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Annual Report to the

Fundy Model Forest

on

Stream Water Quality and Quantity Monitoring

within the

Hayward Brook Watershed Study

During 2000

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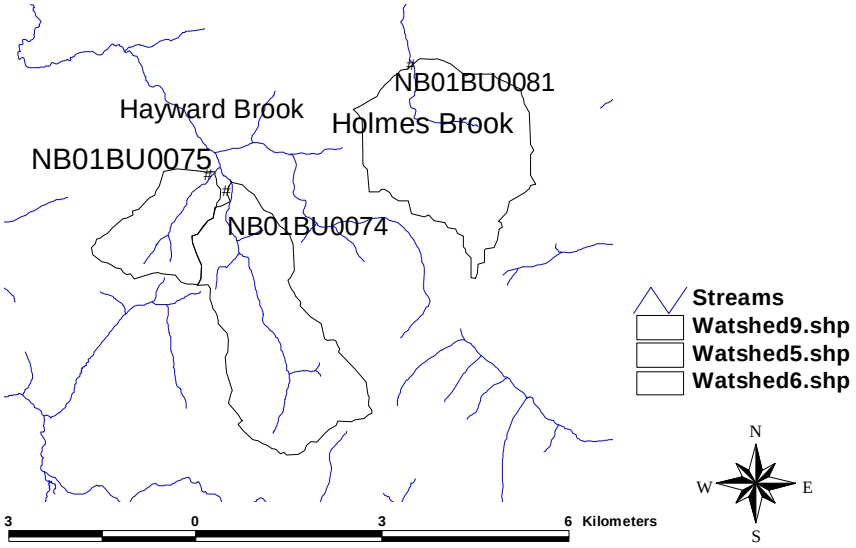
Introduction

This report provides an overview of the water quality monitoring project within the Hayward and Holmes Brooks during 2000. These watersheds are part of the Hayward Brook Watershed Study (HBWS), a multi-partner research project which began in 1993 with a focus on assessing the response of terrestrial and aquatic ecosystems to current forest management practices (Parker 1997). To undertake the assessment various studies were conducted by multiple research agencies. The projects included breeding bird surveys (Parker 1997), bryophytes structure (Hovey 1996), vascular plant structure (Roberts and Zhu 1998), fish community structure (Chiasson 1996), and buffer zone management (Krause 1997).

The water monitoring project was conducted by Environment Canada, Atlantic Region. The objective was to assess the response of water chemistry and quantity of sub-watersheds subjected to various forest harvesting treatments, and to assess the use of automated water quality and quantity monitoring stations (Pomeroy 2001). Stream chemistry was characterized using a Hydrolab water quality probes equipped with selected water quality sensors (pH, specific conductance, temperature, turbidity, and dissolved oxygen), and monthly surface water samples. The water grab samples were analyzed for major ions, nutrients, metals and physical variables at Environment Canada's Environmental Laboratory in Moncton, New Brunswick (Appendix 1). Interpretation of the data has been produced in a series of annual and peer reviewed reports. These are available through the Fundy Model Forest in Sussex, New Brunswick. During the year of 2000 three water monitoring stations were actively collecting water quality and quantity data (Fig.1).

Figure 1: Water monitoring stations and watersheds in Hayward and Holmes Brooks



Results

During the sampling year of 2000 a total of 25 monthly surface water grab samples were collected at three monitoring stations (NB01BU0074, BU0075, BU0081) in Hayward and Holmes Brooks (Fig. 1).

The mean annual specific conductance in the streams ranged between 40 to 90 usie/cm (Fig. 2). Specific conductance provides an indication of the dissolved solids in the water column, but does not indicate which ions are highest in concentration. From the laboratory results potassium and magnesium which are of limited supply have the lowest concentration each stream (Figs. 2,3). Calcium and sulphate have the highest concentrations (Figs. 3,4). The elevated concentrations of calcium-sulphate is due to the high gypsum deposits within the Petitcodiac area. The water chemistry varies as a result of the forest soil units. The three streams (NB01BU0074, BU0075, BU0081) are located in the Parry forest soil unit (Fahmy and Colpitts 1995). The Parry forest soil units contain a higher content of elements and as a result the major ion concentrations (Pomeroy 2001).

