Shawano Lake Outlet and Wolf River
Mercury Monitoring

INTRODUCTION

Mercury concentrations in the top predators of Shawano Lake (Walleyes greater than 22 inches) prompted water resources and fish management personnel to collect sediment samples for mercury analyses. The first sediment samples were collected on July 31, 1985. The results are attached in the document "Mercury In Shawano Lake Sediments" January 9, 1986 Wisconsin DNR District Office - Green Bay. One of six samples collected was above the detectable level. A sediment sample had a concentration of 1.8 mg/kg, just above HWY 47 in the outlet. The concentration is 7.2 times greater than the normal background level of 0.25 mg/kg reported by the National Swedish Environment Board in April 1984.

This report documents samples collected on July 7, 1986 in the area of the Shawano Lake outlet above and below HWY 47.

PROCEDURE

Samples were collected using SCUBA. Metals sample bottles provided by the State Laboratory of Hygiene were inserted into the soft sediments, capped under water and returned to the boat. The samples were mailed to the Lab the same day. Results of the Lab tests were received by the District Office the week of March 16, 1987.

RESULTS

See figure 1 for the location of sample sites.

Sample #	Location	Date	Hg-mg/kg	Moist Cont.
1	Shawano Outlet 200 yds above R.R. bridge	7/14/86	0.4	89.6
2	Shawano Outlet 50 ft. below R.R. bridge	7/14/86	0.5	93.0
3	Shawano Outlet between R.R. bridge & HWY 47	7/14/86	0.6	83.9
4	Shawano Outlet at public dock mouth of storm sewer	7/14/86	0.2	61.9

5*	Shawano Outlet 30' above 47 bridge	7/14/86	<0.1	86.5
6	Shawano Outlet between 47 & mouth of out.	7/14/86	0.2	88.0
7	Wolf River 300 yds. above R.R. bridge	7/14/86	<0.1	79.7
8	Wolf River 1.5 miles above R.R. bridge	7/14/86	<0.1	93.0

* This site was sampled in July 1985 and the concentration was 1.8 mg/kg.

DISCUSSION

Mercury was above the normal background level of 0.25 mg/kg ("Mercury In the Swedish Environment Global and Local Sources, Solna Apr. 84") in 4 of 8 samples. The sample collected above HWY 47 was below the detectable level in July 1986 and 1.8 mg/kg in July 1985. A possible explanation for this is contained in the Swedish paper. The article states "mercury content in sediments depends on a number of factors in addition to the load on the water systems. Most of the mercury in sediments is bound to organic matter and the fine-grained fraction of mineral particles. For this reason, the organic matter content of sediment and the size distribution of mineral particles should be taken into account when the mercury content in sediments is evaluated. Other factors influencing the mercury content are the degree of efficiency of sedimentation, the rate of growth of the sediments, and the stirring of the sediments caused by bioturbation or bottom currents".

