

**LUCKNOW RIVER  
DRAINAGE BASIN STUDY**

**Surface Water Hydrology,  
Quality and Biology**

November 1979



Ontario

Ministry  
of the  
Environment

The Honourable  
Harry C. Parrott, D.D.S.  
Minister

Graham W.S. Scott  
Deputy Minister

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact Service Ontario Publications at [copyright@ontario.ca](mailto:copyright@ontario.ca)

**LUCKNOW RIVER  
DRAINAGE BASIN STUDY**

**Surface Water Hydrology, Quality and Biology**

Water Resources Assessment Unit  
Technical Support Section  
Southwestern Region

## TABLE OF CONTENTS

	Page
LIST OF TABLES LIST OF FIGURES	iii
LIST OF PLATES	iii
SUMMARY	1
RECOMMENDATIONS	1
INTRODUCTION	3
Land and Water Use	
Recreational Uses	
HYDROLOGY	4
WATER QUALITY	6
BIOLOGY	9
Bottom fauna	
Aquatic vegetation	
CONCLUSIONS	16
APPENDIX I. Water quality and biological data for the Lucknow River.	17

## **LIST OF TABLES**

	Page
Table 1. Streamflow data for the Lucknow River downstream from the Village of Lucknow.	5
Table 2. Streamflow data for the Lucknow River during 1978.	7
Table 3. Water quality criteria for the Lucknow River at Lucknow.	10

## **LIST OF FIGURES**

Figure 1. Sampling stations and stream gauging sites on the Lucknow River.	8
--	---

## **LIST OF PLATES**

Plate 1. Lucknow River conditions, June 1978.	12
---	----

## **SUMMARY**

A survey of the Lucknow River carried out in June, 1978, along with an assessment of long-term monitoring data, indicated that stable streamflow and excellent water quality existed throughout most of the Lucknow watershed. In Kinloss Creek, upstream from Lucknow, high nutrient and chloride levels were documented. Bacteriological contamination was evident downstream from the Village of Lucknow in the main Lucknow River.

The Lucknow River supported diverse populations of invertebrate aquatic life including many types of insects and other organisms intolerant of pollution. These invertebrate communities reflected the presence of excellent water quality and relatively constant streamflow.

## **RECOMMENDATIONS**

1. Every effort should be made to ensure that no direct discharge of municipal effluent is made to the Lucknow River at Lucknow.
2. A detailed review should be made of all major drainage proposals in the watershed. Failure to properly regulate and design such drainage works will reduce both water quality and quantity in the Lucknow River. Erosion and groundwater interference are two major concerns that should be avoided in any drainage works undertaken.

3. To protect the Lucknow River from detrimental growths of *Cladophora* spp., nutrient levels must not be increased and total phosphorus concentrations should not be elevated to exceed 0.03 mg/L, particularly during the period May to October.
  
4. The Ministry of the Environment, the Ministry of Natural Resources and the Maitland Valley Conservation Authority should protect the existing excellent water quality that characterizes most of the Lucknow watershed. Efforts should be made to improve sections of the river that have previously been degraded by ensuring proper planning within the watershed and implementing programs to encourage reforestation, proper farming practices and stream enhancement measures. The Ministry of Agriculture and Food should ensure that agricultural practices in the watershed have a minimum affect on water quality. Local planning boards and municipal councils should consider the impact of development activities when planning decisions are made.

## **INTRODUCTION**

During the summer of 1978, the Lucknow River watershed was surveyed to document existing macroinvertebrate communities, aquatic plant growths, water chemistry, water quantity and bacteriological conditions. This information was acquired to assist in determining what type of waste treatment facility is necessary for the Village of Lucknow to prevent any impairment of water quality in the Lucknow River.

### **LAND AND WATER USE**

The major land and water uses in the Lucknow River basin are agriculture (65 percent of land area) and recreation. There is sparse urban development within the watershed, with the Village of Lucknow (population approximately 1000) being the only major urban centre. The remaining hamlets within the watershed are very small and do not pose immediate or potential treatment problems.

### **RECREATIONAL USES**

Angling represents the main recreational use of the Lucknow River. Cold water fish species represent the principal resource of the Lucknow River and are presently being managed intensively by the Ministry of Natural Resources (see Lucknow River Fishery Management Area Master Plan prepared by the Wingham District Office, June 17, 1976).



The Ministry of Natural Resources has stated in this Master Plan that significant sections of excellent migratory salmonid (rainbow trout, salmon) habitat presently exist within the watershed., These include stretches of stream flowing through the Village of Lucknow, within St. Helen's Creek and within Henry's Creek. The plan indicates that "one site within Lucknow, on Andersons Creek, should be highly rated at a provincial level. It constitutes excellent spawning and nursery habitat for salmonids."

The Lucknow River Fishery Management Area Master Plan states that the Lucknow River has a high fisheries rating and should be the principal sport fishery resource to receive attention by the Wingham District Office of the Ministry of Natural Resources.

## **HYDROLOGY**

Measurements of streamflow from 1969 to 1978 are available from gauging station 02FD102, south of Lucknow (Table 1). The drainage area at this site is  $1.26 \times 10^4$  hectares (48.7 square miles) and the minimum recorded flow is 0.15 cubic meters per second ( $\text{m}^3/\text{sec}$ ) or 5.2 cubic feet per second (cfs) in August, 1969. The streamflow annually falls to the 0.28 to  $0.56 \text{ m}^3/\text{sec}$  (10-20 cfs) range in dry periods during the summer and fall. A significant portion of the watershed is forested (30%). These forested areas retain precipitation and as a result runoff is distributed more evenly throughout the year. The Lucknow River produces a higher base flow per unit of drainage area than most streams in the area.

**Table 1.** Streamflow data for the Lucknow River downstream from the Village of Lucknow (from MOE gauge 02FDI02. The drainage area is  $1.26 \times 10^4$  hectares (48.7 square miles)).

