LIMNOLOGICAL STUDY OF

LONG LAKE, WAUSHARA COUNTY

NOVEMBER 1979 THROUGH OCTOBER 1980

by

Ronald Krueger and Richard Martens
Northern Lake Service, Inc., crandon, Wisconsin

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INTRODUCTION AND DISCUSSION

In compliance with Chapter 33 of the Wisconsin Statutes, and Chapter NR60 Wisconsin Administrative Code, the Long Lake Protection and Rehabilitation District, contracted with Northern Lake Service, Inc. of Crandon, Wisconsin, on April 27, 1979 to carry out data collection survey as outlined in Department of Natural Resources specifications of 1979. The purpose of this data collection survey was to provide hydrological and limnological information on which personnel from DNR's Office of Inland Lake Renewal may base lake protection, management, and/or rehabilitation alternatives.

This final report contains data collected during the twelve month study and general interpretations of the data. The lake district furnished a minimal portion of the study labor needs as in-kind help. Two of five alternate Secchi disc and chlorophyll samples were collected by the district. Thus, nearly all of the study was conducted by Northern Lake Service personnel. All changes in the study design were approved by the Office of Inland Lake Renewal.

The following discussion will follow the specifications of the study.

Groundwater Survey

A series of groundwater wells were installed at various sites around the lakes in an attempt to determine groundwater gradients and quality. In addition, seepage meters were used during the ice-free period of the study to determine in-flow rates along shallow shoreline areas.

Three test wells were installed at site "D" on the west end of the lake to augment wells installed by USGS which represent the other three shores of the lake. An additional back well was to be installed at site "B", however an easement was not obtained in this area. Well A-L, which had been damaged by a snowplow was repaired prior to sampling. All wells were surveyed to a spike in a tree at the north boatlanding with an assumed elevation of 100.00 feet.

Seepage meters were to be installed at points where recharge was expected, however only site A was a potential recharge area. Two meters were installed at different depths at this site, but seepage rates were so low that testing was discontinued after two months.

Groundwater levels, when compared to lake levels, suggest poor communication between groundwater and lake water. Average well levels were lower than the average lake level in all wells except well A-L where a slight recharge was apparent. A slight vertical recharge was noted at site A-H, however the gradient was away from the lake at this site. The other three piezometric nest sites demonstrated both vertical and horizontal discharges.

In summary, Long Lake is apparently "perched" with little influence from local groundwater, at least at present groundwater levels.

Groundwater sampling from the wells was conducted monthly with field filtering samples for phosphorus analyses during the final six months of the survey. Groundwater was generally hard and alkaline with low phosphorus levels. The deeper wells were not analysed after the first month, except for D-P. It is interesting to note the abnormally high ammonia nitrogen, conductivity, and hardness in the deeper wells. It appears that groundwater originating from the local area is of higher purity than that of the deeper aquafer. This is of little significance to Long Lake, however since groundwater-lakewater transfer appears minimal.

In-lake

The in-lake survey of Long Lake included several different areas of study.

Lake samples were collected from surface and near bottom on a monthly basis. The data provides nutrient levels typical of fertile lakes. Phosphorus levels one to two times the threshhold level for excessive weed and/or algae production. The moderate alkalinities, when compared to the higher hardness levels of the groundwater, further suggest that the main source of water to the lake is from precipitation, not groundwater influx. Conductivity differences also bear this out.

Severe winter oxygen depletion, which is probably a common occurance, did not occur during the winter of 1979-80. Indeed oxygen levels remained high throughout the winter, due to clear ice and little snow which allowed photosynthetic oxygen production.

The depth of sediment survey conducted through the ice resulted in rather surprising information. It was assumed that this "dishpan" lake located in a relatively flat, sandy, area of the state might never have been very deep. Probing

the soft sediments indicated an original depth of over thirty feet. Thus the original lake basin has filled in about 75% during the last 10,000 years or so. Sedimentation is apparently autochthomous material resulting from partially decomposed plants and animals produced in the lake. This material typically has a high oxygen demand, so oxygen depletion is probably high during snowy winters.

Chlorophyll samples were collected semi-monthly between late April and mid-August, monthly thereafter. Levels were relatively low; nutrients were apparently utilized mainly by the dense macrophyte population in the lake. Secchi disc visibilities were of little value because the disc dissappeared into soft sediment at about five feet. Secchi disc readings are estimated to have ranged from 10-20 feet, had there been a spot deep enough for a measurement.

A single macrophyte study was conducted in mid-July. Macrophyte growths were found at all but two of the 79 sites on the lake. Twenty-three taxa were identified. Major stands of white lily and watershield were present in floating leaf communities.

The submergents typically found in profusion in extremely fertile waters were relatively sparce. Millfoil and elodea were present and coontail absent on the diverse list of ten submergents. Potamogeten gramineus, P. amplifolius, and Charra were the dominent submergents.

In summary, Long Lake is a shallow, fertile lake with minimal communication with groundwater. The lake has undergone eutrophication (natural lake aging) to the point at which sediment accumulation accounts for a major portion of the original basin volume. Macrophyte growth is profuse, interfering with recreational pursuits in some areas. Winter fish kills can be expected during long periods of snow cover.

GENERAL LAKE MANAGEMENT SUGGESTIONS

Although it is not a responsibility of Northern Lake Service to offer detailed management alternatives, it is difficult to conduct a data collection survey for that purpose without having developed some thoughts in this regard. Three categories of alternatives might be considered: lake rehabilitation, lake management, and lake protection.

Lake protection is usually best accomplished by lake community residents and users at minimal cost through

"common sense" practices. Lawn fertilizing where run-off can reach the lake, burning brush on the ice, high speed motorboating in shallow silty areas, disturbing near shore vegitation and major excavations near the lake are all practices which should ba avoided. The lake district should support county zoning and might ask the county zoning committee to advise the commissioners of any variance requests within the district. A working relationship with the township and county governments can result in district participation in land use decisions within the lake district.

Lake management activities might include winter aeration if fish mortalities are a concern to district residents. Macrophyte (weed) control either chemical or mechanical would reduce nuisance growths in swimming and docking areas.

Long Lake would be a prime candidate for a major dredging project as a rehabilitation alternative. While total removal of 700,000 cubic yards would probably be prohibitively expensive at $1.50 to $2.00 per yard, a smaller project might be within the district's grasp, should the district members be willing to make a large monitary committment. This would require a major effort to obtain necessary permits. Unfortunately, the DNR's Lake Michigan District, through which the lake district would apply, has been reluctant to allow even small scale rehabilitation projects within its jurisdiction.

Local residents have shown concern over lake level fluctuations. Although the level fluctuated only about five inches during the survey period, it was apparent that greater fluctuations occur over long periods of time. Any plan to raise or maintain the lake level using high capacity wells should be preceeded by a chemical analysis of the well water. The chemistry of the water taken from well D-P would likely cause major ecological changes in the lake.

Daily Precipitation Data from Hancock Experimental Farm

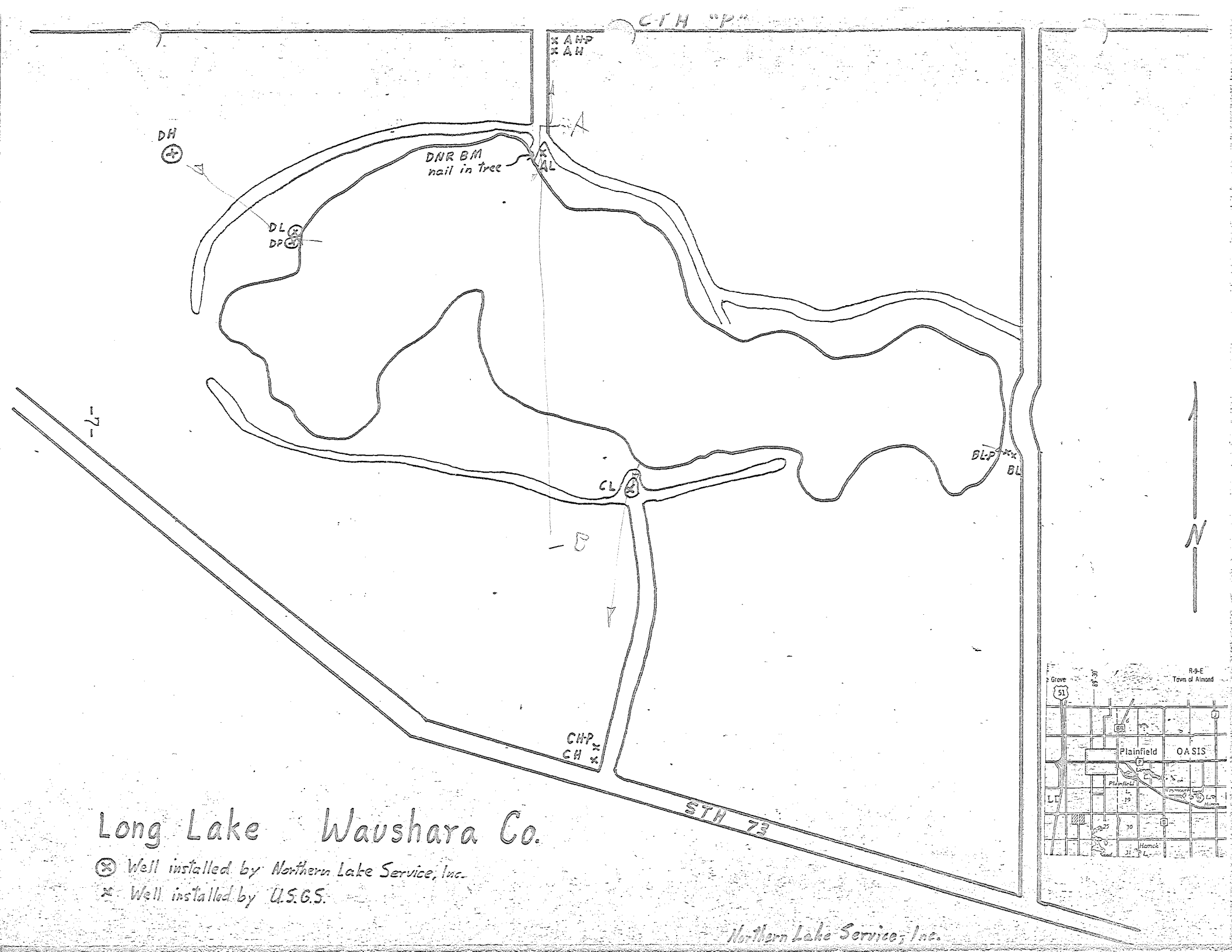
t = trace, - = no record, x = amount included in following measurement. Precipitation given in inches.