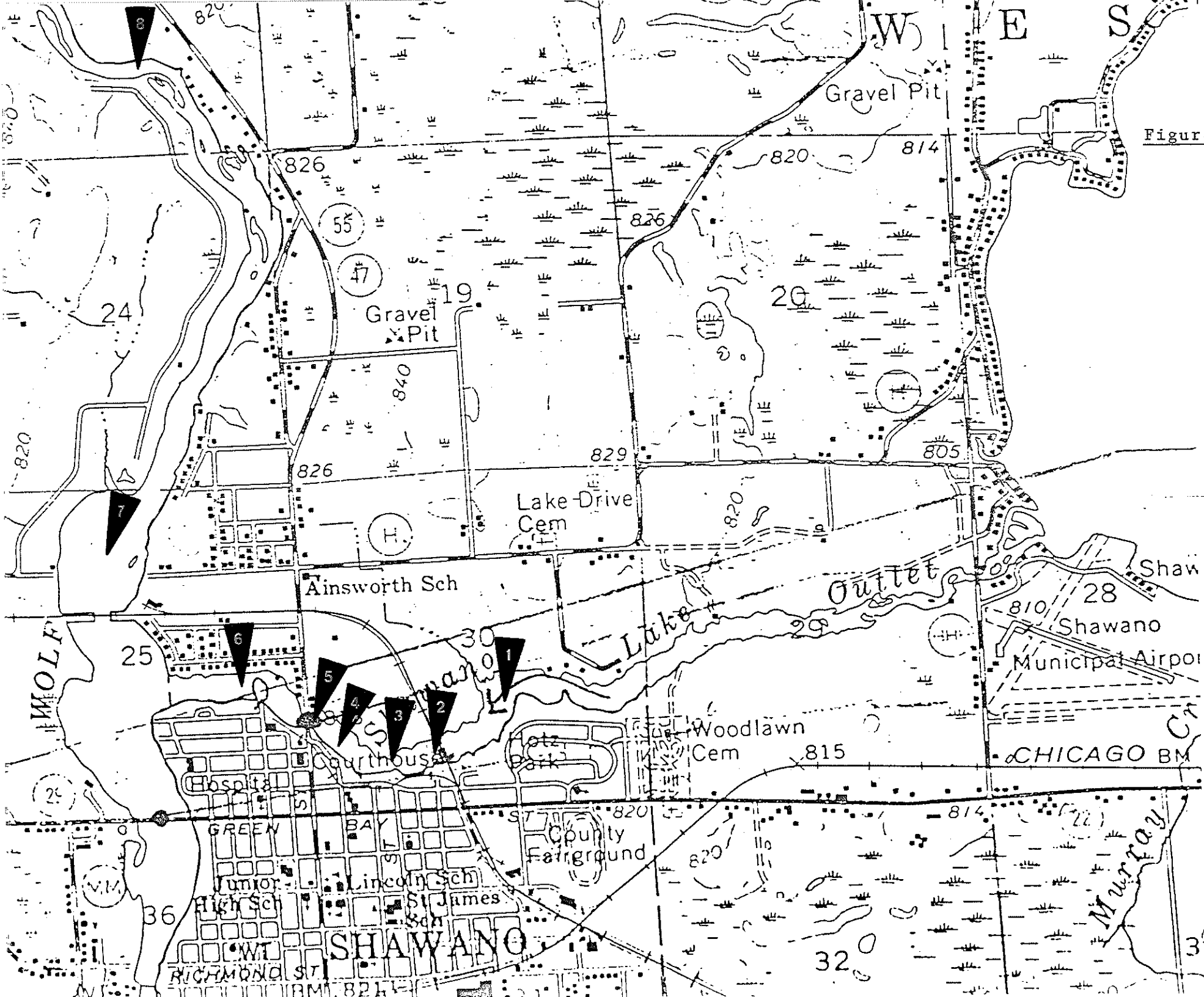
The Shawano Lake outlet runs through the city of Shawano. The area is highly urbanized. Many private businesses and residences are built on the channel. The channel is deep and wide enough to support a great deal of boating activity. However, it is shallow enough that disturbance of the bottom sediments occurs in the channel. The sediments in the channel do not appear to be highly polluted. The Swedish paper goes on to say that "most of the analyses of the mercury content in sediments have been performed in environments receiving mercury discharges. Levels vary considerably. In highly polluted areas levels around 1-10 mg/kg are not rare. In the inner parts of Minamata Bay in Japan a content of 2,010 mg/kg has been recorded (Forstner and Wittman, 1981). Mercury can also be transported in

the atmosphere and

spread far away from the emission source. In two lakes in Switzerland, for example, highly elevated levels of mercury have been recorded in the sediments although there are no discharges in the area (Vernet and Thomas, 1972). A similar situation exists in many Swedish lakes, cf. Chapter 7".

The DNR District will again sample the area for mercury in 1987 to determine if there is need for additional study to determine a source.