Month	Number of measurements when flow in range specified (cfs)					
	0-10	10-20	20-30	30-50	50-100	G100
April	0	0	0	0	1	7
May	0	1	0	2	3	2
June	0	2	6	8	0	0
July	0	8	2	3	3	0
August	2	6	2	2	1	0
September	1	3	1	1	0	1
October	1	5	1	3	0	0
November	0	2	2	3	3	0

G = greater than

note: 1 cfs =  $0.028 \text{ m}^3/\text{sec}$ .

Streamflow was also measured twice during June, 1978 (Table 2) at several stations. The cumulative flows from the tributaries which converge at Lucknow was measured at 0.74 m<sup>3</sup>/sec (26.5 cfs) on June 6 and 0.57 m<sup>3</sup>/sec (20.3 cfs) on June 27. Near Port Albert, at the river mouth, the flows were 1.31 and 1.02 m<sup>3</sup>/sec (46.7 and 36.4 cfs) on these same survey dates. It should be noted that half of the total river flow originated upstream from Lucknow.

## **WATER QUALITY**

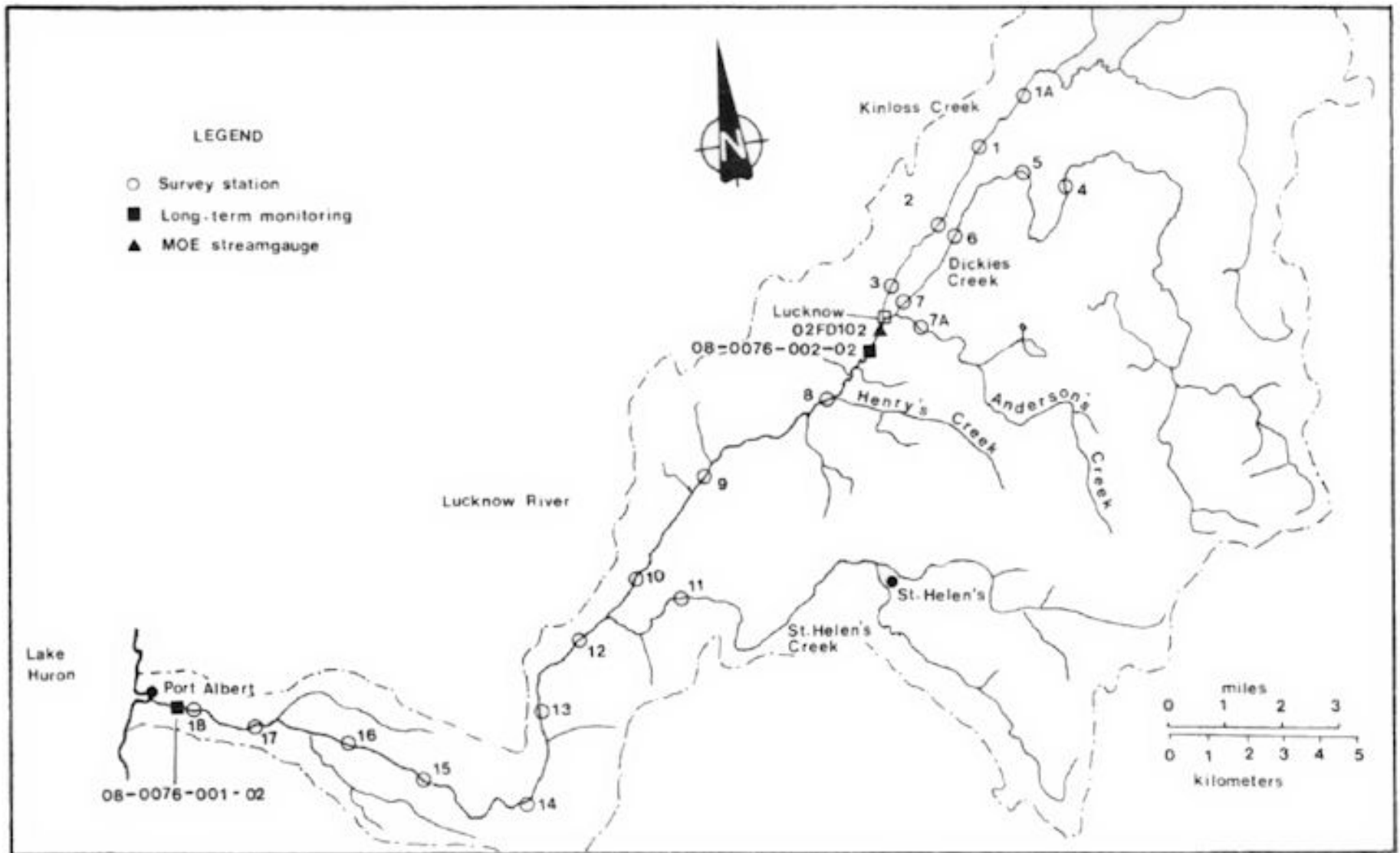
The chemical and bacteriological data obtained during June, 1978 are summarized in Tables 1 and 2 of Appendix I. The surveys consisted of 3 sets of samples collected for chemical analyses during each of the periods June 5 - 6 and June 26-27 and 2 sets of samples for bacteriological examination on June 6. The most notable observation based on the data derived from these samples was the increase in bacteria, chloride, conductivity and turbidity in Kinloss Creek, north of Lucknow, as compared to other tributaries. The lower reaches of Kinloss Creek have been channelized into agricultural drains whereas the other tributaries are essentially in a near-natural state.

Water quality data are available from long-term monitoring stations at Lucknow (08-0076-002-02) and at Port Albert (08-0076-001-02). A review of the data (Tables 3 and 4, Appendix I) indicated that the Lucknow River has had a very high standard of water quality for the period of record, with occasionally increased values of some parameters being recorded.