Date	Hancock Exp. Farm
Nov. 1979	
1	.40
2- 5	
6	.27
7	
8	t
9	.50
10	.02
11	
12	.50
13-14	
15	t
16-20	
21	.14
22	.28
23	t
24	t
25	
26	.52
27	
28	.02
29	.01
30-31	
Dec.	
1-6	
7	.16
8-15	
16	.03
17-21	
22	.03
23	.39
24	.07
25	
26	t
27-31	
Jan. 1980	
1-3	
4	t
5	
6	.11
7	.08
8	
9	t
10	
11	.08
12-14	
15	.02
16	1.02
17	.15
18-20	
21	t
22	.01
23	
24	.07
25	.02
26-27	
28	t
29	
30	t
31	
Feb.	
1-4	
5	.03
6	.01
7-8	
9	t
10	t
11	t
12	
13	.04
14	
15	t
16-19	
20	.07
21	
22	.01
23	t
24-25	
26	t
27	
28	.02
29	
Mar. 1980	
1-3	
4	t
5	.05
6	.06
7	t
8	
9	.03
10	.01
11-12	
13	.22
14	.07
15-21	
22	t
23	.28
24-26	
27	t
28-31	
April	
1-2	
3	.25
4	.03
5	
6	.10
7	.40
8	.49
9	.54
10	.03
11-13	
14	.03
15-28	
29	.11
30	.05
May	
1-9	
10	.02
11	.35
12	
13	.18
14	

Daily Precipitation Data from Hancock Experimental Farm

t = trace, - = no record, x = amount included in following measurement. Precipitation given in inches.

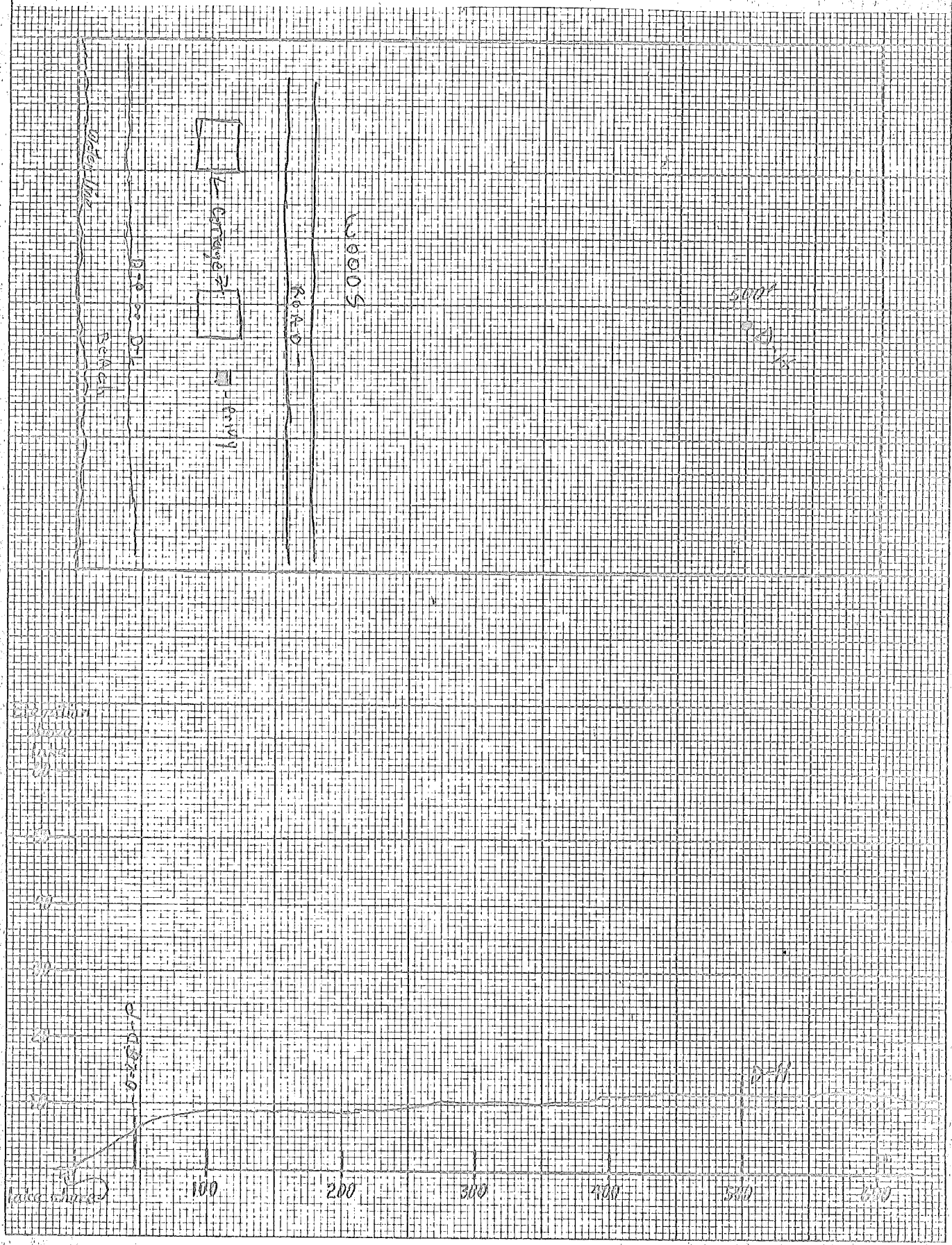
Date	Hancock Exp. Farm	Date	Hancock Exp. Farm
May 1980			
15	.04		
16			
17	.11		
18	.74		
19-23			
24	t		
25-27			
28	1.70		
29	.08		
30	.40		
31			
June			
1	.11		
2	.07		
3-4			
5	.57		
6	1.29		
7	.89		
9-13			
14	.68		
15-17			
18	.08		
19	1.17		
20-27			
28	.18		
29-30			


CTH "P"
AHP
AH
DH
DNR BM
nail in tree
AL
DL
DP
DLP
BL
CL
CHP
CH
STH 73
A
B
N
R-9-E
Town of Almond
Plainfield
OASIS
Long Lake Waushara Co.
Well installed by Northern Lake Service, Inc.
Well installed by U.S.G.S.
Northern Lake Service, Inc.

Well Placement Sketch

Study LONG LAKE

Site D



Northern Lake Service, Inc.

WELL BORING LOG

Study Long Lake

Well D-L + D-P	Depth From Surface	Well D-11
Gray med sandy loam		Sandy loam
lt. brown med. sand		clayey sand
fine white sand	5	red med. sand
water table ------		tan ungraded sand, mostly med sand with ≤ 10% gravel
	10	water table
D-L tan med. sand		coarse sand, 20% pea gravel
	15	D-11
	20	
	25	
	30	
D-P		
	35	
D-L = good yield		D-11 = good yield
D-P = poor yield, does not pump	40	

LONG LAKE WELL SITE SOIL ANALYSIS

Well No.	Percent Retention On Sieves D-H	D-L	D-P
Sieve No.			
10	3.0	1.2	1.1
20	5.7	4.1	5.4
40	42.7	36.4	47.0
60	37.9	41.4	37.3
80	6.2	10.8	6.0
100	1.6	3.2	1.5
Pan	2.9	2.9	1.7
Permeability gal./day/ft.^{2}	384	403	448

Slug tests were run on wells A-L, AH-P, B-L, B-P, and C-L, the data for which has been sent to Jim Vennie of the Office of Inland Lake Renewal who will be using a computor program to determine permeabilities. The remianing three wells could not be slug tested because they were too deep to pump and recovered too fast to draw down by bailing.

LONG LAKE Well A-H USGS No. 665-S Well Elevation 117.98 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.76	186	9.10	78	3.0	0.27	0.05	0.83	0.009
Dec. 11	94.67	265	8.85	122	0.0	0.10	0.07	0.49	0.013
1980									
Jan. 14	94.43	285	8.40	120	0.5	0.13	0.06	0.82	0.008
Feb. 12	94.45	158	8.82	124	0.0	0.04	0.03	0.81	0.001
Mar. 18	94.23	160	9.00	122	1.5	0.36	0.01	0.60	0.005
Apr. 14	94.50	175	9.40	120	1.5	0.22	0.02	0.39	0.005
May 13,	93.40	210	8.60	136	1.0	0.18	0.02	0.66	0.005
June 16	93.97	no sample							
July 14	93.99	182	9.10	sample spilled.					
Aug. 11	93.78	240	8.50	130	2.5	0.22	0.02	0.72	0.007
Sept. 15	94.21	240	8.40	134	1.5	0.27	0.04	1.13	0.002
Oct. 13,	94.46	265	8.28	150	1.5	0.20	0.04	0.82	0.005

LONG LAKE Well AH-P USGS No. 664-D Well Elevation 118.78 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.66	179	10.15	44	6.5	1.33	0.03	1.71	0.010
Dec. 11	94.67	Sampling Discontinued.							
1980									
Jan. 14	94.42								
Feb. 12	94.43								
Mar. 18	94.00								
apr. 14	94.33								
May 13	94.37								
June 16	94.14								
July 14	93.95								
Aug. 11	94.70								
Sept. 15	94.19								
Oct. 13	94.45								

LONG LAKE Well A-L USGS No. WS-29 Well Elevation 110.45 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.77	345	8.50	134	1.5	0.13	0.09	0.96	0.006
Dec. 11	94.85	290	8.00	124	2.0	0.06	0.01	0.68	0.004
1980									
Jan. 14	94.78	295	7.70	122	0.5	0.14	0.05	0.19	0.005
Feb. 12	94.89	Frost in well could not sample.							
Mar. 18	94.81	frost in well.							
Apr. 14	Frost in well.								
May 13	95.46	200	7.85	122	2.0	0.14	0.03	0.48	0.005
June 16	95.55	170	8.75	114	2.5	0.21	0.03	0.24	0.009
July 14	95.13	220	7.75	124	1.0	0.08	0.01	0.12	0.007
Aug. 11	95.07	205	7.75	118	3.0	0.08	0.02	0.38	0.009
Sept. 15	95.37	210	7.75	112	2.5	0.15	0.05	0.75	0.011
Oct. 13	95.20	225	8.18	130	1.0	0.00	0.09	0.51	0.002