Tim Rasman
March 25, 1987


Gravel Pit
826
814
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47
19
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Gravel Pit
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829
805
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Lake Drive Cem
820
Ainsworth Sch
Lake Outlet
28
810
Shawano
Municipal Airpo
25
30
29
Shawano L
Woodlawn Cem
815
CHICAGO BM
Courthouse
Hotz Park
Hospital
GREEN BAY ST
820
814
County Fairground
Junior High Sch
Lincoln Sch
St James Sch
36
SHAWANO
RICHMOND ST
BM 821
32
Murray
1
2
3
4
5
6
7
8

Figure 1

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	860714		M002	030010	004589		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: FASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#6	
165	71921	HG MUD DRY WGT MG/KG-HG	<0.1
259		MOIST CO NTENT(SE IVED)PER	93.0

***** COMMENT: WOLF R. 2MILES ABOVE RR BRIDGE

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	860714	0001	M002	030010	004590		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: FASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#7	
165	71921	HG MUD DRY WGT MG/KG-HG	<0.1
259		MOIST CO NTENT(SE IVED)PER	79.7

***** COMMENT: WOLF R.300 YARDS ABOVE RR BRIDGE

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	860714	0002	M002	030010	004591		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: FASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#6	
165	71921	HG MUD DRY WGT MG/KG-HG	0.2
259		MOIST CO NTENT(SE IVED)PER	88.0

***** COMMENT: SHAWANO OUTLET BETWEEN 47&OUTLET MOUTH

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	860714	0003	M002	030010	004592		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: FASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#5	
165	71921	HG MUD DRY WGT MG/KG-HG	<0.1
259		MOIST CO NTENT(SE IVED)PER	86.5

***** COMMENT: SHAWANO OUTLET ABOVE US47 BRIDGE 30FT

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	860714		M001	030010	004593		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#4	
165	71921	HG MUD DRY WGT MG/KG-HG	0.2
259		MOIST CO NTENT(SE IVED)PER	61.9

***** COMMENT: SHAWANO OUTLET AT PUBLIC DOCK STORM SEWER

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	860714	0004	M002	030010	004594		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#3	
165	71921	HG MUD DRY WGT MG/KG-HG	0.6
259		MOIST CO NTENT(SE IVED)PER	83.9

***** COMMENT: SHAWANO OUTLET BETWEEN RR BRIDGE & HWY 47

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	860714	0005	M002	030010	004595		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#2	
165	71921	HG MUD DRY WGT MG/KG-HG	0.5
259		MOIST CO NTENT(SE IVED)PER	93.0

***** COMMENT: SHAWANO OUTLET 50FT BELOW RR BRIDGE

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	860714	0006	M002	030010	004596		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#1	
165	71921	HG MUD DRY WGT MG/KG-HG	0.4
259		MOIST CO NTENT(SE IVED)PER	89.6

***** COMMENT: SHAWANO L. OUTLET 200 YARDS ABOVE RR BRIDGE

MERCURY IN SHAWANO LAKE SEDIMENTS

Tim Rasman

January 9, 1986

SUMMARY

Six sediment samples were collected for mercury analysis in the Shawano Lake drainage area. Four samples were collected from Shawano Lake, one sample from the outlet and one sample in the Wolf River between the outlet and the HWY 29 bridge. Five samples were below the detectable limit of 0.2 mg/kg. The sediment sample collected from the outlet had a mercury concentration of 1.8 mg/kg; very high and likely the result of a point source discharge.

INTRODUCTION

Shawano Lake is 6,063 acres. It is the largest lake in Shawano County. The Lake and surrounding lakes are highly developed and provide recreation to a large number of people. According to the Department of Natural Resources and East Central Wisconsin Regional Planning Commission the seasonal population nearly doubles each summer. This past year Department of Natural Resource fishery personnel collected walleyes to analyze for mercury contamination. Mercury levels in walleyes over 22 inches did exceed the US Food and Drug Administration health standard. A health advisory for people eating walleyes over 22 inches has been issued for Shawano Lake. The advisory is included in the "1986 Guide to Wisconsin Hook and Line Fishing Regulations" published by DNR.