**Table 2.** Streamflow data for the Lucknow River during 1978.

Station	June 6 (cfs)	June 27 (cfs)
3	10.8	9.4
7	12.7	7.9
7A	3.0	3.0
10	32.5	23.3
11	6.1	
16	46.7	36.4

NOTE: 1 cfs = 0.028 m<sup>3</sup>/sec.



**Figure 1.** Sampling locations and stream gauging sites on the Lucknow River.

This was evident for total phosphorus concentrations, since the annual average values were approximately 0.03 mg/L, while the maximum concentration recorded downstream from Lucknow was 0.365 mg/L and at Port Albert, 0.126 mg/L.

Elevated bacteriological numbers were most apparent downstream and indicated pollution from Lucknow. The geometric mean values at Lucknow consistently exceeded the Ministry's recreational water quality Objectives of 1000 total coliforms per 100 ml and 100 fecal coliforms per 100 ml. At Port Albert, the bacteriological Objectives for total and fecal coliforms have been achieved since 1974 (except fecal coliform in 1975).

The water quality Objectives for the Lucknow River are presented in Table 3.

## **BIOLOGY**

### **BOTTOM FAUNA**

Collections of bottom fauna (animal life) were made at fourteen stations in the Lucknow River during June 28 and 29, 1978. Qualitative sampling with a hand *sieve* and bucket and/or quantitative sampling using a Surber sampler were completed at each station. A total of 51 taxa were collected from the watershed.

Pollution-intolerant species of dobsonfly and/or stonefly were common at stations 7, 9, 11, 12, 14 and 16, indicating excellent water quality conditions in the basin as these organisms are usually associated with cold-water trout streams. The results from this sampling effort are summarized in Table 5 of Appendix I.

**Table 3.** Water quality objectives for Lucknow River at Lucknow.

Month	In-stream conditions				Water quality Objectives			
	Temperature (°C) <sup>a</sup>	pH <sup>b</sup>	Toxic substances		Nutrients Total phosphorus as P	Dissolved oxygen (mg/L)	Fecal coliforms (numbers)	Total coliforms per100ml)
			Free ammonia as N (mg/L)	Hydrogen sulphide as H <sub>2</sub> S (mg/L)				
January	0-5	8.2	0.9	0.015	0.03	8	-	-
February	0-5	8.3	0.7	0.019	0.03	8	-	-
March	5	8.1	1.1	0.015	0.03	7	-	-
April	10	8.4	0.4	0.034	0.03	6	-	-
May	20	8.4	0.2	0.045	0.03	5	100	1000
June	25	8.2	0.2	0.032	0.03	5	100	1000
July	25	8.3	0.1	0.040	0.03	5	100	1000
August	25	8.3	0.1	0.040	0.03	5	100	1000
September	20	8.4	0.2	0.040	0.03	5	100	1000
October	15	8.2	0.4	0.026	0.03	6	100	1000
November	10	8.4	0.4	0.034	0.03	6	-	-
December	5	8.4	0.5	0.029	0.03	7	-	-

Concentrations of free ammonia and hydrogen sulphide in the table are laboratory values at 20°C that are equivalent to in-stream, sub-lethal concentrations of 0.02 mg/L un-ionized ammonia and 0.002 mg/L un-dissociated hydrogen sulphide for the stream temperature and pH conditions cited.

<sup>a</sup> Maximum expected temperatures

<sup>b</sup> From Lucknow River monitoring stations.

## Kinloss Creek

Stations 1A, 1, 2 and 3 were situated upstream from the Village of Lucknow. Bottom fauna collections indicated a more pollution-tolerant (facultative) community of organisms at stations 1A and 1, with improvements in numbers and types at stations 2 and 3.

The portion of the creek that had been channelized lacked sufficient stream cover, was heavily silted and was characterized by growths of the filamentous green alga *Cladophora* (Plate 1). These characteristics are typical of agricultural drains.

## Dickies Creek

Dickies Creek is characterized by swamp and slow-moving water flowing through agricultural land. Rooted aquatic plant growth was observed in the ponded areas.

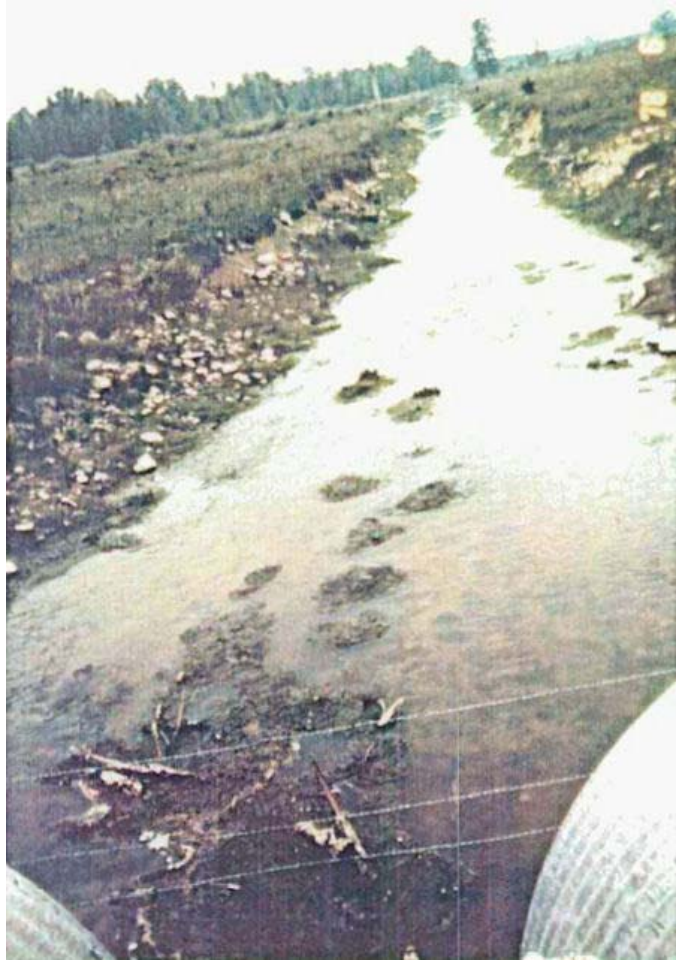
At stations 4, 5 and 6, facultative forms of invertebrates dominated; however, the mayflies, *Caenis*, *Ephemerella* and *Cloeon* and the caddisflies *Pycnopsyche* and *Oecetis* were present, indicating good water quality.