LONG LAKE Well B-L USGS No. 667-S Well Elevation 107.01 Sampled By Pumping

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.21	445	8.00	176	0.5	0.40	0.02	0.89	0.002
Dec. 11	94.18	370	8.25	172	0.0	0.35	0.00	0.76	0.004
1980									
Jan. 14	94.04	335	8.56	150	0.5	0.29	0.02	0.80	0.004
Feb. 12	94.07	228	8.30	178	0.0	0.28	0.01	0.46	0.000
Mar. 18	94.03	170	9.10	122	1.0	0.27	0.02	0.69	0.004
Apr. 14	94.44	242	8.88	162	0.5	0.42	0.00	0.50	0.004
May 13	94.28	260	8.05	170	1.0	0.46	0.03	0.90	0.004
June 16	94.24	175	9.0	116	1.0	0.50	0.00	0.98	0.004
July 14	93.96	150	9.40	80	1.0	0.56	0.01	0.85	0.008
Aug. 11	94.11	215	8.92	124	1.5	0.18	0.05	0.78	0.008
Sept. 15	94.36	190	9.20	102	2.0	0.50	0.02	1.31	0.012
Oct. 13	94.17	250	8.70	144	1.5	0.55	0.02	0.89	0.000

LONG LAKE Well B-P USGS No. 666-D Well Elevation 107.01 Sampled By Not Sampled

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	93.05								
Dec. 11	92.95								
1980									
Jan. 14	92.76								
Feb. 12	92.78								
Mar. 18	92.59								
Apr. 14	92.89								
May 13	92.79								
June 16	92.67								
July 14	92.18								
Aug. 11	92.10								
Sept. 15	92.48								
Oct. 13	92.68								

LONG LAKE Well C-H USGS No. 669-S Well Elevation 120.31 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	92.56	173	9.75	58	3.0	0.40	0.03	1.37	0.015
Dec. 11	92.49	180	9.80	70	2.5	0.36	0.04	1.75	0.014
1980									
Jan. 14	92.27	205	9.20	80	2.5	0.21	0.02	1.56	0.015
Feb. 12	92.23	162	9.70	88	1.5	0.24	0.00	1.04	0.004
Mar. 18	92.07	135	9.80	92	2.5	0.45	0.00	-0.84	0.006
Apr. 14	92.37	155	10.65	74	2.0	0.15	0.00	0.73	0.015
May 13	92.29	180	9.20	104	1.0	0.07	0.02	0.72	0.004
June 16	92.19	no sample							
July 14	94.92	140	9.48	80	1.5	0.52	0.03	1.29	0.014
Aug. 11	91.66	160	9.40	86	2.0	0.11	0.03	0.70	0.014
Sept. 15	91.98	160	9.40	90	2.5	0.29	0.02	0.80	0.001
Oct. 13	92.04	195	9.10	110	3.0	0.27	0.03	1.01	0.004

LONG LAKE Well CH-P USGS No. 668-D Well Elevation 120.54 Sampled By Not Sampled

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	92.52								
Dec. 11	92.46								
1980									
Jan. 14	92.27								
Feb. 12	92.26								
Mar. 18	92.04								
Apr. 14	92.37								
May 13	91.79								
June 16	92.07								
July 14	91.93								
Aug. 11	91.68								
Sept. 15	91.99								
Oct. 13	91.96								

LONG LAKE Well C-L USGS No. 673 Well Elevation 112.78 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.31	655	7.40	278	1.5	2.60	0.01	3.59	0.002
Dec. 11	94.30	730	7.50	310	0.5	2.25	0.02	3.27	0.008
1980									
Jan. 14	94.28	500	7.86	212	0.0	0.73	0.00	1.65	0.009
Feb. 12	94.37	418	7.50	308	1.0	1.89	0.00	2.66	interferance
Mar. 18	94.28	440	7.50	294	1.0	2.27	0.00	2.80	0.003
Apr. 14	94.56	498	8.20	344	1.5	2.37	0.00	2.97	0.004
May 13	94.57	522	7.60	360	1.0	2.28	0.03	5.07	0.012
June 16	94.59	520	7.40	238	1.5	2.18	0.02	3.97	0.006
July 14	94.39	515	7.40	340	0.5	2.63	0.02	3.28	0.015
Aug. 11	94.34	560	7.40	346	1.0	2.21	0.03	3.00	0.007
Sept. 15	94.61	590	7.40	342	1.0	2.35	0.01	3.40	0.003
Oct. 13	94.49	595	7.66	350	2.5	2.17	0.02	3.60	0.001

LONG LAKE Well D-H USGS No. --- Well Elevation 106.61 Sampled By Pumped

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.26	545	7.52	228	1.5	0.40	0.02	0.83	0.006
Dec. 11	94.23	500	7.70	236	0.5	0.43	0.01	0.91	0.008
1980									
Jan. 14	94.07	500	7.38	224	1.0	0.53	0.01	1.19	0.006
Feb. 12	94.06	362	7.70	220	1.0	0.38	0.01	0.85	0.000
Mar. 18	93.91	340	7.82	212	1.0	0.32	0.00	0.62	0.005
Apr. 14	94.39	378	8.60	212	1.5	0.55	0.00	0.78	0.006
May 13	94.26	418	8.00	216	0.0	0.46	0.02	0.64	0.015
June 16	94.06	400	7.80	212	0.5	0.29	0.00	0.39	0.005
July 14	93.88	315	7.98	208	1.5	0.17	0.01	0.46	0.006
Aug. 11	93.81	405	8.02	190	1.0	0.03	0.01	0.49	0.008
Sept. 15	94.10	340	7.85	184	2.5	0.43	0.00	0.62	0.003
Oct. 13	93.99	315	8.12	172	1.0	0.08	0.02	0.64	0.006

LONG LAKE Well D-L USGS No. ----- Well Elevation 101.63 Sampled By Pumping

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.45	255	7.80	106	0.5	0.15	0.02	0.19	0.011
Dec. 11	94.46	230	7.90	108	0.0	0.06	0.00	0.59	0.008
1980									
Jan. 14	94.41	245	7.50	110	0.0	0.22	0.02	0.27	0.014
Feb. 12	94.46	220	7.80	114	0.0	0.17	0.01	0.85	0.001
Mar. 18	94.43	210	7.90	118	0.0	0.21	0.01	0.46	0.006
Apr. 14	94.79	180	8.30	118	0.5	0.20	0.00	0.45	0.011
May 13	94.59	210	8.15	110	0.0	0.15	0.02	0.44	0.005
June 16	94.69	220	8.15	94	0.0	0.11	0.01	0.26	0.007
July 14	94.30	170	8.30	90	0.0	0.06	0.01	0.40	0.008
Aug. 11	94.46	200	8.10	92	0.5	0.10	0.01	0.51	0.008
Sept. 15	94.72	160	8.00	86	0.0	0.27	0.01	interference	0.001
Oct. 15	94.52	170	8.34	96	0.0	0.13	0.01	0.46	0.012

LONG LAKE Well D-P USGS No. ---- Well Elevation 102.12 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.07	305	8.10	122	1.0	0.64	0.01	0.91	0.011
Dec. 11	93.96	305	7.70	138	0.0	0.48	0.01	1.13	0.007
1980									
Jan. 14	93.76	495	7.40	206	0.0	2.03	0.01	2.95	0.006
Feb. 12	93.74	380	7.48	246	0.5	2.66	0.01	3.29	interferance
Mar. 18	93.59	395	7.50	250	1.0	3.04	0.00	3.64	0.004
Apr. 19	93.88	460	8.70	270	1.5	3.37	0.01	3.98	0.005
May 14	93.74	550	7.60	272	0.5	3.46	0.01	4.57	0.011
June 16	93.97	440	7.52	280	0.0	3.68	0.01	4.24	0.005
July 14	93.43	480	7.80	272	1.0	3.53	0.03	3.89	0.007
Aug. 11	93.37	520	7.65	274	1.0	3.47	0.01	3.73	0.018
Sept. 15	93.64	505	7.64	268	0.0	3.79	0.00	4.00	0.015
Oct. 13	93.70	475	7.70	266	1.5	3.42	0.02	4.05	0.006

LONG LAKE SEEPAGE METER INSTILATION AND DATA

Direction of flow information obtained from the well sampling indicated that the only site of groundwater influx to the lake is a localized area near the boat landing. Therefore two seepage meters were placed in differing depths at this location rather than at three seperate sites around the lake. This change in the study was suggested by Mr. James Vennie of the DNR office of inland lake renewal.

Although there is a net flow into the lake at this site, it is very slow and the smaple size obtained during a practical sampling period does not lend itself to any confident analysis.

The sediment type at this location is sand with an overlying layer of silt.

Date	Meter	Depth (in.)	Vol. (L)	Time (Hrs.)	Velocity (μM/sec.)
6/16/80	shallow	10	0.055	5.0	0.012
	deep	18	0.114	5.0	0.024
7/17/80	shallow	9	0.068	5.6	0.013
	deep	16	0.092	5.6	0.018

LONG LAKE Inlake Surface

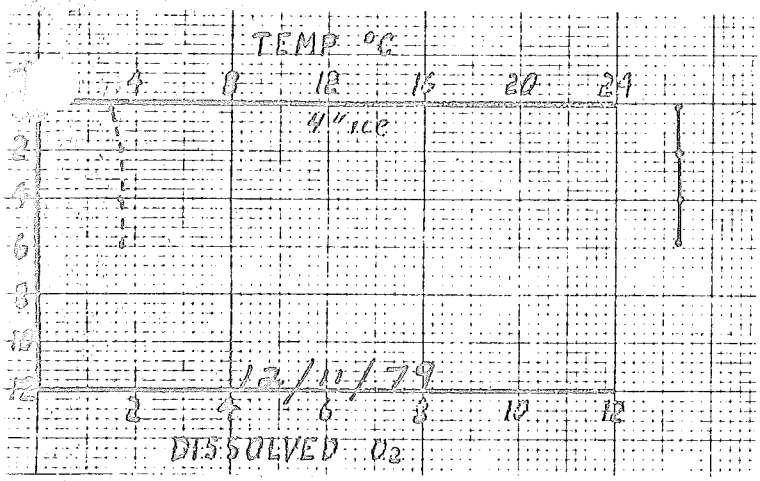
Date	Elev.	pH	Alk.	NH_3-N	NO_2+NO_3-N	TKN	Total PO_4-P
1979							
Nov. 12	94.473	Ice not safe.					
Dec. 11	94.55	7.90	48	0.00	0.02	0.76	0.011
1980							
Jan. 14	----	7.52	58	0.07	0.03	1.43	0.017
Feb. 12	94.74	7.64	60	0.00	0.00	0.84	0.014
Mar. 18	94.63	7.90	54	0.04	0.10	0.86	0.013
Apr. 14	94.83	8.34	42	0.13	0.00	0.90	0.013
	Cond. = 83 microMHO's, color = 13 std. units, sus. solids = 2.4 mg/l.						
May 13	94.52	8.30	44	0.14	0.01	1.04	0.021
June 16	94.69	8.30	44	0.07	0.00	1.12	0.032
July 14	94.39	8.15	38	0.45	0.03	1.20	0.036
Aug. 11	94.54	8.20	46	0.11	0.00	1.23	0.023
Sept. 15	94.78	8.04	40	0.06	0.00	0.70	0.018
Oct. 13	94.66	8.60	46	0.08	0.00	1.26	0.016

