ND	ND	13-Aug-01	ND	ND
39							10-May-01	12	ND	13-Aug-01	70	ND
40	spring									13-Aug-01	144	ND
41				23-Jan-01	ND	ND	10-May-01	> 200	ND	8-Aug-01	ND	ND
							24-May-01	ND	ND			
42				19-Feb-01	32	ND	23-May-01	56	ND	8-Aug-01	41	ND
							05-Jun-01	> 200	ND			
43	28-30			05-Feb-01	41	ND	24-May-01	ND	ND	20-Aug-01	25	ND
44				24-Jan-01	ND	ND	23-May-01	ND	ND	13-Aug-01	4	1
										21-Aug-01	ND	ND
										22-Aug-01	ND	ND
45				23-Jan-01	ND	ND	24-May-01	ND	ND	20-Aug-01	ND	ND
46	85	45	1985	05-Feb-01	1	ND	23-May-01	> 200	ND	13-Aug-01	8	ND
47	145	45		05-Feb-01	ND	ND	23-May-01	ND	ND	13-Aug-01	ND	ND
48	with filter		1974	24-Jan-01	56	ND	23-May-01	74	ND			
49	without filter		1974	24-Jan-01	88	ND						
50							23-May-01	ND	ND	13-Aug-01	ND	ND
51							23-May-01	59	ND	22-Aug-01	ND	ND
52				24-Jan-01	ND	ND	23-May-01	ND	ND	20-Aug-01	ND	ND
53				25-Jan-01	ND	ND	29-May-01	ND	ND	21-Aug-01	ND	ND
54							29-May-01	ND	ND	21-Aug-01	ND	ND
55				25-Jan-01	ND	ND	29-May-01	ND	ND	15-Aug-01	ND	ND
56							29-May-01	ND	ND	21-Aug-01	ND	ND
57	spring			30-Jan-01	19	ND	29-May-01	> 200	ND	15-Aug-01	165	1
58				25-Jan-01	ND	ND	29-May-01	ND	ND	20-Aug-01	ND	ND
59			1975	25-Jan-01	ND	ND	29-May-01	ND	ND	15-Aug-01	ND	ND
60				25-Jan-01	ND	ND	29-May-01	ND	ND	14-Aug-01	ND	ND
61				25-Jan-01	ND	ND	29-May-01	1	ND	21-Aug-01	ND	ND
62	120			25-Jan-01	ND	ND	29-May-01	ND	ND	21-Aug-01	ND	ND
63				24-Jan-01	ND	ND	29-May-01	ND	ND	15-Aug-01	ND	ND
64	90		1972	22-Jan-01	ND	ND	29-May-01	ND	ND	20-Aug-01	>200	ND

T.C. = Total coliforms
E.C. = E. coli
N.D. = Not detected

Results of Groundwater Sampling Events 2001 continued.

Sample #	well depth (ft)	casing depth (ft)	age of well	Winter 2001			Spring 2001			Summer 2001		
				date	T.C.	E.C.	date	T.C.	E.C.	date	T.C.	E.C.
65				28-Feb-01	ND	ND				22-Aug-01	50	ND
										4-Sep-01	14	ND
66							30-May-01	29	8	15-Aug-01	ND	ND
67	52	25-28	1975	19-Feb-01	2	ND	23-May-01	165	ND	15-Aug-01	ND	ND
68	150	30	1970	22-Jan-01	ND	ND	08-May-01	ND	ND	13-Aug-01	ND	ND
69			1980	19-Feb-01	ND	ND	24-May-01	ND	ND	13-Aug-01	ND	ND
70	60		1962	30-Jan-01	25	ND	08-May-01	14	ND	20-Aug-01	4	ND
				05-Feb-01	16	ND	24-May-01	ND	ND			
				14-Feb-01	ND	ND						
				30-Jan-01	18	ND						
71				30-Jan-01	9	ND	08-May-01	3	ND	23-Aug-01	3	ND
72	70-80		1974				25-Jun-01	ND	ND	23-Aug-01	ND	ND
73			1979	22-Jan-01	ND	ND	08-May-01	ND	ND	13-Aug-01	ND	ND
74	85	40	1974	22-Jan-01	1	ND	08-May-01	ND	ND	13-Aug-01	1	ND
75	50		1950	22-Jan-01	2	ND	08-May-01	ND	ND	13-Aug-01	2	ND
				30-Jan-01	ND	ND						
76	150		1950	22-Jan-01	ND	ND	08-May-01	ND	ND	22-Aug-01	ND	ND
77							29-May-01	ND	ND	13-Aug-01	ND	ND
78							29-May-01	12	ND	13-Aug-01	3	ND
79				22-Jan-01	3	ND	08-May-01	ND	ND	13-Aug-01	ND	ND
							17-Jun-01	27	ND			
80	60-70	25-30	1950				08-May-01	2	ND	13-Aug-01	1	1
81							08-May-01	2	ND			
82				23-Jan-01	5	ND	08-May-01	> 200	2	13-Aug-01	6	ND
83	85		1993	22-Jan-01	ND	ND	10-May-01	ND	ND	20-Aug-01	ND	ND
84	144		1988	22-Jan-01	ND	ND	10-May-01	2	ND	20-Aug-01	ND	ND
							25-Jun-01	ND	ND			
85				25-Jan-01	ND	ND	08-May-01	ND	ND	20-Aug-01	ND	ND
86	70-80		"old"	22-Jan-01	ND	ND	23-May-01	12	1	13-Aug-01	ND	ND
							25-Jun-01	ND	ND			
87	85		1988	22-Jan-01	ND	ND	08-May-01	ND	ND	13-Aug-01	ND	ND
88	98	50	1950	05-Feb-01	ND	ND	13-Jun-01	2	ND	9-Aug-01	ND	ND
89				08-Feb-01	ND	ND	27-Jun-01	ND	ND	14-Aug-01	ND	ND
90				05-Feb-01	1	ND				15-Aug-01	118	ND
91							24-May-01	ND	ND	14-Aug-01	ND	ND
92				05-Feb-01	ND	ND	24-May-01	ND	ND	14-Aug-01	ND	ND

T.C. = Total coliforms
E.C. = E. coli
N.D. = Not detected

APPENDIX III

Additional Sample Information

Table 7: Additional sample information

Date	Site Number	Sample	Reason
November 7, 2001	9	No FC	Bottle broken
September 23, 2001	1		Sampled twice
August 30, 2001	AN2	No FC	E. coli tested
May 10, 2001	VM3	No FC	Bottle broken
*Note: TN not tested in 2001 until after May 10, 2001			