Station 7 downstream from the dam in Lucknow produced 28 taxa with 346 organisms per foot square. Of the 28 taxa collected, 14 are considered intolerant of pollution and typical of cool water environments.



**Plate I.** Lucknow River conditions, June, 1978.

Kinloss Creek  
upstream from Lucknow.  
Note unstable banks  
and aquatic plant growth.



Lucknow River near Dungannon.



## The Main Stream of the Lucknow River

The river downstream from the junction of Kinloss and Dickies creeks at Lucknow is characterized by fast flow over cobble, gravel and sand substrate. Aquatic plant growths such as pondweeds (*Potamogeton spp.*) were noted in deeper sections, but were not profuse. Riffle areas were void of any algal growths and the water was very clear.

Collections of bottom fauna at stations 8 and 9 immediately downstream from Lucknow produced 35 and 31 taxa respectively, with an average of approximately 250 organisms per foot square. The communities present were composed mainly of intolerant and facultative organisms yielding the highest diversity and total numbers of organisms documented in the watershed, indicative of excellent and productive water quality.

Station 12 located downstream from the junction of St. Helen's Creek produced a wide variety of taxa including several stonefly species and dobsonflies not encountered at stations 8 and 9.

Similar benthic communities were documented at Station 14 near Dungannon and at Station 16, 4.8 kilometers upstream from the mouth of the river. Intolerant organisms dominated the benthic community.

## St. Helen's Creek

This is the only major tributary to the lower main Lucknow River and enters from an easterly direction approximately 10.4 kilometers downstream from the Village of Lucknow. Macroinvertebrate collections indicated extremely good water quality as intolerant organisms dominated throughout. The intolerant dobsonfly, *Corydalis cornutus*, and the numerous stoneflies and mayflies collected are typical of cold water streams. (see Table 5 of Appendix I).

In summary, the macroinvertebrate communities documented in the Lucknow River reflect water of excellent quality, especially downstream from the Village of Lucknow on the main Lucknow River. Few other streams support benthic communities displaying this degree of diversity in Southwestern Ontario. The Lucknow River is rivaled only by sections of the Saugeen and Beaver rivers for the presence of intolerant macroinvertebrate species.

Table 3 (page 10) presents water quality objectives that should be met to protect the macrobenthos and fish communities in the Lucknow River.

## **AQUATIC VEGETATION**

During the week of June 4, 1978, observations were made on aquatic plant growths in the Lucknow River.

Estimations of percentage bottom cover were made for numerous locations throughout the watershed (see Tables 6 and 7 of Appendix I). Stream characteristics including temperature, width, depth, stream cover and substrate type were also recorded.

Growths of pondweed, (*Potamogeton spp.*) were documented to be moderate upstream from the Village of Lucknow in Dickies Creek and in deeper ponds immediately downstream from Lucknow.

The filamentous green alga, *Cladophora spp.* (indicative of nutrient enrichment) was common in channelized reaches of Kinloss Creek upstream from the Village of Lucknow.

To summarize, the Lucknow River at this time is almost totally void of the filamentous green alga *Cladophora spp.* Growths of pondweeds indigenous to the watershed were moderate and at this time pose no nuisance problems.

As substrate type and water temperatures in the lower half of the watershed are ideal for *Cladophora spp.*, the river downstream from Lucknow to its termination at Port Albert would support luxuriant growths of *Cladophora spp.* should sufficient nutrients become available.

The Lucknow River is used by rainbow trout, brown trout, brook trout and salmon species for spawning during the spring and fall. The eggs and fry of these spawning fish require good quality, sustained flow, cool temperatures and high dissolved oxygen levels to survive. Severe *Cladophora* growth would restrict flow, foul spawning beds and cause serious oxygen fluctuations.

## CONCLUSIONS

The high base flow produced in the headwaters of the Lucknow River constitutes a valuable resource and is one of the factors directly responsible for aquatic invertebrate and fish communities that reflect the excellent water quality in the main Lucknow River downstream from Lucknow, as documented earlier in this report. Major changes to these headwater streams, such as occurred with the channelization of sections of Kinloss Creek upstream from Lucknow, would serve to increase erosion and water temperatures, and reduce base flow. When one considers the high quality of this valuable stream and its angling potential, the desirability of agricultural drainage works, especially as performed previously on sections of Kinloss Creek, is open to serious question.

Excessive erosion of the land and severe silting of the Lucknow River will result from improperly executed drainage works. Other measures such as the protection of swamps, adequate controls on the extractive industry, maintenance of bank cover and practices to reduce the impact of agriculture, especially in the headwater areas, will be important considerations in determining the future water quality throughout in the Lucknow River system.

## APPENDIX I

### WATER QUALITY AND BIOLOGICAL DATA FOR LUCKNOW RIVER

- Table 1. Water quality data for the Lucknow River, June 5 and 6, 1978.
- Table 2. Water quality data for the Lucknow River, June 25 and 26, 1978.
- Table 3. Water quality data from long-term monitoring station 08-0076--001, Lucknow River at Port Albert.
- Table 4. Water quality data from long-term monitoring station 08-0076-002, Lucknow River at Lucknow.
- Table 5. Macroinvertebrates collected at 14 stations in the Lucknow River, June 1978 (number per foot square) .
- Table 6. Station locations for *Cladophora* observations on the Lucknow River (June 7, 1978).
- Table 7. Observations and documentation of *Cladophora* growth in the Lucknow River (June 7, 1978).