The annual mean range of pH is between 6.9 to 7.5 pH units. Higher pH is found in stream NB01BU0075 (Fig 5) as a result of higher concentrations of alkalinity, which is a measure of the capacity of ions to neutralize acidity (Fig 5). Holmes Brook is located on the boundary of the Parry-Salisbury soils and as a result has lower pH levels. Total phosphorus and dissolved nitrate/nitrogen concentrations are normally low in water as they are quickly utilized by vegetation (Fig.6). Total nitrogen concentrations are higher as the concentrations includes nitrogen in both dissolved and non-dissolved forms.

Extractable metals are normally low in concentration due to their hydrophobic characteristics. Aluminum had the highest concentrations of metals found in the water samples (Fig. 7), and is related to the higher concentration of sediment found in each stream (Fig.8). Extractable zinc concentrations were elevated in stream NB01BU0075 as a result of a new galvanized culvert installed above the monitoring station in 1995. This stream also had higher concentrations of suspended sediment (Pomeroy et al. 1998).

Daily mean discharge was calculated for each site using 30 minute records of stage height. Using these values and a selection of velocity measures which represent the annual discharge cycle a stage-height-discharge curve is developed. Each stations shows similar annual cycles of low summer flows and high spring/fall flows (Fig 9).

Conclusion

This report provides an overview of the water quality and quantity data which has been collected within the Hayward Brook Watershed Study during 2000 under funding from the Fundy Model Forest. A more detailed assessment of this dataset is currently being undertaken by various thesis studies at the University of New Brunswick. These reports will be available from the Fundy Model Forest in 2001.

The author would like to acknowledge the efforts of Peter DeLong, and Guy Leger (Environment Canada, Meteorological Service Canada, Environmental Monitoring Division - Fredericton) for their support and dedication to maintaining the water quality probes and stations.

Appendix 1.0: Water quality analyses schema for surface water grab samples.

Variable Name	**Units**
Apparent Colour	Relative Units
Specific Conductance	Usie/cm
Turbidity	Jackson T. Units
Nitrogen, Dissolved Nitrate	Mg/L
Total Nitrogen	Mg/L
Alkalinity Gran (CACO3)	Mg/L
Iron Extractable	Mg/L
pH	pH Units
Sodium Extractable	Mg/L
Magnesium Extractable	Mg/L
Phosphorous total	Mg/L
Sulphate, Dissolved	Mg/L
Chloride, Dissolved	Mg/L
Potassium, Dissolved	Mg/L
Calcium, Dissolved	Mg/L
Carbon, Total inorganic	Mg/L
Carbon, Total organic	Mg/L
Aluminum Extractable	Mg/L
Manganese, Extractable	Mg/L
Zinc, Extractable	Mg/L

Appendix 2.0: Annual means of water chemistry from surface water grab samples during 1993 to 2000.

