Attn: Jim Datt
2161 Eagle Drive
Freeport, Illinois 61032

February17,1995

Dear Jim,

Please accept the maps and the letter report concerning sediment accumulations at Willow Lake. If you have any questions concerning our survey please call me at (708) 244-6662.

Sincerely,

James K. Bland
Director, Integrated Lakes Management

Willow.doc

SEDIMENT ASSESSMENT FOR WILLOW LAKE IN FREEPORT ILLINOIS

Prepared By: Integrated Lakes Management
83 Ambrogio Drive
Suite K
Gurnee, Illinois 60031
February 17, 1995

Prepared For: Willow Lake Homeowners Association
Attn: Mr. Jim Datt
2161 Eagle Drive
Freeport, Illinois 61032

Bathymetric Survey of Willow Lake, Stevenson County, Illinois

On January 31 and February 1, 1995 ILM personnel performed a bathymetric survey and sediment probing of Willow Lake, located a few miles north of Freeport, Illinois. The aerator had been turned off for approximately nine days before the Lake was surveyed. Ice conditions ranged from 3 - 6 inches, with the thinner areas occurring over the aerator. Most of the Lake was covered with several inches of snow. The temperature at the time of the survey varied from 25 to 40 degrees Fahrenheit. The weather was sunny with calm winds.

A slight trickle of water was flowing over the dam spillway indicating that the Lake was at normal water level. A small amount of water (less than 1 cfs) was flowing into the Lake from the four culverts located below Jay Street. A small area of open water, approximately fifty feet long, occurred by this culvert. At the time of the survey, the open water was inhabited by about thirty ducks.

Methods

A baseline (Transect 1) was surveyed with a transit from the dam to the inlet culverts. Fifty foot intervals were marked along this baseline and holes were drilled through the ice at these locations. Fifteen additional transects were surveyed perpendicular to the baseline to determine cross-sectional areas along the width of the lake (Figure 1). These fifteen transects were spaced at different intervals varying from 50 - 250 feet along the baseline. Holes were drilled at 50 foot intervals along each of these transects. The location of the transects was determined by a plat map provided by the Willow Lake Homeowners Association and an aerial photograph supplied by the Stevenson County Soil Conservation Service.

One hundred and fifty-seven holes were drilled through the ice using a motorized ice auger. The holes were then probed using a 1 1/4 inch PVC pole graduated in tenths of a foot. Measurements were made to the nearest tenth of a foot. The length of the PVC pole varied from 10 - 20 feet depending on what size was needed. Two measurements were recorded at each hole. One was the depth to the top of the sediment (water depth), and the second was the depth to firm substrate below the sediment (water + sediment depth). The sediment thickness was determined by subtracting the water depth from the water + sediment depth.

The plat map was enlarged and the data points were placed on the map. Water depth contours were drawn at 1 foot intervals and sediment thickness contours were drawn at 0.5, 1, 2, and 3 foot intervals.

Water volume in the Lake was determined by measuring the area within each of the contour lines and multiplying by the average depth. This results in a measurement in cubic feet that was then converted into acre-feet.

Sediment volume was calculated by the average sediment depth for each of the cross-sectional transects, and multiplied by the average width between the transect lines. This results in an estimate of sediment volume for the entire Lake.

Results

The results of the bathymetric and sediment surveys are listed in Table 1 and are graphically shown by the two large maps provided.

Surface area	22 acres
Lake volume	113 acre-feet
Average water depth	5.2 feet
Sediment volume	10.2 acre-feet
	16439 cu. yds.
Average sediment depth	0.6 feet

Discussion

A large portion of the sediment occurs in the northern portion of the Lake by the inlet. Sediment depth up to 3.6 feet was found near this culvert. A large area in the northern section has more than a foot of sediment. The shallow depths in this area make navigation very difficult.

The deep area near the dam also had a large amount of sediment accumulation. However, since the water depth is greater than 12 feet, the sediment is not causing any problems.

A third area of thick sediment occurred in the western bay. Most of this area contained between half a foot and a foot of deposition. The water depths at this location were quite shallow and navigation is limited in this area.