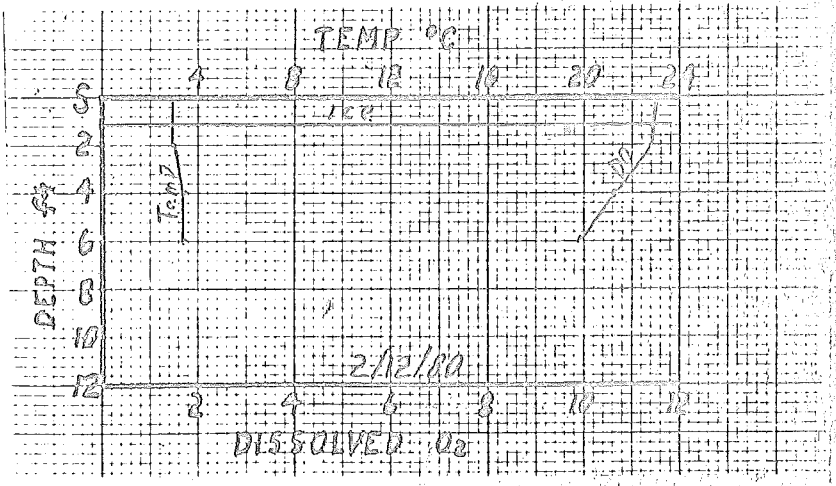
LONG LAKE Inlake Bottom

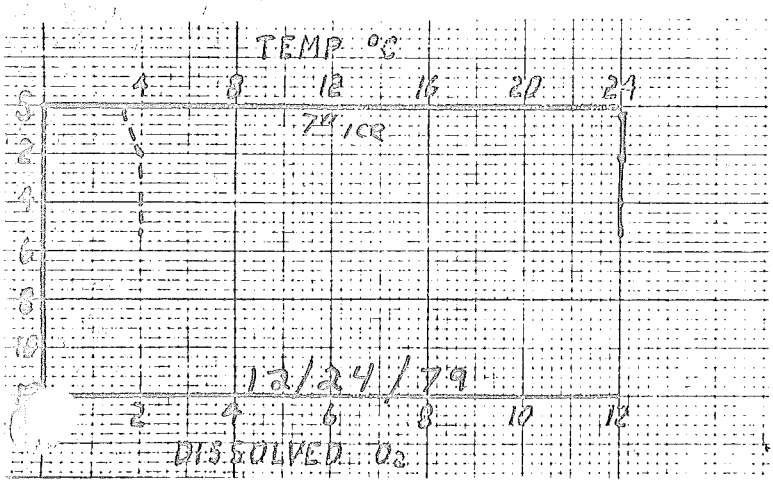
Date	Elev.	pH	Alk.	NH_3-N	NO_2+NO_3-N	TKN	Total PO_4-P
1979							
Nov. 12	-5 ft.	Ice not safe					
Dec. 11	-5.5	7.90	48	0.00	0.02	1.18	0.012
1980							
Jan. 14	-5	7.18	58	0.10	0.01	1.01	0.025
Feb. 12	-5	7.58	60	0.17	0.01	1.34	0.014
Mar. 18	-5	7.60	54	0.00	0.03	0.76	0.016
Apr. 14	-4.5	8.20	36	0.00	0.01	0.73	0.019
	cond. = 80 microMHO's, color = 22 std. units, total sus. solids = 3.2 mg/l						
May 13	-5	8.30	44	0.07	0.01	1.04	0.025
June 16	-5.5	8.55	42	0.06	0.00	0.95	0.034
July 14	-5	8.40	44	0.24	0.00	0.84	0.034
Aug. 11		8.22	46	0.00	0.01	1.18	0.027
Sept. 15		7.80	42	0.06	0.00	0.81	0.023
Oct. 13		8.52	44	0.17	0.01	0.90	0.020

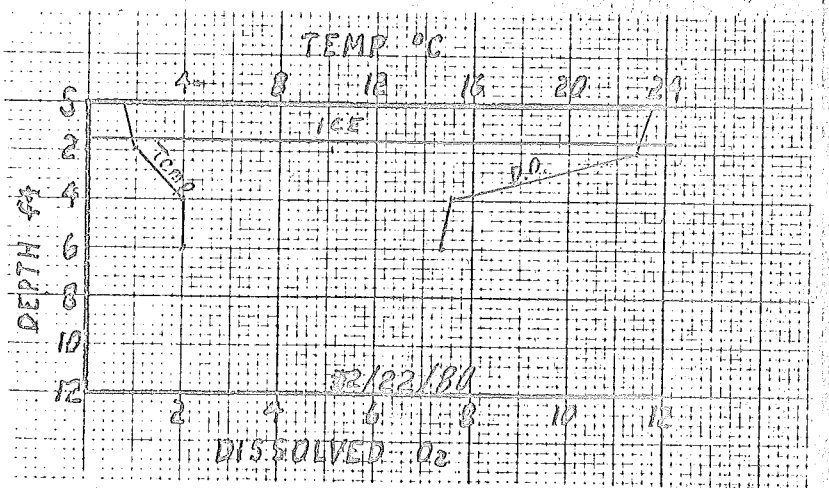
D.O.
TEMP.