Shawano Lake is atypical of other lakes in Wisconsin that are experiencing problems with mercury contamination. A number of acidic lakes (pH's less than 7) in northern Wisconsin have fish contaminated with mercury. pH affects the accumulation of mercury in fish (Dept. of Meteorology, U. of Stockholm Apr. 84). Most of these lakes are oligotrophic with low nutrient concentration and reduced productivity. Shawano is a meso-eutrophic lake with recent pH's measuring 8, and alkalinities ranging from 100 to 130 as total carbonate hardness. It doesn't fall into the class of lakes experiencing mercury problems.

PROCEDURE

Lake Michigan District personnel collected sediment samples for mercury analyses on July 31, 1985. The analyses was completed and results were received in LMD in January 1986. The sites are shown on the attached maps and a description follows:

Site 1. Identified as SP was 45 meters from the mouth of Pickerel Creek; a stream that flows through the Village of Cecil. Depth was 2.5 meters. The bottom consisted of soft organic material. The primary type of vegetation in the area was Najas sp.

Site 2. Identified as EB was East of the southeast point approximately 200 meters from shore. Depth was 3.5 meters.

Site 3. Identified as SED was in the deepest area of the lake. Depth was 8.8 meters. This site is where water chemistry samples have been collected the past three years.

Site 4. Identified as ISL was 140 meters northeast of the island visible from the public park and beach along the northwest shore. Depth was 5.0 meters.

Site 5. Identified as 47 was in the outlet channel above or east of the HWY 47 bridge. Depth was less than 2.0 meters.

Site 6. Identified as 29 was between the HWY 29 bridge and Shawano Lake outlet. Depth wasn't recorded.

Samples were collected with a standard size PONAR dredge, transferred to 250 ml. Wis. State Lab of Hygiene "metals bottles" and sent to Madison for analyses.