Comparison of ILM Sediment Accumulation Rates and SCS Sediment Yield Estimates

Willow Lake was created in 1973. The Lake was completely filled during 1974. For purposes of evaluating annual sediment delivery ILM will assume that 1974 was the first full water year and that the Lake has been in existence for exactly 20 years. ILM has estimated a sediment volume of 10.2 acre-ft. It is reasonable to assume an error margin of +/- 20% for this figure based on the estimation techniques that we have employed. ILMs estimated rate of accumulation then is on the order of 0.51 acre-ft/yr +/- 0.10 acre-ft. By contrast SCS estimates approximately twice this rate or 0.96 acre-ft./yr. Rates can change substantially based on changes in land use patterns. For purposes of evaluating potential dredging projects ILM suggests that the community assume a range of delivery values in line with what we have measured and SCS has estimated. This translates an effective lake volume loss of 0.5 to 1% per year.

ILM interprets this to mean that sediment accumulation is localized and that whole lake sedimentation rates are not excessive. Sediment which is delivered to a lake is subject to about six different types of physical factors which are capable of "focusing" its accumulation in different sectors. In Willow Lake there are three principle foci for sediment accumulation: 1.) the northern arm of the Lake just beyond the inlet 2.) the deep central basin of the Lake and 3.) the western bay.

The community will need to make some decisions concerning the purpose of its dredging program. If the principle purpose of the dredging program is to achieve navigation and original depth contours then only the northern arm and the western bay should be dredged. If the concern is rerelease of nutrients from accumulated sediments then it would be reasonable to dredge all three sectors. It is important to emphasize that while sediment delivery appears to be modest the associated nutrient delivery may be quite large.

Willow Lake Bathymetric Survey

January 31 & February 1, 1995

Transect 1

Hole No.	Distance from Dam	Water Depth (ft)	Sediment Depth (ft)
Dam	0	0	0
1	3	1.2	0
2	53	10.1	0.2
3	103	10.2	0
4	153	13.2	2.3
5	203	11.8	1.1
6	253	10.9	0.4
7	353	10.3	0.6
8	403	10.1	0.5
9	453	9.4	0.6
10	553	8.2	0.3
11	603	7.9	0.2
12	653	6.5	0.2
13	703	1	0
14	803	6.1	0.7
15	853	6	0.7
16	903	5.9	0.2
17	953	5.3	0.3
18	1003	5.1	0.2
19	1053	5	0.1
20	1103	5.3	0.3
21	1153	4.9	0.5
22	1203	4.6	0.3
23	1253	4.6	0.3
24	1303	4.2	0.2
25	1353	4	0.6
26	1403	3.5	0.5
27	1453	3.9	0.3
28	1503	3.3	0.5
29	1553	3	0.2
30	1603	2.7	1.6
31	1653	1.9	0.4
32	1703	1.8	1.4
33	1753	1.4	2.3
34	1853	1.6	0.4
35	1953	1.2	1.9
36	2003	1	1.7

37	2053	1	3.1
Culvert	2100	0	0

Transect 2

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East Shore		0	0
1	36	3.4	0.1
2	86	6.2	0.7
3	136	8.7	0.3
4	186	10.1	0.2
5	236	10.8	0.6
6	286	10.1	0
7	336	10.7	0.8
8	386	9.3	0.2
9	436	5.4	0.3
10	486	2.4	0.1
West Shore	506	0	0

Transect 3

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	10	1.6	0.1
2	60	5.4	0.1
3	110	9.6	0
4	160	10	0.5
5	210	13.2	2.3
6	260	11.2	0.8
7	310	12.2	1.7
8	360	10	0.1
9	410	8.7	0.1
10	460	10	0.4
11	510	9.2	0.8
12	560	8.7	0.5
13	610	5.2	0
West shore	645	0	0

Transect 4

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	2	1	0
2	52	4.9	0.5
3	102	7.7	0.4
4	152	8.4	0.1
5	202	11	1.3
6	252	10.9	0.4
7	302	11.1	1.1
8	352	10.3	0.7
9	402	9.6	0.4
10	452	8.8	0.2
11	502	10.1	0.4
12	552	10	0.3
13	602	9.4	0.3
14	652	8.3	0.2
15	702	7.5	0.4
16	752	5.7	1.1
17	802	2.7	0.4
West shore	814	0	0

Transect 5

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	26	2.8	0.2
2	76	4	0.1
3	126	4.8	0.2
4	176	6.4	0.2
5	226	8.7	0.3
6	276	12.4	1.6
7	326	10.3	0.6
8	376	10.9	2.4
9	426	9.3	0.7
10	476	8.5	0.6
11	526	7.3	0.1
12	576	8.1	0.1

13	626	8	1.3
14	676	7	0.9
15	726	6	0.5
16	776	5.2	0.4
17	826	5	0.7
18	876	4.3	0.7
19	926	3.4	0.5
20	976	2.8	0.1
21	1026	2.2	1.6
West shore	1042	0	0