Station-year	Colour	Conduc	Turb	NO3-TN	Tnitro	Alkal	Ph	Na	Mg	AL	Tphos
BU74-1993	5.0	67.9	0.2	0.012	0.02	23.0	7.5	3.4	1.0	.012	0.007
BU74-1994	5.3	62.7	0.3	0.020	0.01	19.2	7.4	3.1	0.9	.011	0.007
BU74-1995	7.0	61.6	0.5	0.020	0.01	18.5	7.2	3.1	0.8	.019	0.013
BU74-1996	41.5	56.5	0.2	0.020	0.01	17.3	7.3	2.8	0.8	.013	0.008
BU74-1997	68.1	65.6	0.4	0.010	0.01	20.8	7.3	3.2	0.9	.015	0.009
BU74-1998	L 5.0	66.2	0.2	0.010	0.01	20.4	7.3	3.1	0.9	.020	0.008
BU74-1999	70.0	72.9	0.2	0.010	0.01	23.1	7.4	3.5	1.0	.009	0.008
BU74-2000	4.9	47.2	0.3	0.02	0.02	12.7	7.3	2.4	0.7	.016	0.009
BU75-1993	8.8	79.3	0.6	0.018	0.03	27.6	7.5	3.8	1.3	.044	0.004
BU75-1994	7.1	73.6	0.6	0.020	0.04	23.1	7.4	3.4	1.1	.024	0.005
BU75-1995	20.3	71.3	2.4	0.021	0.03	22.5	7.2	3.3	1.1	.060	0.028
BU75-1996	16.8	62.2	1.0	0.010	0.02	19.6	7.3	2.8	1.0	.067	0.007
BU75-1997	12.8	69.0	0.5	0.010	0.02	22.3	7.4	3.2	1.1	.047	0.008
BU75-1998	36.0	76.7	0.6	0.010	0.02	24.9	7.4	3.3	1.2	.070	0.006
BU75-1999	58.0	83.4	0.7	0.010	0.01	27.6	7.5	3.6	1.2	.045	0.007
BU75-2000	13.5	69.2	2.2	.02	0.02	21.0	7.5	3.1	1.1	.062	.007
Station-year	**Colour**	**Conduc**	**Turb**	**NO3-TN**	**Tnitro**	**Alkal**	**Ph**	**Na**	**Mg**	**AL**	**Tphos**
BU81-1994	15.4	73.9	1.0	0.027	0.04	21.8	7.4	8.2	1.2	.041	0.008
BU81-1995	26.7	55.8	1.9	0.020	0.04	14.8	7.0	5.9	1.0	.061	0.015
BU81-1996	34.1	39.2	2.2	0.010	0.04	10.0	7.0	4.0	0.8	.083	0.006
BU81-1997	26.1	61.1	2.3	0.010	0.03	17.9	7.2	6.4	1.1	.048	0.010
BU81-1998	20.3	68.1	0.6	0.010	0.03	19.6	7.2	7.0	1.1	.064	0.009
BU81-1999	41.5	80.7	0.7	0.010	0.03	24.5	7.3	8.6	1.2	.045	0.010
BU81-2000	21.0	51.5	2.1	0.02	0.03	13.2	7.2	5.1	0.9	.068	0.008

Station-year	So4	K	Ca	Mn	Fe	Zn	TOC	TIC	Cl	Sed	Sio2
BU74-1993	8.8	0.5	8.9	0.01	0.02	0.01	0.3	6.9	2.3		8.5
BU74-1994	7.2	0.5	7.7	0.01	0.02	0.01	0.6	5.7	2.1	1.0	8.0
BU74-1995	7.1	0.5	7.4	0.01	0.04	0.01	1.2	5.4	2.0	4.3	8.0
BU74-1996	6.1	0.5	6.7	0.01	0.02	0.01	0.6	4.5	1.9	1.0	7.4
BU74-1997	7.0	0.5	7.9		0.03	0.01	0.4	5.1	2.0		7.7
BU74-1998	7.3	0.4	7.6		0.01	0.01	1.0	4.9	2.1		7.9
BU74-1999	8.0	0.5	8.7	0.01	0.01	0.01	0.8	5.9	2.0		
BU74-2000	5.2	0.2	5.5	.004	0.05	0.00	0.5	3.4	2.0		
BU75-1993	9.4	0.6	10.7	0.02	0.06	0.01	0.9	8.2	3.0		10.5
BU75-1994	8.0	0.5	9.1	0.01	0.03	0.01	1.3	7.3	2.5	1.4	9.3
BU75-1995	7.4	0.5	8.7	0.04	0.15	0.02	2.6	6.4	2.4	36.2	9.3
BU75-1996	5.8	0.5	7.1	0.02	0.10	0.01	6.3	5.2	2.2	7.0	8.5
BU75-1997	6.6	0.5	8.5		0.06	0.01	1.0	5.3	2.4		9.0
BU75-1998	7.7	0.5	9.2		0.06	0.01	2.2	14.6	2.5		8.6
BU75-1999	8.5	0.5	10.3	0.01	0.05	0.02	1.2	6.8	2.4		
BU75-2000	6.6	0.4	8.0	.015	0.071	0.02	1.3	4.1	2.5		
Station-year	**So4**	**K**	**Ca**	**Mn**	**Fe**	**Zn**	**TOC**	**TIC**	**Cl**	**Sed**	**Sio2**
BU81-1994	5.7	0.5	5.2	0.01	0.07	0.01	2.4	6.0	5.4	3.0	
BU81-1995	4.6	0.5	3.9	0.02	0.09	0.01	3.7	4.4	4.2	5.6	
BU81-1996	3.2	0.5	2.6	0.01	0.10	0.01	3.6	2.6	3.0	5.0	
BU81-1997	4.3	0.6	4.1		0.16	0.01	1.9	4.2	4.3		
BU81-1998	4.9	0.5	4.5		0.08	0.01	3.1	4.7	4.8		
BU81-1999	5.7	0.5	5.4	0.01	0.07	0.01	1.9	6.0	5.4		
BU81-2000	3.9	0.4	3.4	0.01	0.07	0.001	2.2	2.8	4.1		