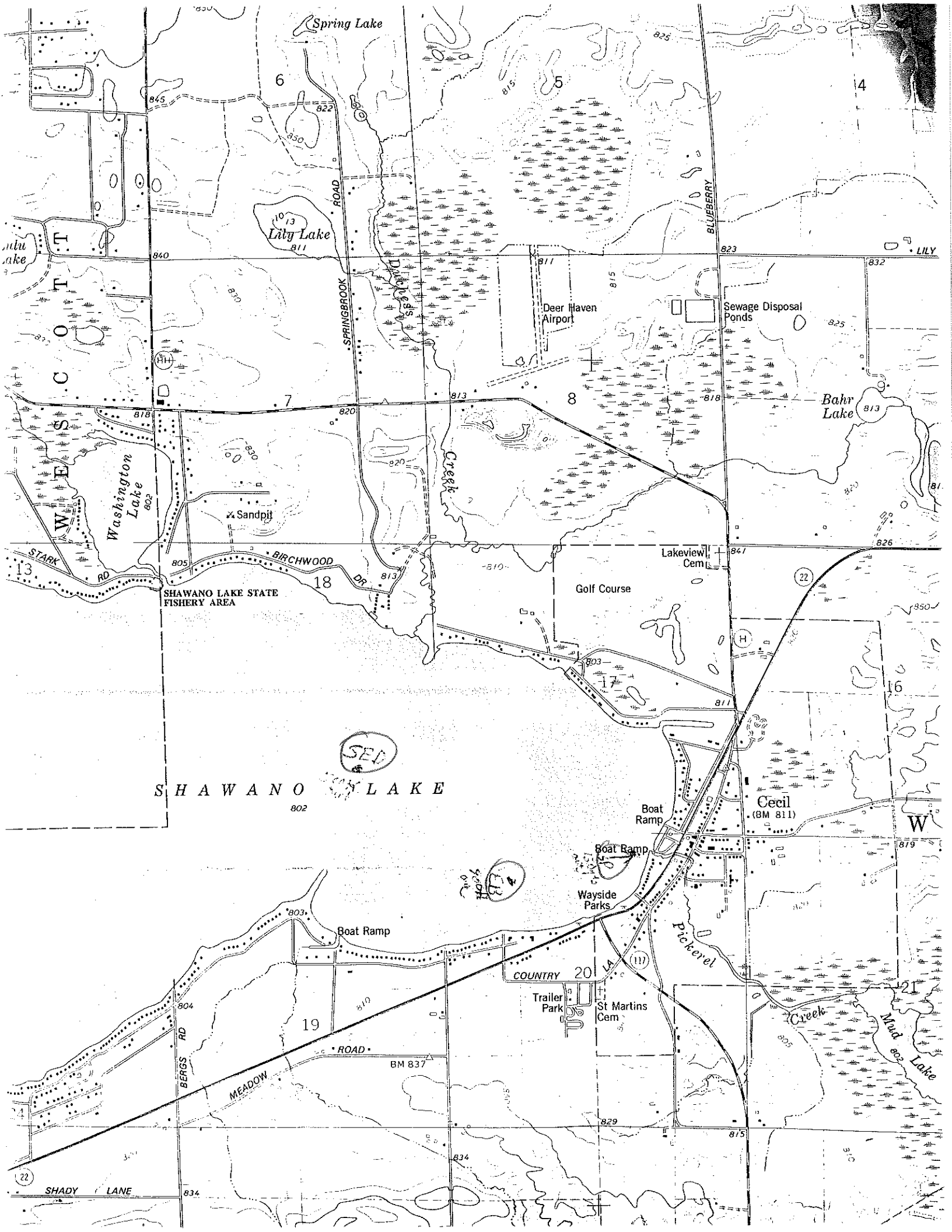
RESULTS

Five of the six samples had levels of mercury below the detectable limit of 0.2 mg/kg. The sample collected in the outlet above the HWY 47 bridge in the city of Shawano had a concentration of 1.8 mg/kg. (See attached lab sheets.)

DISCUSSION AND RECOMMENDATIONS

Fourteen lakes in Sweden were sampled for mercury in the sediments (Dept. of Meteorology, U. of Stockholm Apr. 1984). Figure 7.5 shows the concentration of mercury in the surface sediments as well as mercury content in relationship to the content of organic matter. None of the lakes in Sweden were as high as the Shawano Lake sediment sample. The Swedish report goes on to say that "on the basis of analysis in some fifty lakes in Europe and the USA, Hakansson (1980) has assumed than an upper limit of natural mercury levels in sediments is 0.25 mg/kg DS. The values for a number of unpolluted lakes in Sweden are 0.02-0.12 mg/kg and for sediments from lakes and water courses in Switzerland 0.05 mg/kg.".

The District in 1986 will attempt to quantify the contaminated sediments in the area of HWY 47 in Shawano. The heavy metal series will be included in the analyses.