**Table 1.** Water quality data for the Lucknow River, June 5 and 6, 1978.

Station	Dissolved Oxygen			Temp °C	Phosphorus as P				Nitrogen as N					
	Ave.	Max.	Min.		Total			Sol.	FA	Kjeldahl			NO <sub>2</sub>	NO <sub>3</sub>
					Av.	Max	Min.			Ave.	Max.	Min.		
1 (t)	13.4	14.1	10.2	14.8	0.029	0.032	0.025	0.011	0.016	0.527	0.545	0.515	0.017	0.60
5	6.6	6.9	6.0	15.1	0.024	0.029	0.022	0.008	0.018	0.498	0.540	0.450	0.007	0.09
3 (t)	12.5	13.5	10.7	14.7	0.021	0.021	0.021	0.008	0.027	0.450	0.455	0.445	0.015	0.61
7	9.8	10.4	9.1	16.5	0.019	0.021	0.017	0.005	0.023	0.503	0.525	0.475	0.007	0.19
7A(t)	10.4	11.4	9.6	16.6	0.015	0.016	0.013	0.003	0.028	0.488	0.525	0.440	0.012	1.20
8	10.7	12.2	9.5	15.6	0.024	0.035	0.018	0.005	0.020	0.530	0.595	0.480	0.011	0.62
10	12.4	12.8	12.0	18.4	0.017	0.018	0.017	0.004	0.022	0.483	0.510	0.470	0.011	0.64
11 (t)	12.8	16.6	10.2	14.4	0.024	0.026	0.022	0.006	0.018	0.523	0.565	0.495	0.012	1.03
12	11.7	13.2	9.3	17.3	0.017	0.020	0.016	0.003	0.025	0.492	0.500	0.485	0.010	0.71
14	11.3	11.6	11.0	17.5	0.012	0.013	0.012	0.002	0.020	0.443	0.535	0.395	0.009	0.75
16	10.7	11.6	10.0	17.0	0.019	0.020	0.018	0.004	0.022	0.452	0.455	0.450	0.001	0.77
18	10.4	11.5	9.4	19.1	0.014	0.015	0.013	0.003	0.020	0.418	0.435	0.395	0.009	0.75

NOTE: All results in mg/L, except where indicated

**Table 1.** Continued

Station	Bacteria /100ml				Solids		Chl	Cond. µmho/cc	Turb Form	pH	BOD <sub>5</sub>		
	TC	PC	FS	PA	Total	Susp.					Ave.	Max.	Min.
1 (t)	C676	119	143	<4		8.0	29.3	631	2.4	8.24	1.4	1.6	1.3
5	C882	118	141	<4		6.0	4.7	486	1.4	7.86	1.3	1.5	1.2
3 (t)	G1500	163	280	<4		7.5	28.0	618	2.5	8.27	1.3	1.4	1.3
7	C744	100	185	<4		6.0	5.2	482	1.1	8.15	1.4	1.4	1.3
7A (t)	C1060	107	104	<4		8.3	10.5	513	1.7	8.30	1.4	1.5	1.2
8	C1587	163	131	<4		16.5	16.8	555	1.7	8.26	1.5	1.9	1.1
10	G1500	125	90	<4		6.5	16.8	549	1.3	8.35	1.4	1.5	1.3
11 (t)	C877	48	78	<4		8.7	5.5	517	1.8	8.21	1.2	1.3	1.2
12	C1475	44	35	<4		7.0	15.3	544	1.7	8.34	1.2	1.3	1.2
14	C677	32	43	<4		8.5	15.4	533	1.5	8.44	1.2	1.4	1.0
16	C329	41	56	<4		10.2	14.5	520	2.5	8.46	1.2	1.2	1.1
18	C435	24	90	<4		15.0	14.7	526	4.3	8.48	1.3	1.4	1.1



**Table 2.** Water quality data for the Lucknow River, June 25 and 26, 1978.

Station	Dissolved Oxygen			Temp °C	Phosphorus as P				Nitrogen as N					
	Ave.	Max	Min.		Total			Sol.	FA	Kjeldahl			NO <sub>2</sub>	NO <sub>3</sub>
					Ave.	Max	Min.			Ave.	Max.	Min.		
1 (t)	12.4	18.0	8.5	22.4	0.222	0.026	0.019	0.004	0.020	0.557	0.580	0.520	0.048	0.78
5	6.1	7.6	3.2	22.2	0.038	0.057	0.028	0.009	0.050	0.773	0.885	0.655	0.008	0.06
3 (t)	13.7	19.8	7.6	22.3	0.038	0.064	0.024	0.007	0.025	0.605	0.730	0.525	0.032	0.71
7	9.8	13.2	6.6	24.8	0.035	0.047	0.021	0.007	0.035	0.695	0.730	0.655	0.008	0.08
7A (t)	11.6	14.6	6.5	24.3	0.028	0.036	0.020	0.002	0.032	0.637	0.720	0.585	0.015	1.06
8	8.2	8.9	6.8	22.7	0.034	0.049	0.026	0.009	0.030	0.643	0.690	0.615	0.018	0.57
0	14.1	19.0	8.1	24.0	0.028	0.037	0.021	0.005	0.018	0.593	0.610	0.575	0.013	0.60
11 (t)	13.0	17.2	7.6	22.3	0.058	0.107	0.030	0.008	0.025	0.702	0.940	0.570	0.013	0.89
12	13.5	17.0	8.6	24.2	0.021	0.023	0.018	0.004	0.018	0.573	0.595	0.540	0.015	0.69
14	8.9	10.6	7.2	24.4	0.022	0.023	0.021	0.007	0.018	0.551	0.585	0.540	0.014	0.70
16	11.3	14.0	7.6	25.9	0.015	0.016	0.014	0.001	0.022	0.570	0.685	0.485	0.010	0.66
18	10.3	13.1	6.3	25.9	0.020	0.027	0.014	0.002	0.020	0.567	0.605	0.520	0.011	0.61

(t) = tributary

NOTE: All results in mg/L, except where indicated.