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Figure 2: Annual concentrations of specific conductance (usie/cm), sodium (mg/L) and magnesium (mg/L) for Hayward Brook and Holmes Brook

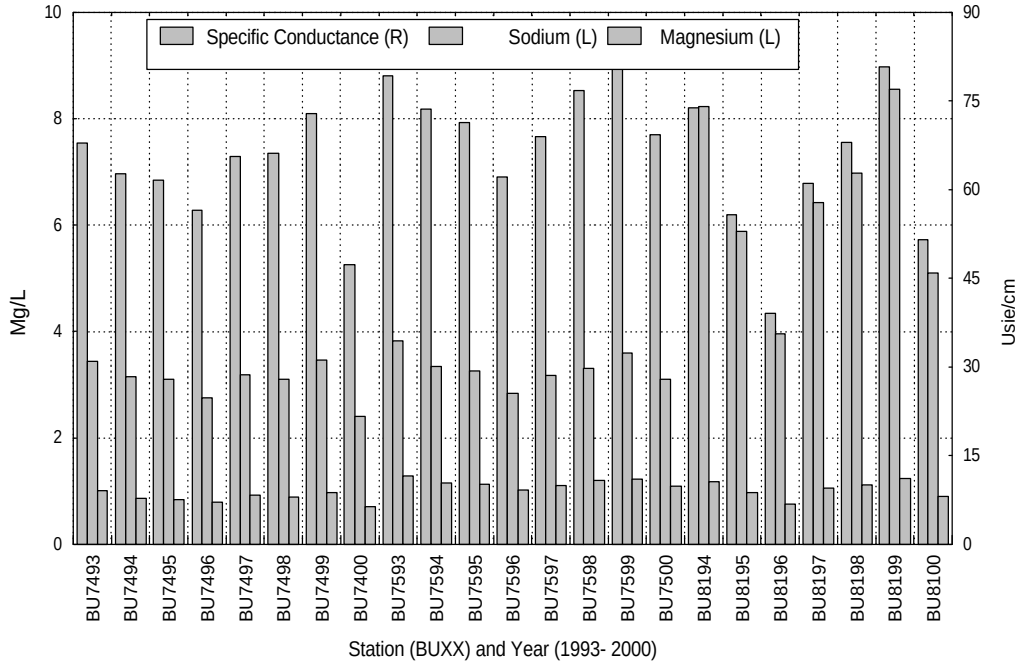

Figure 3: Annual concentrations of specific conductance (usie/cm), potassium (mg/L), and calcium (mg/L) for Hayward and Holmes Brook

