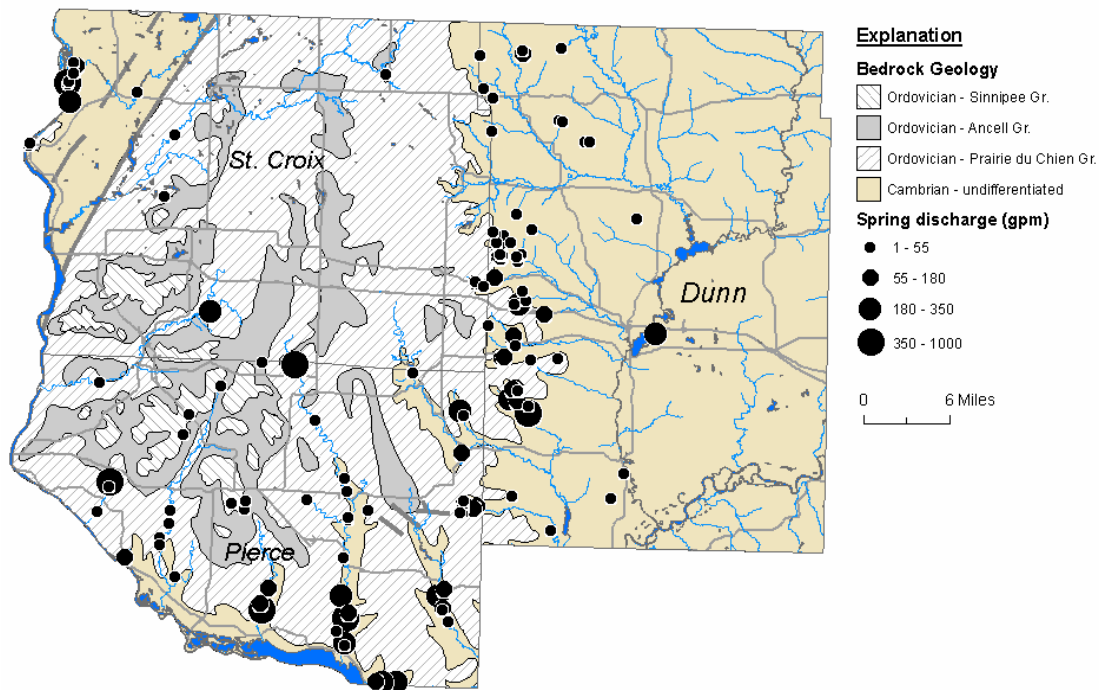


Karst Feature and Spring Inventories

- **WGNHS Karst Features Inventory and related clippings for Pierce, Dunn and St. Croix Counties**
- **Wisconsin Conservation Department Spring Surveys**
 - [Dunn County](#)
 - [Pierce County](#)
 - [St. Croix County](#)



Distribution of springs with flow greater than 1 gpm in the project study area, as listed in Wisconsin Conservation Dept. (1959a, 1959b, 1960).

ST. CROIX NEWS

HAMMOND
The **HEART** OF
ST. CROIX COUNTY

"Serving the People"

August 17, 1988 35c

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Pine Lake's bottom fell out

Pine Lake north of Baldwin has gone dry for the fourth time in the 20th century. A large sink hole opened up on the north end of the lake, just off the park, and drank a large part of Pine Lake dry.

The lake has been known for its extremely fluctuating water level and has been dry in 1919, 1936, 1959, and now in 1988, according to information given by nearby land owners.

The fluctuation of the lake is said to be due to the limestone bottom and consists of several sinkholes. It is a water table fed lake, and the drought of 1988 is probably as much a reason for the dry lake as the sinkholes.

Water reaches the lake by runoff and three small springs. Watersheds make up an approximately drainage area of 3,000 acres. Pine Lake itself has varied from 66 acres in 1958 to 124 acres in 1965 and 116 acres in 1973.

Heavy snowfall in the early winter months of 1965 led to the high spring water levels that year, but levels have lowered little by little each year until the ultimate climax this year. The last years of light snowfall and minimal rainfall were main factors contributing to the lake's seepage.

In 1959, the last year the lake went dry, the north sinkhole was filled with rock from neighboring farms and sealed with bentonite. It was filled approximately one-third to one-half full. Southern sinkholes were not filled at the



Pine Lake north of Baldwin is dry...again!

same time; although, they were partially filled with field rock, plastic, and soil twice since 1959.