**Table 2.** Continued

Station	BOD <sub>5</sub>			Solids		Chl	Cond. µmho/cc	Form Turb	pH
	Ave.	Max.	Min.	Total	Susp.				
1 (t)	0.5	0.6	0.5		1.8	35.0	650	5.4	8.41
5	0.7	0.8	0.6		2.8	4.8	482	1.3	7.75
3 (t)	0.7	0.9	0.5		10.1	34.0	630	4.4	8.43
7	0.7	0.8	0.6		3.3	5.8	456	1.2	8.12
7A (t)	0.6	0.7	0.6		6.8	9.0	482	2.7	8.38
8	0.6	0.7	0.6		2.7	20.7	560	1.9	8.33
10	0.6	0.7	0.5		5.0	17.7	537	1.7	8.45
11 (t)	1.0	1.8	0.6		5.0	6.2	512	2.3	8.31
12	0.6	0.7	0.5		1.2	15.5	525	1.6	8.42
14	0.5	0.7	0.4		0.3	14.7	509	1.4	8.51
16	0.5	0.6	0.5		8.2	14.2	479	2.8	8.53
18	0.5	0.8	0.3		2.0	14.0	482	4.1	8.56

**Table 3.** Water quality data from long-term monitoring Station 08-0076-001, Lucknow River at Port Albert.

Station	Dissolved Oxygen			Temp °C	Phosphorus as P				Nitrogen as N					
	Av.	Max	Min.		Total			Sol.	Kjeld	FA			NO <sub>2</sub>	NO <sub>3</sub>
					Av.	Max	Min.			Ave.	Max.	Min.		
1965	10.9	15.0	4.8	12.7	0.095	0.20	0.04	0.0636	0.38	0.082	0.20	0.03	TR	0.46
1966	10.6	15.0	6.0	12.1	0.056	0.14	0.00	0.065	0.64	0.077	0.20	0.00	0.006	0.58
1967	10.9	15.0	5.0	7.5	0.019	0.07	0.00	0.004	0.59	0.117	0.33	0.00	0.001	0.54
1968	10.0	12.0	8.0	10.0	0.028	0.06	0.01	0.014	0.47	0.108	0.23	0.04	0.001	0.68
1969	9.8	13.0	6.0	9.0	0.030	0.060	0.010	0.012	0.62	0.056	0.11	0.02	0.009	0.59
1970	8.3	14.0	3.0	12.5	0.042	0.190	0.010	0.015	0.53	0.033	0.07	0.02	0.010	0.69
1971	9.8	11.5	8.0	11.8	0.022	0.034	0.014	0.007	0.49	0.023	0.05	0.01	0.007	0.79
1972	10.5	13.0	8.4	8.1	0.062	0.360	0.011	0.039	0.66	0.170	1.40	0.01	0.009	0.87
1973	10.1	13.8	7.9	14.0	0.034	0.120	0.010	0.013	0.46	0.012	0.02	0.01	0.006	0.70
1974	11.1	14.5	8.5	10.7	0.022	0.048	0.007	0.007	0.50	0.023	0.05	0.01	0.010	0.94
1975	12.1	17.0	8.5	12.0	0.031	0.103	0.006	0.011	0.52	0.023	0.09	<0.005	0.038	0.75
1976	15.5	24.0	10.0	11.3	0.027	0.083	0.006	0.012	0.50	0.022	0.075	<0.005	0.009	0.69
1977					0.030	0.126	0.007	0.007	0.53	0.040	0.195	0.005	0.008	1.34
1978					0.028	0.116	0.006	0.006	0.47	0.026	0.055	0.005	0.008	1.00

NOTE: All results in mg/L, except where indicated.

**Table 3.** Continued

Station	Bacteria /100ml				Chlorides	BOD <sub>5</sub>		
	TC	FC	FS	PA		Ave.	Max.	Min.
1965	3978				16.2	1.4	29.0	0.3
1966	118				14.8	1.9	3.7	0.5
1967	1041				12.2	1.3	3.3	0.4
1968	258				11.9	1.1	2.1	0.4
1969	678				11.0	1.1	1.8	0.4
1970	331				12.4	1.5	3.0	0.6
1971	594				11.7	1.1	2.2	<0.5
1972	546	85	37		15.3	1.6	7.0	0.4
1973	1248	253	483		15.8	1.4	3.0	0.4
1974	444	92	157		14.8	1.1	2.5	<0.5
1975	547	120	703	3	10.8	1.1	2.2	<0.5
1976	442	97	50	3	12.1	0.8	1.6	0.3
1977	427	31	282	4	12.9	1.1	4.0	0.3
1978	317	8	36	<4	14.5	0.8	1.5	0.3