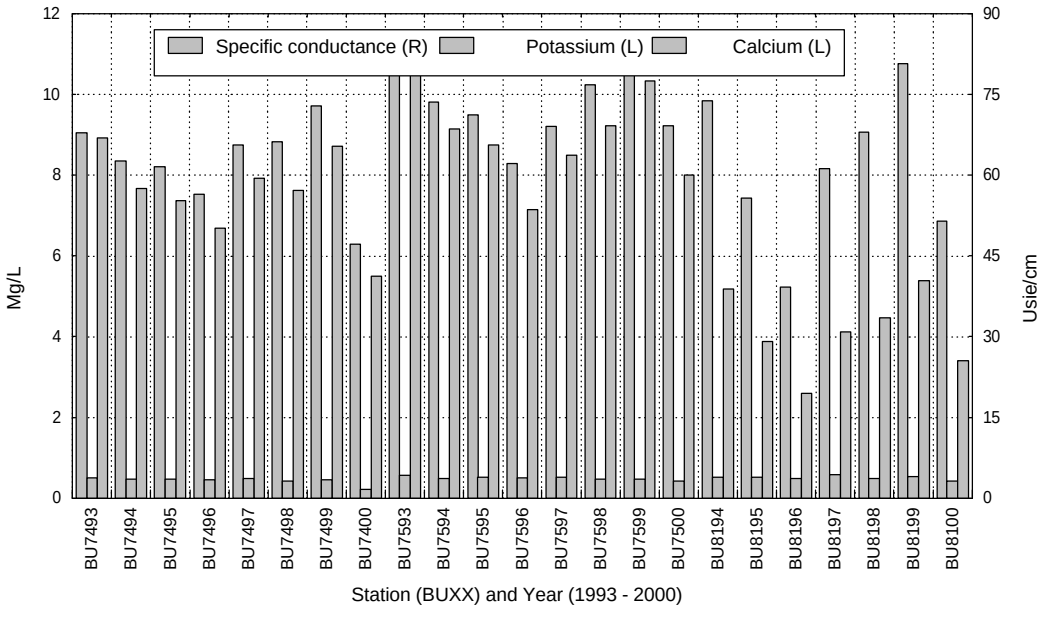

Figure 4: Annual concentrations of specific conductance (usie/cm), sulphate (mg/L), and chloride (mg/L) for Hayward and Holmes Brook

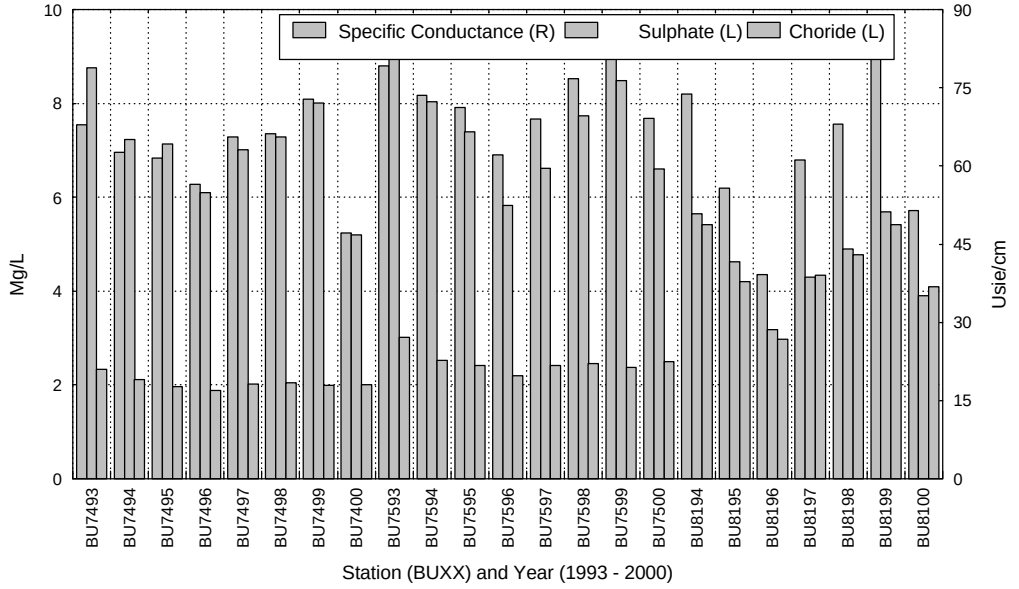

Figure 5: Annual concentrations of alkalinity (mg/L), and pH (pH units) for Hayward and Holmes Brook