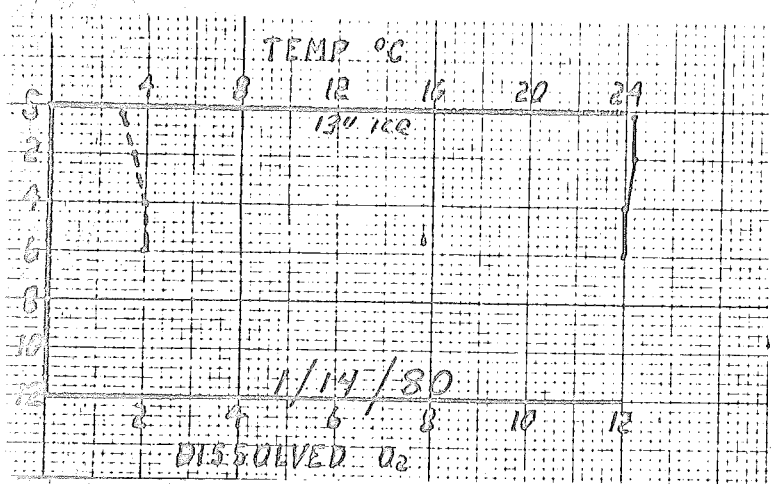
LONG LAKE

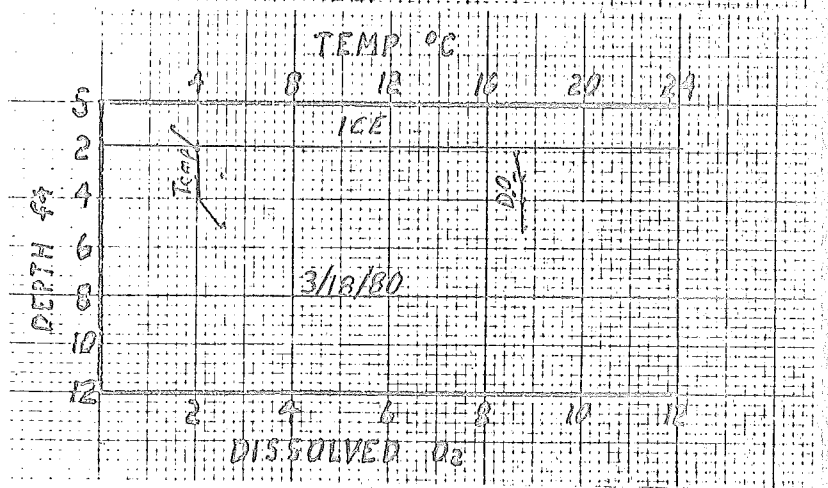


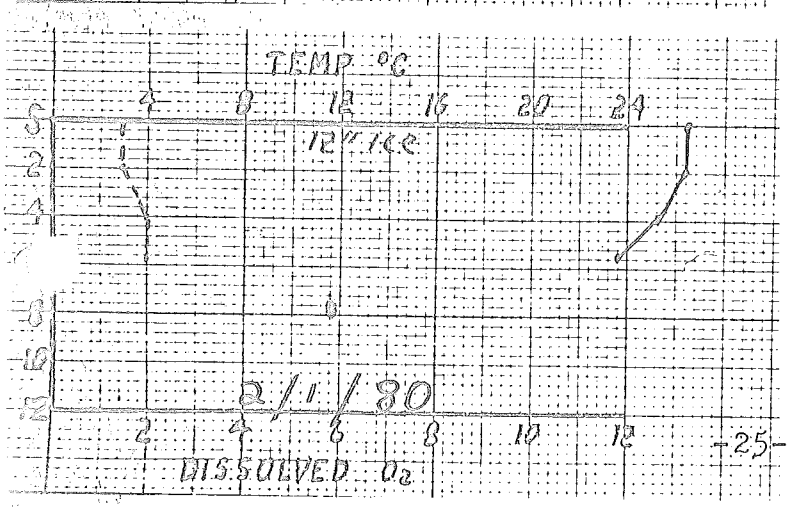


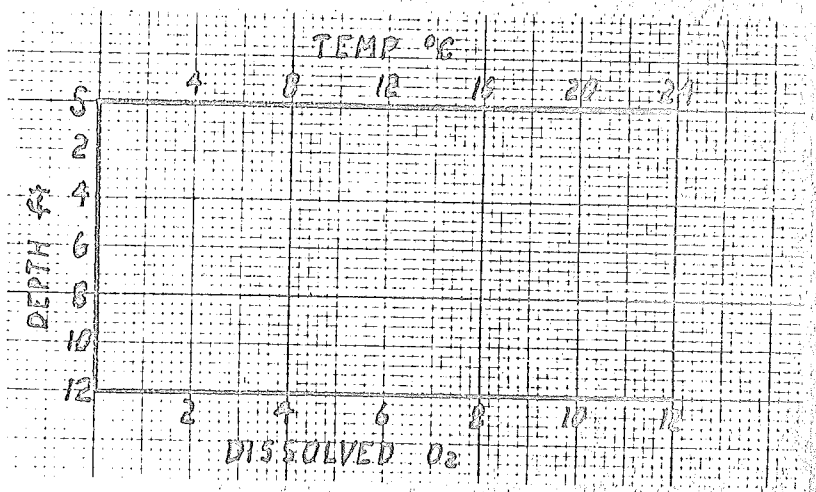


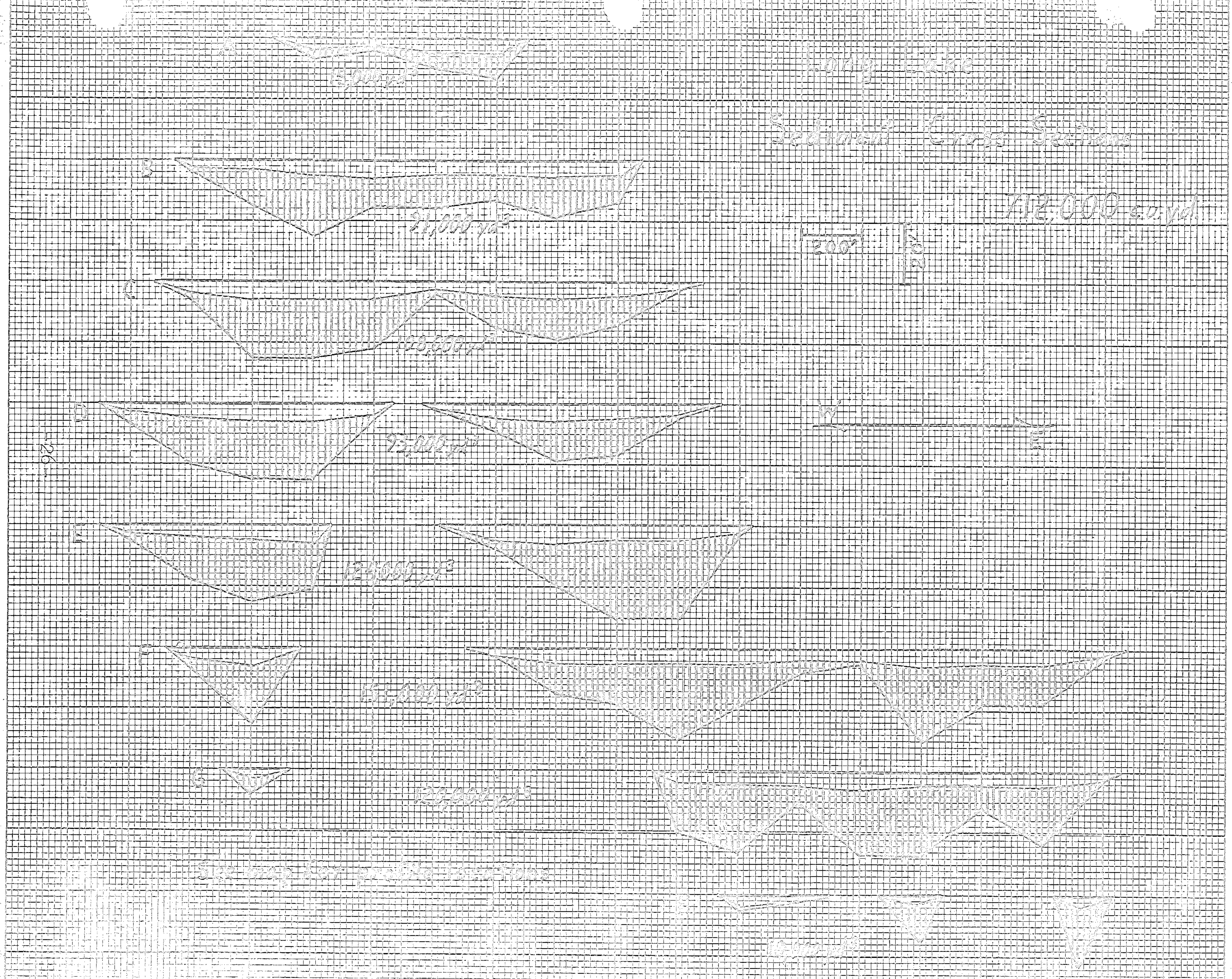


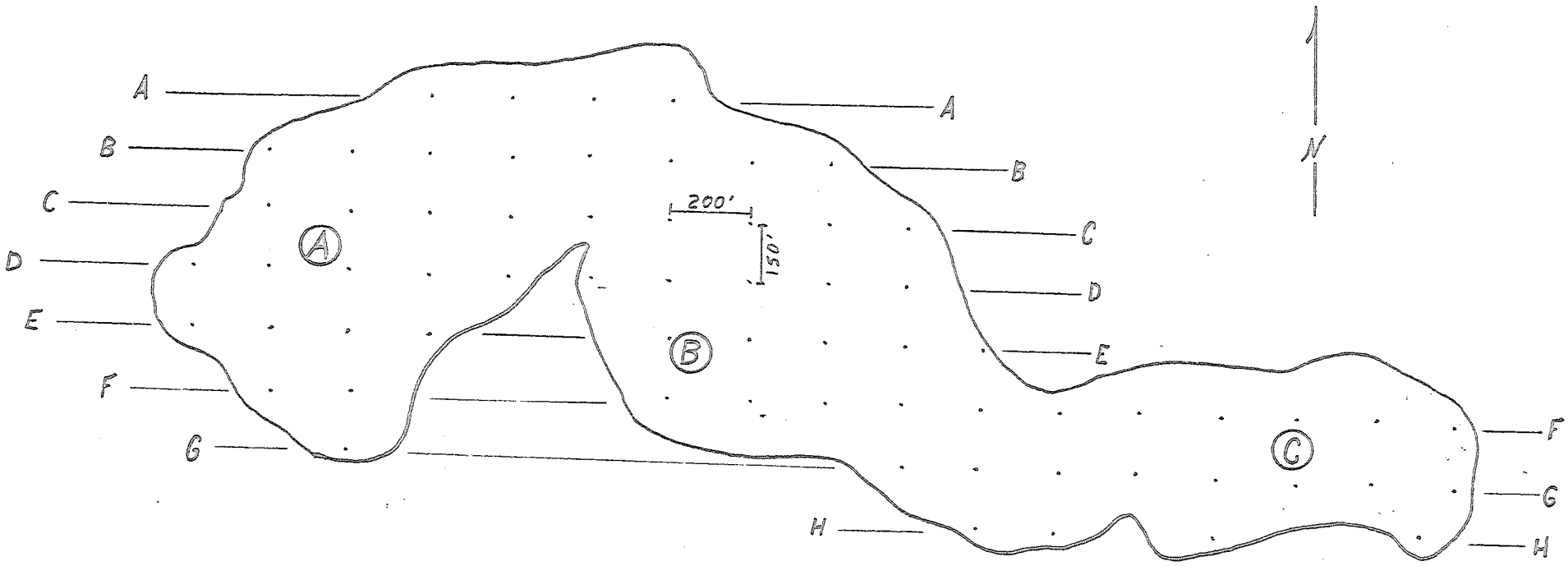






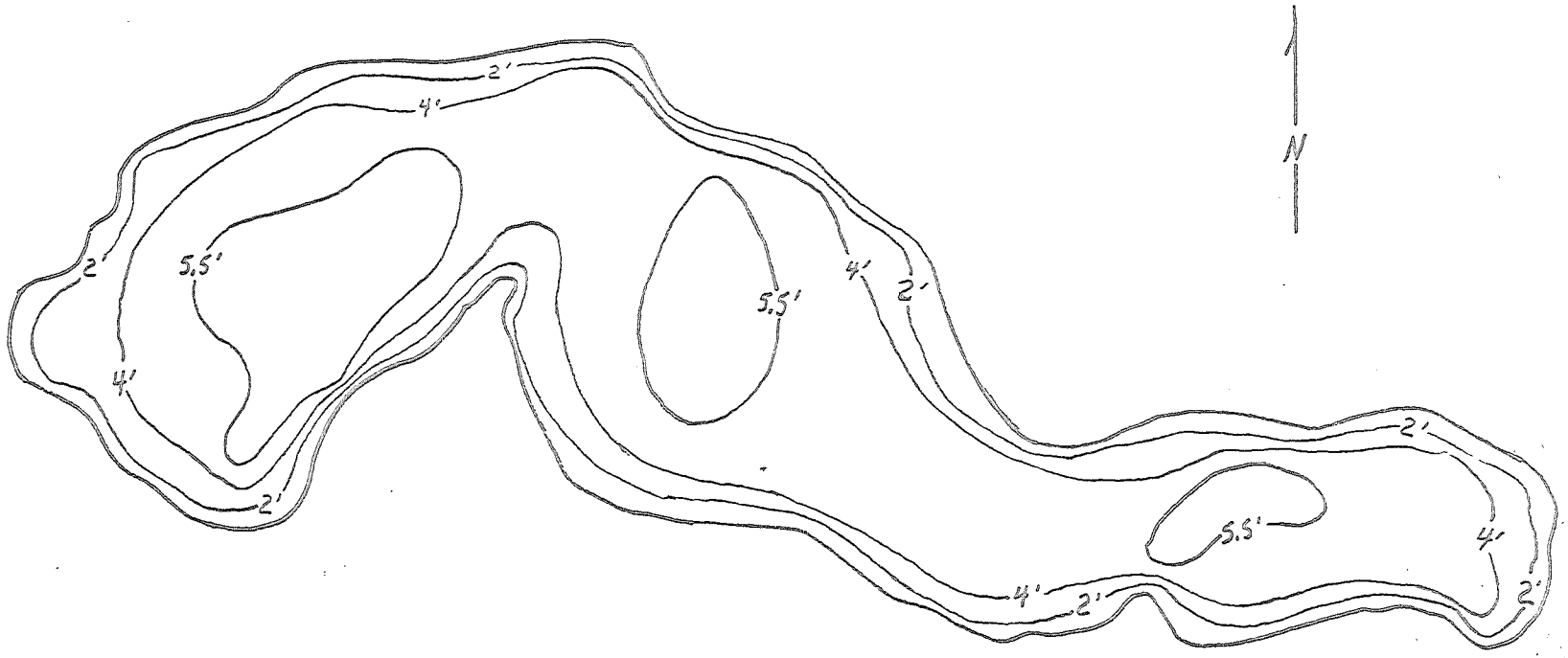



Long Lake
Sediment Cross Sections
712,000 cu. yd.
200'
20'
W
E
A
15,000 yd³
B
21,000 yd³
C
108,000 yd³
D
93,000 yd³
E
124,000 yd³
F
151,000 yd³
G
120,000 yd³
See map for profile locations