Transect 6

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	26	1.7	0
2	76	3.6	0.1
3	126	4.9	0.1
4	176	8.3	0.6
5	226	8.7	0.7
6	276	8.6	0.3
7	326	8.2	0.3
8	376	7.6	0.5
9	426	7.6	0.5
10	476	6.9	0.6
11	526	5.1	0.3
12	576	5.2	0.3
13	626	2.6	0.2
West shore	645	0	0

Transect 7

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	26	2.7	0.1
2	76	4.5	0.2
3	126	6.5	0.5
4	176	7.1	0.9

5	226	6.2	0.8
6	326	1	0
7	376	6.5	0.6
8	426	6	0.4
9	476	5.2	0.2
10	526	5.1	0.3
11	576	0.4	0
West shore	578	0	0

Transect 8

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	46	1.7	0.2
2	96	4.1	0.2
3	146	5	0.2
4	196	6.9	0.8
5	246	6.1	0.7
6	296	6	0.7
7	346	5.9	0.3
8	396	4.8	0
9	446	4	0.1
10	496	3	0
West shore	499	0	0

Transect 9

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	3	0.7	0.1
2	53	2.7	0.1
3	103	4.1	0.5
4	153	5.1	0.6
5	203	6.1	2.1
6	253	5.3	0.3
7	303	4.9	0.5

8	353	4	0.2
9	403	2.1	0.3
West shore	429	0	0

Transect 10

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	40	2.5	0.1
2	90	3.6	0.2
3	140	3.5	0.3
4	190	4	0.3
5	240	4.2	0.2
6	290	3.5	0.2
7	340	2.9	1.1
West shore	386	0	0

Transect 11

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	9	1.2	0.1
2	59	3	1.6
3	109	3.1	0.8
4	159	3	1.2
5	209	3.3	0.5
6	259	2.9	1.1
West shore	305	0	0

Transect 12

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0

1	38	2.7	1.8
2	88	2.3	1.6
3	138	2.2	0.9
4	188	2.7	1.6
5	238	1.7	0.7
West shore	268	0	0

Transect 13

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	16	1.7	1.5
2	66	1.9	0.6
3	116	1.7	1.3
4	166	1.8	1.4
5	216	1	1.8
West shore	229	0	0

Transect 14

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
1	33	2.1	2.6
2	83	1.5	1.3
3	133	1.6	0.4
West shore	171	0	0

Transect 15

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0

	34	1.2	1.2
	84	1	1.7
West shore	104	0	0

Transect 16

Hole No.	Distance from East shore	Water Depth (ft)	Sediment Depth (ft)
East shore	0	0	0
	19	1	3.6
	44	1	2.5
	69	1	3.1
West shore	83	0	0

NORTH

MALLARD DRIVE

ORIOLE DRIVE

DOVE STREET

Note: Data for this map was prepared by drilling holes over the ice and probing lake bottom sediments with graduated 1 1/4" PVC piping. Transect lines were run on a perpendicular to a base line that traversed the long axis of the lake. One base line and 15 cross sectional transects were established . Approximately160 holes were drilled in the ice along these transects.ILM estimates spatial error for sampling points at +/- 10 ft.and depth error of +/- 6". Transect lines were shot with a transit and angles recorded. Ice levels were even with the dam spillway and thus all depths are recorded against Normal Water Level (NWL). The survey was done on Jan 31,1995 and Feb. 1, 1995. Normal Water Level (NWL). The survey was done on Jan 31,1995 and Feb. 1, 1995. Contour lines involves interpolation between transects and therefore all

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WILLOW LAKE BATHYMETRIC MAP

Estimates of bathymetric contours of Willow Lake in Freeport , Illinois. Bathymetric contours are based on transects over the ice during February 1995.

Prepared By: J. K. Bland
S. Kubillus

2/15/95

Dedicated to safe, long-term management of aquatic resources

NORTH

MALLARD DRIVE

ORIOLE DRIVE

DOVE STREET

Note: Data for this map was prepared by drilling holes over the ice and probing lake bottom sediments with graduated 1 1/4" PVC tubing. Transect lines were run on a perpendicular to a base line that traverses the long axis of the lake. One base line and [illegible] transects were established. Approximately 160 holes were drilled in

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WILLOW LAKE SEDIMENT MAP

Estimates of sediment distribution across Willow Lake in Freeport, Illinois. Estimates of sediment accumulation are based on probes performed through the ice during February 1995.

Prepared By: J. K. Bland
S. Kubilius

2/15/95