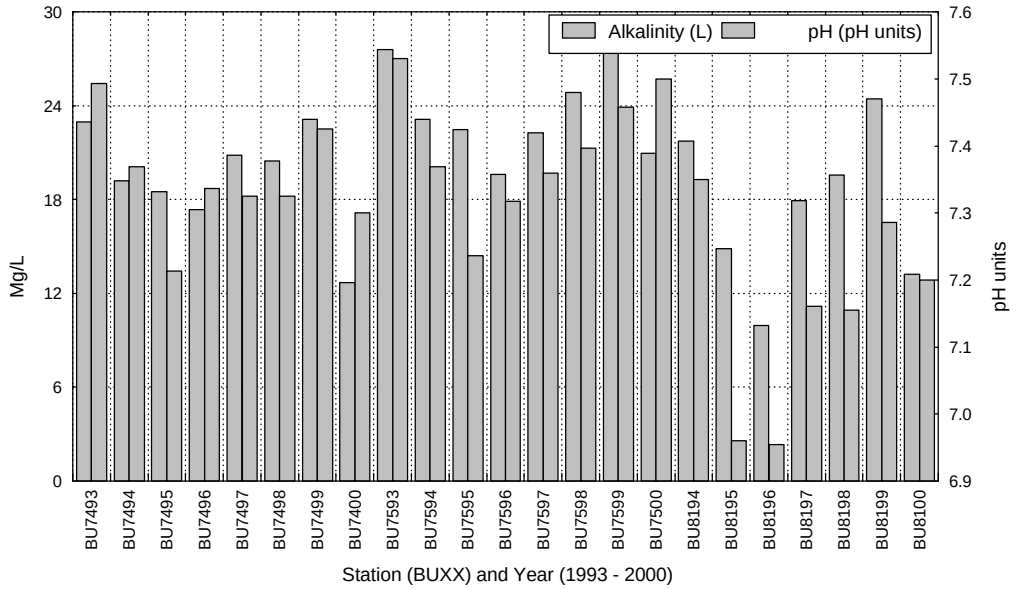

Figure 6: Annual concentrations of dissolved nitrate/nitrogen (mg/L), total nitrogen (mg/L), and total phosphorus (mg/L) in Hayward and Holmes Brooks

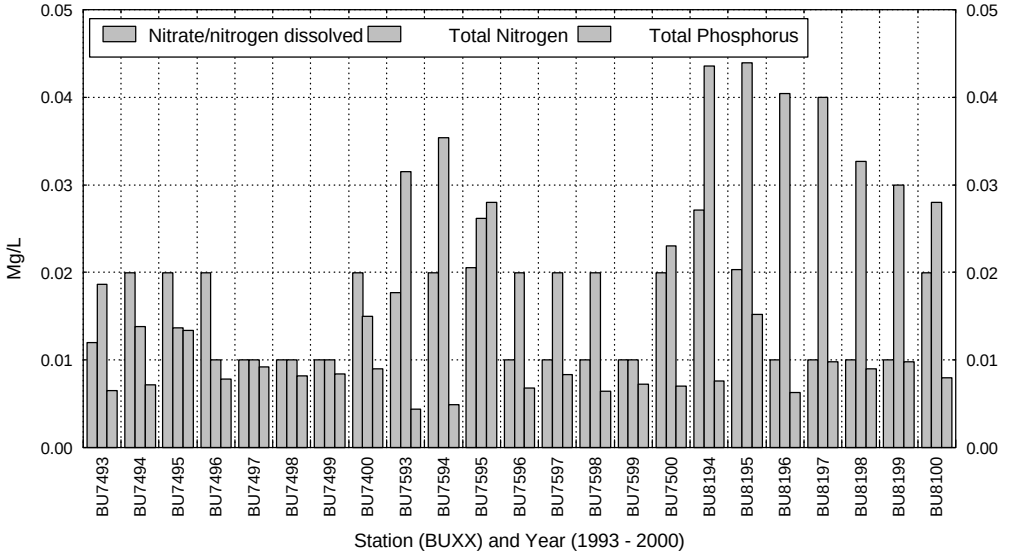

Figure 7: Annual concentrations of extractable aluminum, manganese, iron and zinc in Hayward and Holmes Brooks