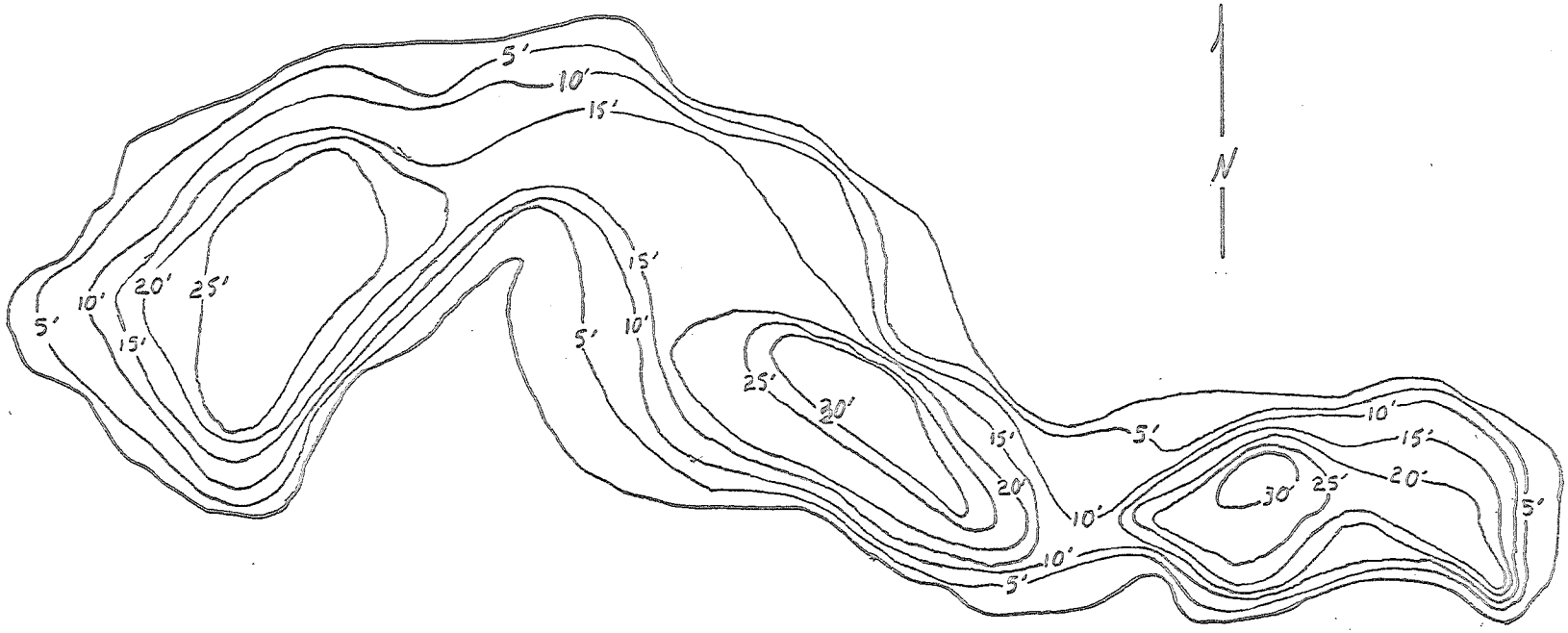


Long Lake Sediment Survey Transects

○ = core collection sites



Long Lake Water Depths



Long Lake Depths to Hard Bottom

LONG LAKE SEDIMENT CORES

See map for core locations.

Core	% Water	% Organic Matter	% Nitrogen	% Phosphorus
A	95.3	63.6	2.5	0.019
B	91.4	51.4	1.7	0.016
C	92.2	59.2	2.3	0.037

%s organic matter, nitrogen, and phosphorus are given on a dry weight basis.

LONG LAKE CHLOROPHYLL DATA

DATE OF COMPUTATION- 12/4/80
PHOTOSYNTHETIC PIGMENTS IN MICROGRAMS PER LITER- SECCHI DISC READING IN METERS

SAMPLE	TRI-CHLA	CCHLA	PHEOPT	CHLB	CHLC	(665B)/(665A)	SECCHI DISC
LL 4/28/80	3.88274	3.88752	0	1.51299	5.60394	1.7	> BOTTOM
LL 5/13/80	2.52348	.75294	2.93647	.321668	2.04535	1.14286	> BOTTOM
LL 5/27/80 *	1.98104	1.80492	.236028	.25584	.249288	1.61905	> BOTTOM
LL 6/16/80	4.37866	3.26274	1.83216	1.23469	1.17378	1.44828	> BOTTOM
LL 7/2/80 *	2.1827	1.79424	.627964	.622848	.396768	1.51852	> BOTTOM
LL 7/14/80	5.8035	5.87811	-.239478	1.4142	.982865	1.72973	> BOTTOM
LL 8/11/80	3.74374	2.98277	1.19311	.645446	.854023	1.5	> BOTTOM
LL 9/15/80	2.36012	1.6821	1.09336	.44685	.49419	1.42424	> BOTTOM
LL 11/13/80	5.77773	9.08334	-5.78642	.809568	3.2062	2.92857	> BOTTOM

* Collected, filtered, and frozen by district.

Samples on or about 8/1, 9/1, and 10/1, were to be collected by the district, however samplings were not taken on the first two dates and the early October sample had not been delivered as of the date of computation.

Secchi disc readings were always greater than the depth to bottom.

LONG LAKE 1980 - PLANKTONIC ALGAE IDENTIFICATION AND ENUMERATION

Name	units counted	May 13	Jun 16	Jul 14	Aug 11	Sep 15	Oct 13
CHLOROPHYTA							
Ankistrodesmus falcatus	cells						3
Chlorogonium elongatum	cells			51	30		
Oocystis borgei	cells		1,621				
Scenedesmus sp.	cells		20			40	10
Scenedesmus abundans	cells			81			
Scenedesmus bijuga	cells				71		
Sphaerocystis schroteri	cells		853	11,666			
Tetraedron sp.	cells				35		
CRYPTOPHYTA							
Chroomonas nordstedtii	cells	192		51		35	30
Cryptomonas erosa	cells	51		167	146	25	33
Cryptomonas ovata	cells	5	40				28
PYRRHOPHYTA							
Ceratium hirundinella	cells			15			
Gymnodinium sp.	cells			5			3
CYANOPHYTA							
Anabaena sp.	cells		51				
Anabaena macrospora	cells					404	
Aphanothece sp.	colonies	5	20	10	40	15	

LONG LAKE (2) 1980 - PLANKTONIC ALGAE IDENTIFICATION AND ENUMERATION

Name	units counted	May 13	Jun 16	Jul 14	Aug 11	Sep 15	Oct 13
CYANOPHYTA (continued)							
Chroococcus dispersus	cells	657		1,242	364	20	40
Coelosphaerium naegelianum	colonies		20		15	5	3
Dactylococcopsis sp.	Colonies				5		
Merismopedia glauca	cells						101
Microcystis aeruginosa	colonies		15	10	25	40	5
Oscillatoria sp.	trichomes				20	8	
CHRYSOPHYTA							
Acnanthes sp.	cells				20		
Cocconeis sp.	cells					10	3
Dinobryon cylindricum	cells	1,100					61
Dinobryon sociale	cells						146
Fragillaria sp.	cells						25
Mallomonas sp.	cells			10	20	15	
Navicula sp.	cells		10				
UNKNOWN	cells	116				104	967

LONG LAKE MACROPHYTE COMMUNITIES

7/14/80

Major Community Types

- mostly submergent, non-surfacing, light to moderate
- surfacing submergent, mostly Potamogeton amplifolius
- floating leaf
- emergent

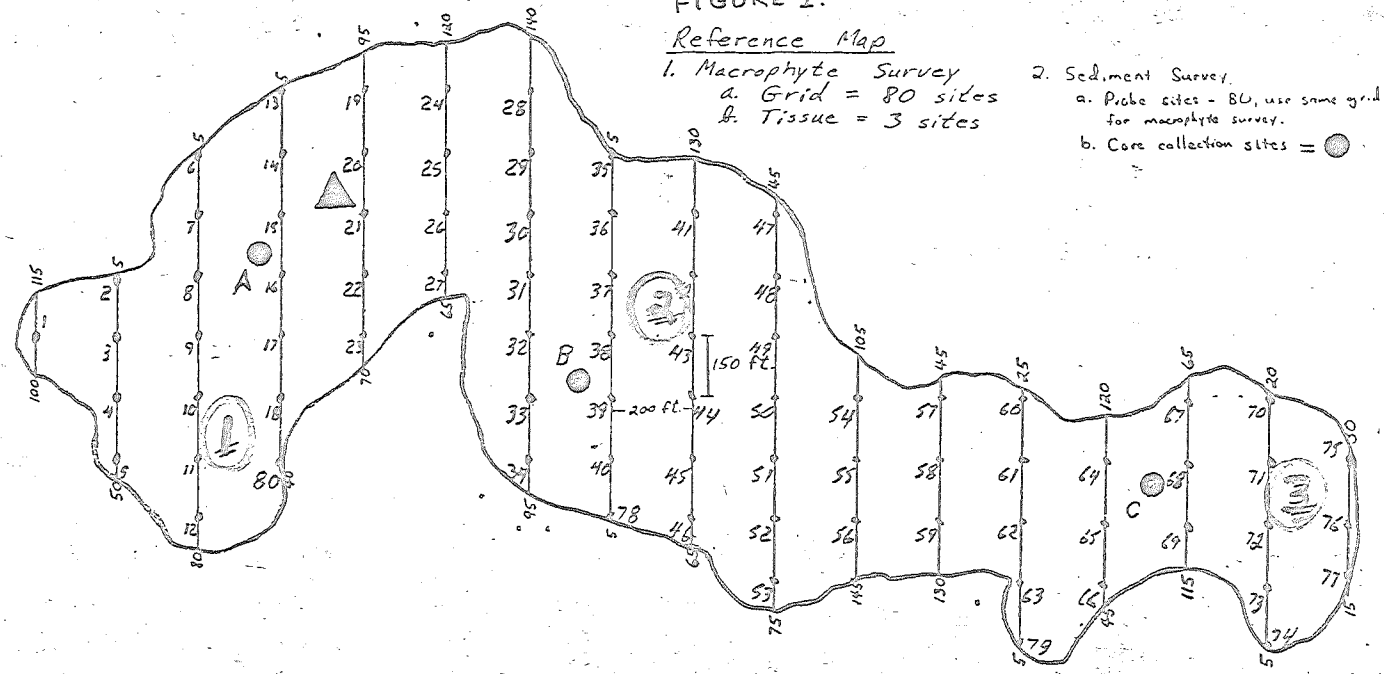
Northern Lake Service, Inc

FIGURE 1.