**Table 4.** Water quality data from long term monitoring station 08-0076-002, Lucknow River at Lucknow.

Station	Dissolved Oxygen			Phosphorus as P				Nitrogen as N					
	Ave.	Max	Min.	Total			Sol.	Kjel	FA			NO <sub>2</sub>	NO <sub>3</sub>
				Ave.	Max	Min.			Ave.	Max.	Min.		
1965	10.8	13.8	4.8	0.13	0.70	0.08	0.20	0.51	0.09	0.12	0.08	0.01	0.27
1966	10.9	16.0	7.0	0.66	5.6	0.00	0.50	0.79	0.08	0.23	0.00	0.01	0.74
1967	10.0	15.0	8.0	0.02	0.08	0.00	0.01	0.66	0.14	0.33	0.06	0.01	0.59
1968	9.2	11.5	5.0	0.040	0.070	0.01	0.11	0.54	0.11	0.20	0.04	0.00	0.67
1969	9.2	12.0	6.0	0.020	0.040	0.01	0.01	0.60	0.06	0.14	0.01	0.09	0.54
1970	8.9	14.0	6.0	0.035	0.053	0.010	0.013	0.55	0.04	0.07	0.01	0.010	0.61
1971	8.8	11.0	5.0	0.061	0.200	0.020	0.039	0.47	0.02	0.04	0.01	0.008	0.66
1972	10.5	13.8	9.1	0.040	0.082	0.022	0.020	0.54	0.03	0.07	0.01	0.009	0.69
1973	9.8	11.2	7.2	0.029	0.040	0.020	0.009	0.47	0.02	0.04	0.01	0.008	0.54
1974	10.9	14.2	6.1	0.030	0.044	0.014	0.006	0.56	0.02	0.06	0.01	0.012	0.71
1975	11.9	14.6	7.5	0.059	0.365	0.015	0.013	0.61	0.030	0.060	0.015	0.016	1.165
1976	14.8	22.0	11.9	0.030	0.074	0.012	0.012	0.527	0.028	0.040	0.005	0.010	0.611
1977	10.6	19.0	7.0	0.025	0.083	0.011	0.006	0.563	0.042	0.165	0.005	0.011	0.822

NOTE: All results in mg/L, except where indicated.

**Table 4.** Continued

Station	Bacteria /100 ml				BOD <sub>5</sub>			Chl.
	TC	FC	FS	PA	Ave.	Max.	Min.	
1965	4065				2	3	1	21
1966	3469				2	4	1	23
1967	3080				1	4	1	15
1968	6835				1	2	1	13
1969	3373				1	3	1	13
1970	2119				1	4	1	15
1971	13027				1	2	0	19
1972	9765	253	473		1	2	0	21
1973	22390	891	320		2	3	0	21
1974	6158	427	162		1	2	0	21
1975	7536	526	234	9	1	2	0	15
1976	5905	340	156	<4	1	2	0	17
1977	3239	132	37	<4	1	3	0	17

**Table 5.** Macroinvertebrates collected at 14 stations on the Lucknow River, June 1978. (number per ft. sq.)

	Sta.1A	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 11	Sta. 12	Sta. 14	Sta. 16
ORGANISMS														
DOBSONFLIES														
<i>Corydalus cornutus</i>								P			P	2	P	
ALDERFLIES														
<i>Sialis</i>										4			1	1
STONEFLIES														
<i>Acroneuria</i>								2			P	P	1	3
<i>Neophasganophora</i>								1				1		
<i>Paragnetina</i>											P	P		
<i>Perlesta placida</i>								1			1			
MAYFLIES														
<i>Baetis</i>								12	P	2	6	2	1	1
<i>Caenis</i>		P		P	P		P	P	P	1	2	3	3	6
<i>Cloeon</i>		P	P	1		P								
<i>Ephemerella</i>			P		P			1	2	3	6	7	9	2
<i>Hexagenia</i>			P						P	1			2	34
<i>Isonychia</i>								1					2	2
<i>Neocloeon</i>									1					1
<i>Paraleptophlebia</i>								20	10	1	5	2		
<i>Siphonurus</i>														
<i>Stenonema</i>				P			P	4	11	4	7	7	14	10
<i>Tricorythodes</i>									2	6		6	12	2
CADDISFLIES														
<i>Anabolia</i>							P							
<i>Cheumatopsyche</i>				24				91	29	5	11	17	21	14
<i>Chimarra</i>								34				5	1	
<i>Helicopsyche</i>				10				11	9	10	4	27		1
<i>Hydropsyche</i>				18				43	71	23	23	37	45	52

**Table 5** - continued

	Sta. 1A	Sta. 1	Sta.2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 11	Sta. 12	Sta. 14	Sta. 16
<b>CADDISFLIES -continued</b>														
<i>Nectopsyche</i>									P	P				
<i>Oecetis</i>						P			4	8				
<i>Polycentropus</i>										1			1	1
<i>Psychomyia</i>									1		1			
<i>Pycnopsyche</i>				2	P		P			P	P	P		P
<i>Rhyacophilia</i>													1	
<i>Triaenodes</i>				P		P								
pupae (unidentified)		P		6			P	3	17	1	5	5	4	
<b>DAMSELFLIES</b>														
Agrionidae			P	P	P				P	P		P		
<i>Argia</i>			P			P								
Coenagrionidae			P	P		P	P	P	P	P		P		P
<b>DRAGONFLIES</b>														
<i>Aeschna</i>														
<i>Gomphus</i>					P		P		P			P		
<i>Sympetrum</i>						P								
<b>BEEPLES</b>														
Dytiscidae		P	P											
Elmidae		P	P	13	P	P		68	51	11	5	39	9	43
Haliplidae		P	P											
Hydrophilidae	P	P	P						P			P		
Psephenidae				5				26	1	6	10	1	1	
adults (unidentified)	P	P	P	6	P		P	7	32	25	2	20	3	3
<b>TRUE BUGS</b>														
Corixidae	P	P	P		P	P	P	P	P			P		P
Notonectidae														