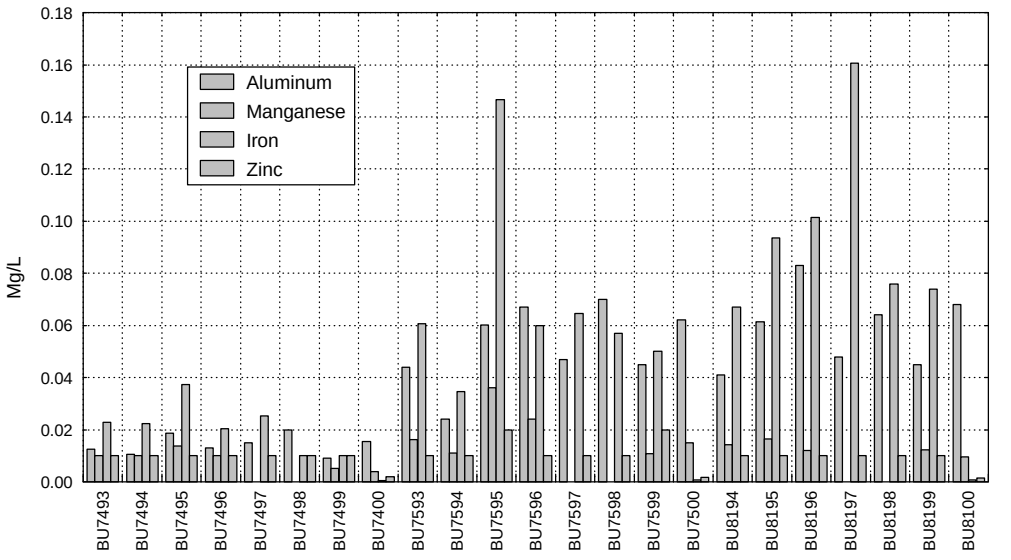

Figure 8: Annual concentrations of suspended sediment (mg/L),
and turbidity (Jackson Turbidity Units) at Hayward and Holmes Brooks

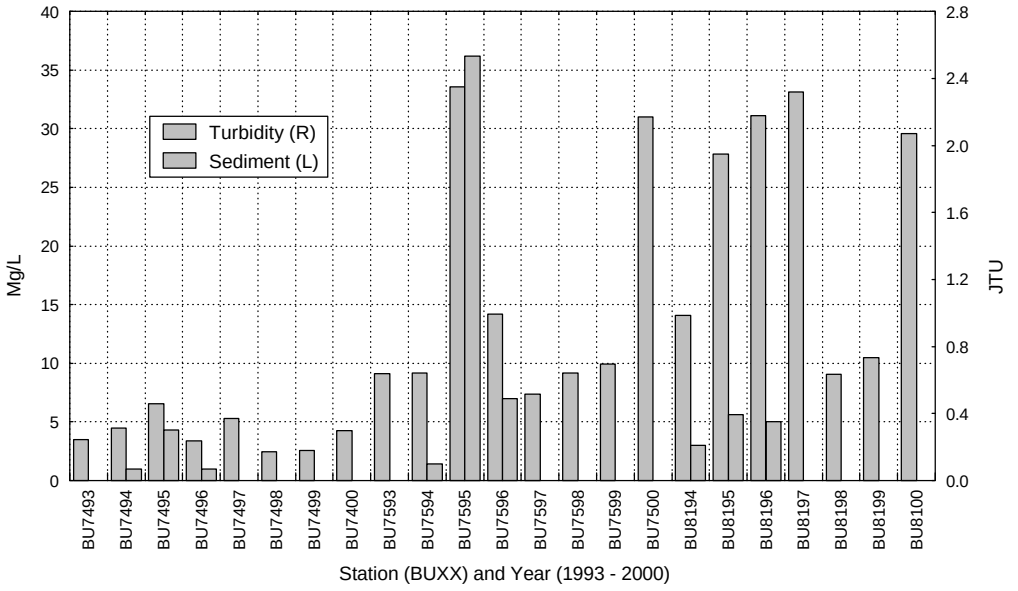

Figure 9: Daily mean discharge (cubic meter per second) for
streams in the Hayward and Holmes Brook during 1994 to 2000