Reference Map

1. Macrophyte Survey
   a. Grid = 80 sites
   b. Tissue = 3 sites

2. Sediment Survey.
   a. Probe sites - 80, use same grid as for macrophyte survey.
   b. Core collection sites = ●



○ = weed sample sites

△ SAMPLING SITE FOR: WATER CHEMISTRY, DISSOLVED OXYGEN, TEMPERATURE, SECCHI DISC, CHLOROPHYLL a, AND ALGAE.

LONG LAKE MACROPHYTE SURVEY Date 7/14/80

Species (common name)	Frequency (% occurance)	Average Density	Depth of Growth (ft.)
Polygonum natans	6.5	2.2	.5- 3
P. coccineum pratincola	6.5	1.4	.5 - 3
Brasenia Schreberi	24.6	3.2	.5 - 4.5
Nuphar variegatum	6.5	1.6	.5 - 4.5
Nympheae tuberosa	24.6	2.8	.5 - 4.5
Carex sp.	2.6	3.0	.5
Juncus pelocarpus	2.6	3.0	.5
Sagittaria sp.	15.6	2.6	.5 - 4
Dulichium arundinaceum	5.2	1.8	.5 - 2.5
Scirpus validus	3.9	2.0	.5 - 1
S. subterminalis	2.6	2.5	.5 - 2
Eleocharis acicularis	23.4	3.9	.5 - 4.5
Isoetes sp.	1.3	2.0	1.5
Myriophyllum exalbescens	5.2	2.0	1 - 4
M. alterniflorum	1.3	1.0	2.5
Elodea canadensis	11.7	2.4	3 - 5
Charra sp.	27.3	3.7	2.5 - 5
Megalodonta Beckii	2.6	3.0	3.5 - 4
Potamogeten praelongus	3.9	2.7	3.5 - 5
P. foliosus	10.4	3.5	1 - 5
P. gramineus	35.1	3.2	.5 - 4.5
P. amplifolius	23.4	2.9	2.5 - 5
P. Richardsonii	1.3	2.0	2.5

LONG LAKE MACROPHYTE TISSUE ANALYSIS

Site (see map)	Species	%Phos.
June 16, 1980		
#1	Brazenia Shreberi (watershield)	0.098
#2	Potamogeton amplifolius (largeleaf pondweed)	0.083
#3	Potamogeton gramineus (variable pondweed)	0.075
#3	Vallisneria americana (eel grass)	0.067
#3	Chara sp. (chara)	0.065
Aug. 11, 1980		
#1	Chara sp.	0.13
#1	Brazenia Shreberi	0.12
#2	Myriophyllum sp. (milfoil)	0.22
#2	Potamogeton gramineus (variable pondweed)	0.30
#3	Valisneria americana	0.19
#3	Potamogeton gramineus	0.16
Sep. 15, 1980		
#1	Sediments	0.10
#2	Sediments	0.08
#3	Sediments	0.09

MACROPHYTE SURVEY DATA Lake: 7/14/80 Date: Lohg

Transect																
Station	1	2	3	4	6	5	7	8	9	10	11	12	13	14	15
Brazenia Shreberi	4	2	4	4		3	5				5	3			3
Carex sp		4											2		
Ceratophyllum demersum															
Charu	4		4								4				
Eleocharis acicularis		3			5				1	4					
Elodea canadensis															
Isoetes sp															
Lemna minor															
L. trisulca															
Myriophyllum alterniflorum															
M. exalbescens											1				
M. Tuncus sp. (spheacarpus?)		3			3				3						
Najas flexilis		3								3				3	3
N.															
Nitella Sagittaria sp.		3											3	4	
Nuphar variegatum			2												
Nymphaea tuberosa			2	2		1		1	4			1		3	3
Polygonum natans		3				2						2	2		
Pontederia cordata															
Potamogeten crispus praelongus								2							
P. amplifolius															
P. gramineus			3		5	4		3			1	4	3		1
P. natans															
P. pectinatus															
P. Richardsonii								2							
P. zosteriformis															
P. Robbinsii Fockii								3		3					
Polygonum coccineum pratincola		1				2									
Ranunculus															
Scirpus validus															
Spirodella polyrhiza													2		
Typha latifolia Scirpus subterminalis							4								
Utricularia													1		
Valisneria americana															
Vilchina cymbiferum		2			1	1							4		
Depth to vegitation	0	0	0		0	0	0	3	2	3.5	0	0	0	0	0
% OPEN WATER	0	20	30	50	80	20	0	60	40	100	30	20	50	0	50
Water depth (ft)	3	.5	4	3.5	.5	2.5	2	3.5	4	4	2.5	3	.5	3	3.5
Bottom type	M	S	D	D	D	D	M,D	D	D	D	M,D	D	D	D	D

MACROPHYTE SURVEY DATA Lake: Long Date: 7/14/81

Transect															
Station	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Brazenia Shreberi	1			4				2							
Carex															
Ceratophyllum demersum															
Chara		2	2		4	5		4							
Eleocharis acicularis									4						4
Elodea canadensis					4					4				2	
Isoetes															
Lemna minor															
L. trisulca															
Myriophyllum															
M.															
M.															
Najas flexilis	3														
N.															
Nitella															
Nuphar variegatum				1											
Nymphaea tuberosa			1	2				2							
Polygonum															
Pontederia cordata															
Potamogeton ~~crispus~~ praelongus															
P. amplifolius	1	2	2		2		2				2		4		
P. gramineus	1						3				4		4		
P. ~~natans~~ foliosus		3	4		4		5			4					
P. pectinatus															
P. Richardsonii															
P. zosteriformis															
P.															
P.															
Ranunculus															
Scirpus															
Spirodella polyrhiza															
Typha latifolia															
Utricularia															
Valisneria americana															
							2		4						
Depth to vegetation	0	2	3	-	3	3	3	0	2	3	0	-	-	1	2
% OPEN WATER	95	100	95	100	100	100	100	50	100	100	80	100	100	100	100
Water depth (ft)	4.5	5	4	5	4.5	5	4.5	2.5	2	4.5	4	2	3	5	2.5
Bottom type	D	D	M,D	M,D	M,D	M,D	D	M	S	D	D	S	D	D	D

MACROPHYTE SURVEY DATA Lake: Long Date: 7/14/82

Transect																
Station	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	
Brazenia Shreberi		4	5	3												
Carex										2						
Ceratophyllum demersum																
Charu	5	5														
Eleocharis acicularis						4	3		3			4				
Elodea canadensis									4	4						
Isoetes					4	2		1								
Lemna minor																
L. trisulca																
Myriophyllum																
M.																
M.																
Najas flexilis																
N.									2		4					
Nitella																
Nuphar																
Nymphaea Tuberosa	4	4														
Polygonum			3						4	4					4	
Pontederia cordata																
Potamogeton crispus																
P. amplifolius																
P. gramineus						2	2	4				3	4	4		
P. natans fabaceus					4	4	2	4							2	
P. pectinatus						2										
P. Richardsonii																
P. zosteriformis																
P.																
Polygonum coccineum pratincola			1													
Ranunculus																
Scirpus																
Spirodella polyrhiza																
Typha latifolia																
Utricularia																
Valisneria americana	2	2				1	3									
										3						
Depth to vegitation	0	0	0	0	0	1	0	.5	0	0	3	0	0	0	0	
% OPEN WATER	50	50	20	50	90	100	90		50	80	100	100	100	90	20	
Water depth (ft)	4	2.5	3	2	1	3.5	4	3.5	3.5	3	4.5	4.5	4.5	4.5	3	
Bottom type -40-	M,D	M,D	M,D	M,S	S,D	M,D	D	D	M	M	M,D	D	M,D	D	M,D	

NORTHERN LAKE SERVICE

MACROPHYTE SURVEY DATA Lake: Long Date: Unkn

Transect															
Station	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Brazenia Shreberi	3														
Carex												1			
Ceratophyllum demersum															
Chara															
Eleocharis acicularis				4											
Elodea canadensis				4			4		4					3	
Isoetes sp.	2														
Lemna minor															
L. trisulca															
Myriophyllum															
M.															
M.															
Najas flexilis				3											
N.												1			
Nitella Sagittaria sp.															
Nuphar variegatum									2			4			
Nymphaea tuberosa	3							1				1			
Polygonum natans	2														
Pontederia cordata															
Potamogeton crispus															
P. amplifolius					4	4				3		4			
P. gramineus					4	4						2		4	
P. natans foliosus										4					
P. pectinatus															
P. Richardsonii															
P. zosteriformis															
P.															
Polygonum Coccineum pratincola	2														
Ranunculus															
Scirpus															
Spirodelia polyrhiza															
Typha latifolia															
Utricularia															
Valisneria americana					4				3						
Depth to vegitation	0	/	0	3.5	0	0	4	0	3	2	-	0	3	-	0
% OPEN WATER	50	/	100	100	95	95	100	95	100	100	100	100	100	100	100
Water depth (ft)	1.5		3	4	4.5	4.5	4.5	4.5	2.5	4.5	4	3	4	3	1
Bottom type	M,D		S	D	M,D	M,D	M,D	S,D	S	M,D	M,D	M,D	D	S	S

MACROPHYTE SURVEY DATA Lake: Long Date: Sinco

Transect

Station	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Brazenia Shreberi															
Carex															
Ceratophyllum demersum															
Chara	4	3	4		5		2		4						
Eleocharis acicularis				4		4		4			4	4			
Elodea canadensis	2								3						
Isoetes															
Lemna minor															
L. trisulca															
Myriophyllum															
M. exalbescens			1						3						
M.															
Najas flexilis															
N.															
Nitella Sagittaria sp.	2		3	2		1	4				1	1			
Nuphar variegatum			3												
Nymphaea															
Polygonum															
Pontederia cordata															
Potamogeton crispus															
P. amplifolius															
P. gramineus	4	4		4		4							4		3
P. natans															
P. pectinatus															
P. Richardsonii															
P. zosteriformis															
P.															
P.															
Ranunculus															
Scirpus validus															
Spirodella polyrhiza				A											2
Typha latifolia															
Utricularia															
Valisneria americana			2			3		4							
Filalgae					5										
depth to vegetation	3	3	0	3	2	1	2	2.5	.5	0	2	2.5	1		2
% open water	100	100	50	100	100	100		100	100	100	100	100	100		50
Water depth (ft)	4	4	3.5	4	4	2	3	4	4	1	3	3	2		1
Bottom type	D	D	M.D	M.D	M.D	M.P	MD	M.D	M.D	M.S	M.D	M.D	M.D		M