Spring Lake
Lily Lake
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Deer Haven Airport
Sewage Disposal Ponds
Bahr Lake
Washington Lake
Sandpit
Creek
Stark Rd
Birchwood Dr
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Lakeview Cem
Golf Course
SHAWANO LAKE
Boat Ramp
Cecil
(BM 811)
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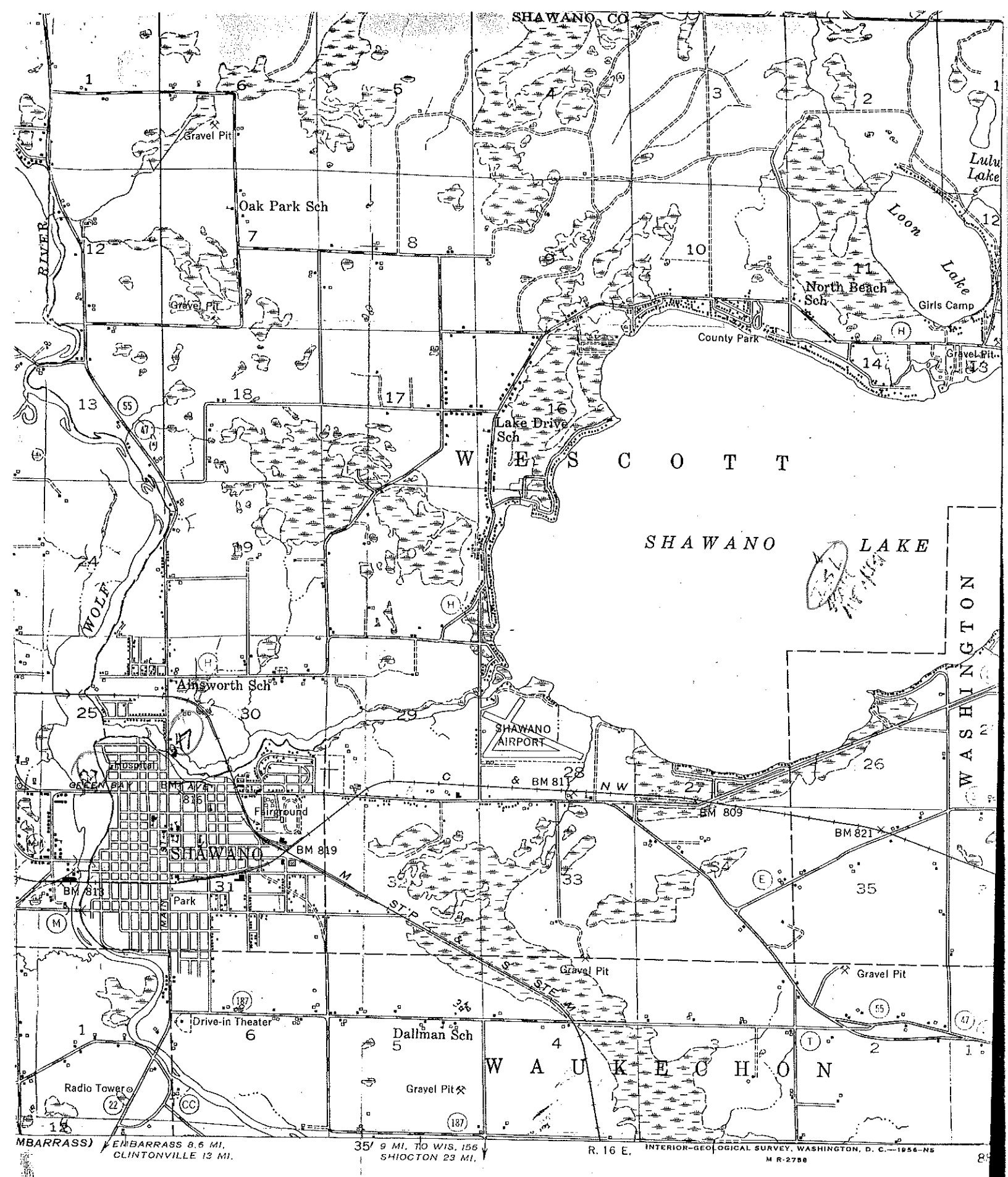
Pickerel Creek
Mud Lake
Country Ln
Trailer Park
St Martins Cem
Bergs Rd
Meadow Road
BM 837
Shady Lane


SHAWANO CO
Gravel Pit
Oak Park Sch
RIVER
Lulu Lake
Loon Lake
North Beach Sch
Girls Camp
County Park
Gravel Pit
Lake Drive Sch
W E S C O T T
SHAWANO LAKE
WOLF
Ainsworth Sch
SHAWANO AIRPORT
WASHINGTON
Hospital
GREEN BAY
BM 816
Fairground
SHAWANO
BM 819
BM 813
Park
C & NW
BM 809
BM 821
ST P
Gravel Pit
Drive-in Theater
Dallman Sch
W A U K E C H O N
Radio Tower
Gravel Pit
(EMBARRASS) 4 EMBARRASS 8.6 MI, CLINTONVILLE 12 MI.
35' 9 MI. TO WIS. 156 SHIOCTON 23 MI.
R. 16 E.
INTERIOR-GEOLOGICAL SURVEY, WASHINGTON, D. C.—1956-NS
M R-2788
ale 1:48000
1 2 3 Miles
8000 4000 5000 Yards
9000 12000 Feet
1 2 3 Kilometers
ROAD CLASSIFICATION
Heavy-duty
4 LANE 6 LANE
Light-duty
Medium-duty
4 LANE 6 LANE
Unimproved dirt
U. S. Route
State Route