**Table 5.** continued

	Sta. 1A	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 11	Sta. 12	Sta. 14	Sta. 16
MITES (unidentified)	P	P				P	P	1	4	14		2	1	4
AMPHIPODS														
<i>Hyalella azteca</i>		P	P	1	P	P	P	P	1	2	P	1		
ISOPODS														
<i>Asellus</i>				3										
CRAYFISHES														
<i>Orconectes propinquus</i>		P		2	p			3	1	P		P	1	P
<i>O. immature</i>		P	P		P	P	P	1	2	4	1			P
SNAILS														
<i>Amnicola</i>				P	P	P	P	1	2	5	1	2		1
<i>Ferrissia</i>							P							
<i>Gyraulus</i>		P	P			P	P			P				P
<i>Helisoma</i>		P				P	P							
<i>Lymnaea</i>	P		P		P		P						P	
<i>Physa</i>	P	P	P	P	P	P	P	1	P	5	1		P	1
<i>Pleurocera</i>														1
<i>Valvata tricarinata</i>						P	P	1	P	1				
CLAMS														
<i>Pisidium</i>		P			P	P	P	3	2	P				
<i>Sphaerium</i>		P			P		P	P	4	3		1		
Unionidae									P					
TRUE FLIES														
Anthomyiidae												1		
Certopogonidae			P											
Chironomidae	P	P	P	19	P	P	P	9	46	57	55	168	53	50

**Table 5.** continued

	Sta.1A	Sta. 1	Sta.2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 11	Sta. 12	Sta. 14	Sta. 16
TRUE FLIES - continued														
Rhagionidae									1	1				
Sciomyzidae							P							
Simuliidae					P									
Stratiomyiidae							P							1
Tabanidae	P								p					
Tipulidae						P			1		1	1	1	
pupae unidentified	P									2	3	1	1	5
WORMS														
Tubificidae	P	P	P			P								
LEECHES														
Glosiphoniidae						P								
Hirudinidae	P													
FLATWORMS (unidentified)	P			6		P		1	7	2	2	1		
GORDIAN WORMS														
Nematomorpha (unidentified)														1
Total number of taxa	10	18	20	18	16	21	24	28	35	31	23	30	24	27
Total number of organisms				116				346	312	208	152	357	191	239

P - present in Qualitative sample

**Table 6.** Station locations for *Cladophora* observations on the Lucknow River (June 7, 1978).

Station	Lot	Concession	Township	Remarks
<b>Bruce County</b>				
1A	13	VIII	Kinloss	Kinloss Creek
1	11	IV	Kinloss	
2	11	II	Kinloss	
3	60	I	Kinloss	at Lucknow on Kinloss Creek
4	16	IV	Kinloss	Dickeys Creek
5	14	IV	Kinloss	Dickeys Creek
6	12	II	Kinloss	Dickeys Creek
7	67	I	Kinloss	at Lucknow on Dickeys Creek
<b>Huron County</b>				
8	13	XIII	Wawanosh West	Downstream Lucknow
9	10	XI	Ashfield East	
10	10	IX	Ashfield East	
11	11	IX	Ashfield East	St. Helens Creek
12	10	VIII	Ashfield East	
13	9	VI	Ashfield East	
14	11	V	Ashfield East	
15	7	IV	Ashfield East	
16	3	IV	Ashfield East	
17	1	III	Ashfield East	
18	2	III	Ashfield West	Port Albert

**Table 7.** Observations and documentation of *Cladophora* growth in the Lucknow River (June 7, 1978).

Location	Temp. (°C)	Depth	Substrate	Stream cover	Growth present June 5,6,1978
Station 1A	16	15-30 cm	gravel, some cobble	field, pasture stream stream channelized	<i>Cladophora</i> - 40% cover 30cm long strands
Station 1	16	15 - 60 cm	sand, gravel some cobble	no stream cover stream ditched	<i>Cladophora</i> -50 % cover, poor condition. sloughing off, mats in shallow water
Station 2	15	15 -90 cm	sand, gravel	pasture, wooded areas	vegetation sparse - some green algae along shore, reeds and water lilies
Station 3	15	15 - 90 cm	sand, gravel some cobble	pasture, meadow	<i>Cladophora</i> - sparse, some green algae alongshore with rooted aquatics
Station 4	15	60 cm - 1.5 m	black mud	willow marsh, trout water	No <i>Cladophora</i> or aquatic growth present
Station 5	18	1-2 metres	black mud	willow marsh marshy conditions	No <i>Cladophora</i> , yellow water lilies
Station 6	18	60 cm -1m	black mud	marsh area willow bog well bushed	rooted aquatics along shore yellow water lilies <i>Potamogeton spp.</i> common
Station 7	19	15 - 60cm	gravel, cobble	trees, grass, buildings flowing through Lucknow	algae and diatom growth, slime on rocks very clean
Station 8	18	30 - 90 cm	sand, gravel	well bushed	No <i>Cladophora</i> heavy <i>potamogeton spp.</i> 80% cover to surface
Station 9	17	30 - 90 cm	sand, gravel	pasture, meadow some erosion	<i>Potamageton</i> - 25% cover
Station 10	19	15cm - 1.2m	sand, gravel	meadow	sparse vegetation - all types

**Table 7.** Continued

Location	Temp. (°C)	Depth	Substrate	Stream cover	Growth present June 5,6,1978
Station 11	17	15 -30 cm	cobble	open field trees along bank	<i>Cladophora</i> -trace 1cm strands on odd rock
Station 12	19	15cm - 1.5m	sand, gravel cobble, rock	field, well bushed	bottom excellent for algae growth no growth present
Station 13	19	15 cm -1.5 m	gravel, cobble	bushed area good bank cover	* bottom excellent for algae growth BUT NO growth present
Station 14	19	15 -30 cm	cobble	valley, well treed	some algae growth * excellent riffles for growth, BUT NO growth present
Station 15	19	15cm -1.2m	cobble, rock	forested ravine	No <i>Cladophora</i> * excellent substrate very clean stretch
Station 16	19	15cm -1.2m	gravel, cobble, rock	meadow, forested area	no growth * excellent substrate bottom clean
Station 17	19	15 - 90 cm	cobble, rock gravel	trees and meadow	no growth * excellent growth potential
Station 18	19	15 - 60cm	rock	trees, bush	<i>Cladophora</i> -10% cover healthy, excellent substrate