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MACROPHYTE SURVEY DATA Lake: Long Date: 7/6/80

Transect															
Station	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Brazenia Shreberi	2			3											
Carex															
Ceratophyllum demersum															
Chara															
Eleocharis acicularis				4											
Elodea canadensis															
Isoetes															
Lemna minor															
L. trisulca															
Myriophyllum															
M. exalbescens				1											
M.															
Najas flexilis	2														
N.															
Nitella															
Nuphar															
Nymphaea tuberosa	3			2											
Polygonum															
Pontederia cordata															
Potamogeton crispus															
P. amplifolius															
P. gramineus	4	3		4											
P. natans-foliosus				2											
P. pectinatus															
P. Richardsonii															
P. zosteriformis															
P.															
P. gramineus graminoeus pratincola		-		1											
Ranunculus															
Scirpus validus		2													
Spirodella polyrhiza															
Typha latifolia															
Utricularia															
Valisneria americana	4	3													
depth to vegitation	0	0	/	0	/	/	/	/	/	/	/	/	/	/	/
% OPEN WATER	25	20	/	50	/	/	/	/	/	/	/	/	/	/	/
Water depth (ft)	1.5	1		1											
Bottom type -43-	M, D	M		M											

NORTHERN LAKE SERVICE

MACROPHYTE SURVEY DATA Lake: Long Date: 7/14/80

Transect															
Station	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Brazenia Shreberi															
Carex															
Ceratophyllum demersum															
Chara	4	3	4		5		2		4						
Eleocharis acicularis				4		4		4			4	4			
Elodea canadensis	2								3						
Isoetes															
Lemna minor															
L. trisulca															
Myriophyllum															
M. exalbescens			1						3						
M.															
Najas flexilis															
N.															
~~Nitella~~ Sagittaria sp.	2		3	2		2	4				1	1			
Nuphar variegatum			3												
Nymphaea															
Polygonum															
Pontederia cordata															
Potamogeten crispus															
P. amplifolius															
P. gramineus	4	4		4		4									
P. natans													4		3
P. pectinatus															
P. Richardsonii															
P. zosteriformis															
P.															
P.															
Ranunculus															
Scirpus validus															
Spirodella polyrhiza															2
Typha latifolia															
Utricularia															
Valisneria americana			2				3		4						
Fil algae					5										
Depth to vegetation	3	3	0	3	2	1	2	3.5	.5	-	2	2.5	1		0
% OPEN WATER	100	100	50	100	100	100		100	100	100	100	100	100		20
Water depth (ft)	4	4	3.5	4	4	2	3	4	4	1	3	3	2		.5
Bottom type	D	D	M,D	M,D	M,D	M,D	M,D	M,D	M,D	M,S	M,D	M,D	M,D		M

101-LFS-3

AUG 21 1980

Work Copy

NORTHERN LAKE SERVICE, INC.

ROUTE 1 • CRANDON, WISCONSIN 54520 • (715) 478-2777

Mr. Oliver Williams, Director
Office of Inland Lake Renewal
P.O. Box 7921
Madison, Wisconsin 53707

Dear Ollie:

Enclosed is the third quarter data for the Long Lake study. The study continues to progress smoothly.

The following notes accompany the data:

- Seepage meter samples were not chemically analysed due to the very small sample amounts collected.
- Field filtering for total P samples was begun in May on all well samples. The July samples were not filtered, however, due to a filter shortage.
- Samples were not collected from wells A-H and C-H in June, due to equipment failure.
- One macrophyte survey was conducted in mid-July rather than the early and late summer surveys called for in the study specifications. This was cleared through Doug Knauer of your office. The diversity variety of the macrophyte community did not lend itself to Phillip's abundance descriptions.
- An additional attempt was made in June to survey wells A-H and A-HP but poor data resulted once again. This will be rerun in the near future along with the in-situ permeabilities on USGS wells.

Sincerely

Ron Krueger

copy: Richard Lee, Lake District Chairman

LONG LAKE Well A-H USGS No. 665-S Well Elevation _____ Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12		186	9.10	78	3.0	0.27	0.05	0.83	0.009
Dec. 11		265	8.85	122	0.0	0.10	0.07	0.49	0.013
1980									
Jan. 14		285	8.40	120	0.5	0.13	0.06	0.82	0.008
Feb. 12		158	8.82	124	0.0	0.04	0.03	0.81	0.001
Mar. 18		160	9.00	122	1.5	0.36	0.01	0.60	0.005
Apr. 14		175	9.40	120	1.5	0.22	0.02	0.39	0.005
May 13,		210	8.60	136	1.0	0.18	0.02	0.66	0.005
June 16		no sample							
July 14		182	9.10	sample spilled.					

LONG LAKE Well A-L USGS No. WS-29 Well Elevation 110.45 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.77	345	8.50	134	1.5	0.13	0.09	0.96	0.006
Dec. 11	94.85	290	8.00	124	2.0	0.06	0.01	0.68	0.004
1980									
Jan. 14	94.78	295	7.70	122	0.5	0.14	0.05	0.19	0.005
Feb. 12	94.89	Frost in well could not sample.							
Mar. 18	94.81	frost in well.							
Apr. 14	Frost in well.								
May 13	95.46	200	7.85	122	2.0	0.14	0.03	0.48	0.005
June 16	95.55	170	8.75	114	2.5	0.21	0.03	0.24	0.009
July 14	95.13	220	7.75	124	1.0	0.08	0.01	0.12	0.007

LONG LAKE Well B-L USGS No. 667-S Well Elevation 107.01 Sampled By Pumping

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.21	445	8.00	176	0.5	0.40	0.02	0.89	0.002
Dec. 11	94.18	370	8.25	172	0.0	0.35	0.00	0.76	0.004
1980									
Jan. 14	94.04	335	8.56	150	0.5	0.29	0.02	0.80	0.004
Feb. 12	94.07	228	8.30	178	0.0	0.28	0.01	0.46	0.000
Mar. 18	94.03	170	9.10	122	1.0	0.27	0.02	0.69	0.004
Apr. 14	94.44	242	8.88	162	0.5	0.42	0.00	0.50	0.004
May 13	94.28	260	8.05	170	1.0	0.46	0.03	0.90	0.004
June 16	94.24	175	9.0	116	1.0	0.50	0.00	0.98	0.004
July 14	93.96	150	9.40	80	1.0	0.56	0.01	0.85	0.008

LONG LAKE Well C-H USGS No. 669-S Well Elevation 120.31 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	92.56	173	9.75	58	3.0	0.40	0.03	1.37	0.015
Dec. 11	92.49	180	9.80	70	2.5	0.36	0.04	1.75	0.014
1980									
Jan. 14	92.27	205	9.20	80	2.5	0.21	0.02	1.56	0.015
Feb. 12	92.23	162	9.70	88	1.5	0.24	0.00	1.04	0.004
Mar. 18	92.07	135	9.80	92	2.5	0.45	0.00	0.84	0.006
Apr. 14	92.37	155	10.65	74	2.0	0.15	0.00	0.73	0.015
May 13	92.29	180	9.20	104	1.0	0.07	0.02	0.72	0.004
June 16	92.19	no sample							
July 14	94.92	140	9.48	80	1.5	0.52	0.03	1.29	0.014

LONG LAKE Well D-P USGS No. ---- Well Elevation 102.12 Sampled By Bailing

Date	Elev.	Cond.	pH	Hard.	Cl^-	NH_3-N	NO_2+NO_3-N	Total-N	Total PO_4-P
1979									
Nov. 12	94.07	305	8.10	122	1.0	0.64	0.01	0.91	0.011
Dec. 11	93.96	305	7.70	138	0.0	0.48	0.01	1.13	0.007
1980									
Jan. 14	93.76	495	7.40	206	0.0	2.03	0.01	2.95	0.006
Feb. 12	93.74	380	7.48	246	0.5	2.66	0.01	3.29	interferance
Mar. 18	93.59	395	7.50	250	1.0	3.04	0.00	3.64	0.004
Apr. 19	93.88	460	8.70	270	1.5	3.37	0.01	3.98	0.005
May 14	93.74	550	7.60	272	0.5	3.46	0.01	4.57	0.011
June 16	93.97	440	7.52	280	0.0	3.68	0.01	4.24	0.005
July 14	93.43	480	7.80	272	1.0	3.53	0.03	3.89	0.007

LONG LAKE MACROPHYTE TISSUE ANALYSIS

June 16, 1980

Site (see map)	Species	%Phos.
#1	Brazenia Shreberi (watershield)	0.098
#2	Potamogeton amplifolius (largeleaf pondweed)	0.083
#3	Potamogeton gramineus (variable pondweed)	0.075
#3	Vallisneria americana (eel grass)	0.067
#3	Chara sp. (chara)	0.065

LONG LAKE MACROPHYTE SURVEY Date 7/14/80

Species (common name)	Frequency (% occurance)	Average Density	Depth of Growth (ft.)
Polygonum natans	6.5	2.2	.5- 3
P. coccineum pratincola	6.5	1.4	.5 - 3
Brasenia Schreberi	24.6	3.2	.5 - 4.5
Nuphar variegatum	6.5	1.6	.5 - 4.5
Nympheae tuberosa	24.6	2.8	.5 - 4.5
Carex sp.	2.6	3.0	.5
Juncus pelocarpus	2.6	3.0	.5
Sagittaria sp.	15.6	2.6	.5 - 4
Dulichium arundinaceum	5.2	1.8	.5 - 2.5
Scirpus validus	3.9	2.0	.5 - 1
S. subterminalis	2.6	2.5	.5 - 2
Eleocharis acicularis	23.4	3.9	.5 - 4.5
Isoetes sp.	1.3	2.0	1.5
Myriophyllum exalbescens	5.2	2.0	1 - 4
M. alterniflorum	1.3	1.0	2.5
Elodea canadensis	11.7	2.4	3 - 5
Charra sp.	27.3	3.7	2.5 - 5
Megalodonta Beckii	2.6	3.0	3.5 - 4
Potamogeten praelongus	3.9	2.7	3.5 - 5
P. foliosus	10.4	3.5	1 - 5
P. gramineus	35.1	3.2	.5 - 4.5
P. amplifolius	23.4	2.9	2.5 - 5
P. Richardsonii	1.3	2.0	2.5