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	850731	1045	M004	030010	010854		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#ISL	
165	71921	HG MUD DRY WGT MG/KG-HG	<0.2
259		MOIST CO NTENT (SE IVED) PER	19.7

***** COMMENT: SHAWANO LAKE WEST ISLAND

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	850731	1020	M009	030010	010853		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#SED	
165	71921	HG MUD DRY WGT MG/KG-HG	<0.2
259		MOIST CO NTENT (SE IVED) PER	89.3

***** COMMENT: SHAWANO LAKE EAST DEEP AREA

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	850731	0950	M004	030010	010852		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#EB	
165	71921	HG MUD DRY WGT MG/KG-HG	<0.2
259		MOIST CO NTENT (SE IVED) PER	90.1

***** COMMENT: SHAWANO LAKE EAST BASIN

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	850731	0930	M003	030010	010851		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#SP	
165	71921	HG MUD DRY WGT MG/KG-HG	<0.2
259		MOIST CO NTENT (SE IVED) PER	48.0

***** COMMENT: SHAWANO LAKE AT PICKEREL [illegible]

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	850731	1215	M005	030010	010856		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#29	
165	719[illegible]1	HG MUD DRY WGT MG/KG-HG	<0.2
259		MOIST CO NTENT (SE IVED) PER	71.9

***** COMMENT: WOLF R ABOVE HWY 29

LOCATION	DATE	TIME	DEPTH	ACCOUNT-#	LAB-SLIP-#	END-DATE	END-TIME
59MISC	850731	1200	M002	030010	010855		

TEST-#	STORET-#	TEST--NAME--AND--UNITS	TEST-VALUE
		EXTRA INFORMATION ABOUT SAMPLE: RASMAN	
		EXTRA INFORMATION ABOUT SAMPLE: F#47	
165	71921	HG MUD DRY WGT MG/KG-HG	1.8
259		MOIST CO NTENT (SE IVED) PER	79.4

***** COMMENT: SHAWANO OUTLET ABOVE 47

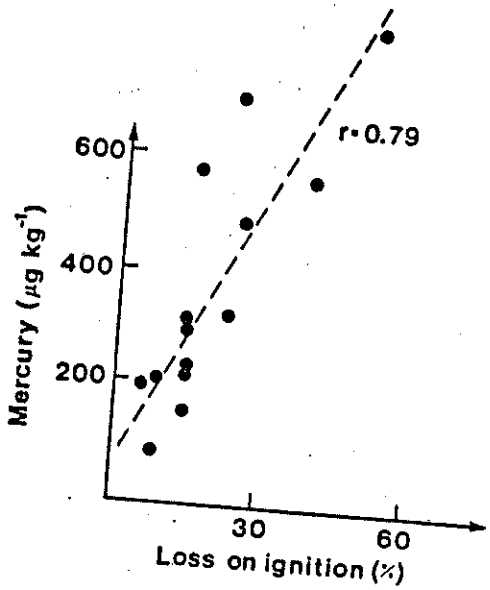


Fig. 7.5. The mercury content of the surface layer (0-2.5 cm) of lake sediments as a function of the content of organic matter in the sediment. The lakes are situated near the coast in central Sweden. Data from Påhlsson (1975).

7.3 Budget calculations of the load and turnover of mercury in a lake

No direct budget calculations of the load and turnover of mercury in oligotrophic lakes in woodland regions have been made so far. Such calculations are very difficult to make due to lack of detailed data. A comprehensive measurement program is needed for estimating the load from surface water run off from the catchment area. At present, it is only possible to coarsly estimate the flow of mercury in and around a lake in the southern part of Sweden.