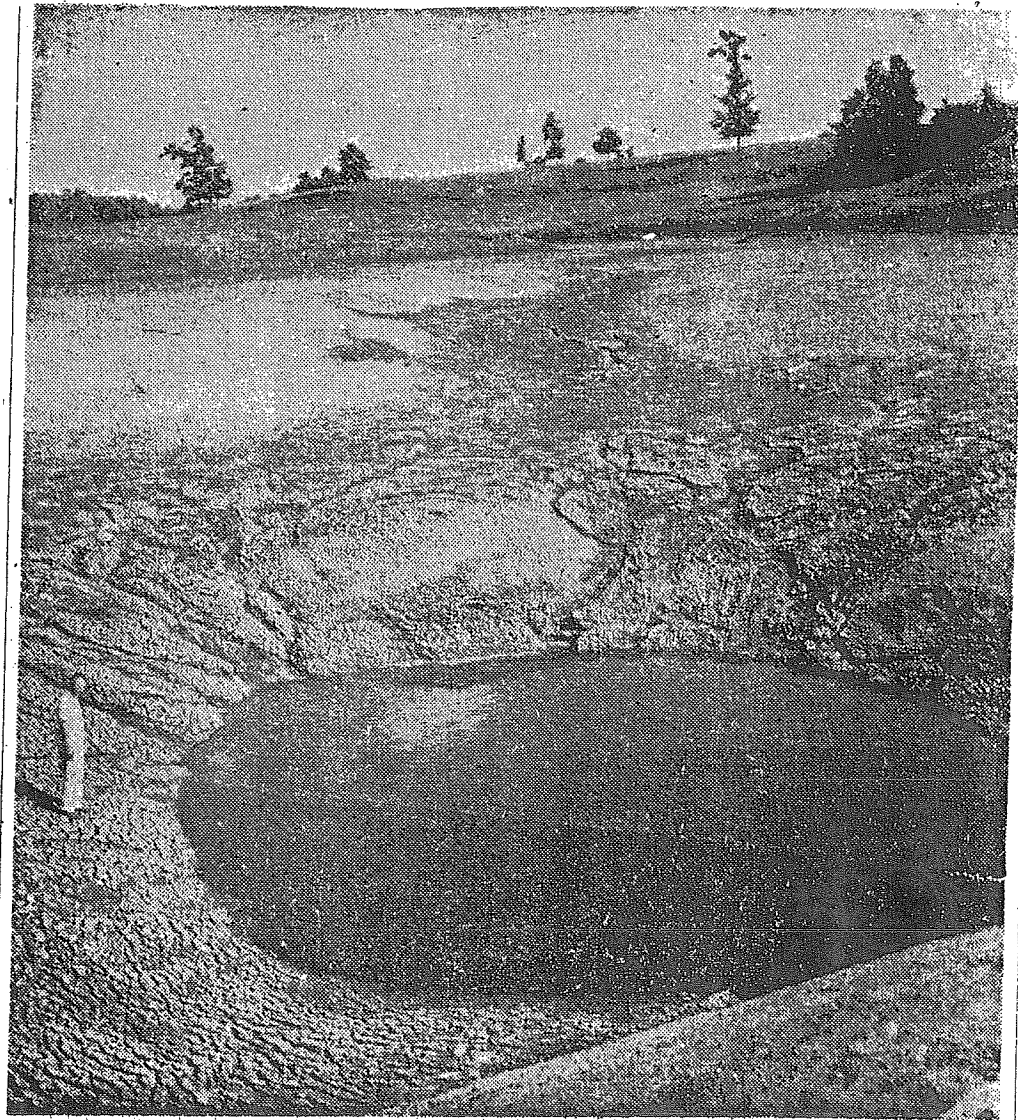
Pine Lake has been known to be an excellent walleye lake, and at one time was said to be the best pan fish lake in Wisconsin. Besides walleye, the lake has been stocked with Northern Pike, perch, and sunfish while bullhead made their way to the waters even though bullhead had been killed out.

In good years, fishermen came from as far away as Illinois to enjoy the sport and taste of the large and plentiful sunfish of Pine Lake.

In recent years, the restocked lake was aerated to prevent fish dying from lack of oxygen as has happened in the past.

According to Marty Engel, St. Croix County DNR representative, it is unknown at this time what will be done with the lake. He said it will probably take some time to gather information, survey conditions, plan and fund improvements to the lake, but he thought everything within reason would be done to save the lake.

In the meantime, fishermen and property owners near Pine Lake are left high and dry, wondering what will be done and when.



DISAPPEARANCE of a lake is graphically depicted in this photo of the dry lake bed and sink hole in Upper Pine lake, St. Croix county. Bottom of the sink is estimated at about 35 feet below maximum lake level. Gordon Frederic, Woodville, stands in left foreground.—Staff Photo.

Sinkholes Found--

Funds Sought To Salvage Pine Lake

Pioneer Press News Service

BALDWIN, WIS.—The final disappearance of the major portion of Pine lake, several miles north of here, is actually welcomed by sportsmen of the area.

For the draining of the lake clearly and the one large sinkhole through lake has periodically disappeared

...you old son, Doug, was boating bluegills as big as his hands and wearing an expression which said he thought it was fine right now. A farm couple on the bank was doing as well. They were in fishing shallow water. The depth under our boat was 22 feet.

Talk about comebacks!

Just three summers ago there was only parched mud at the bottom of this little valley three miles west of Baldwin on Hy. 63. Area anglers had literally watched their fishing spot go down the drain. There was a hole in the bottom of the lake.

"A hole you could put a house in," Apelgren recalls.

Visible in 1959

The huge hole first became visible in 1959, revealing why Pine lake had been dwindling down for several years. About 80 feet in diameter, it was like a huge funnel into which the remainder of the 114 acre lake slowly swirled. Bullheads, the last survivors, were a gasping swarm in the shallow puddle which finally remained.

Pine lake had its ups and downs before, old timers recalled. There was a history of sink holes which periodically opened up and drew the lake waters into secret caverns in the magnesium-limestone strata of the region. Kettle shaped depressions of age old sink holes are also visible on the uplands around the south end of the lake.

The lake level is maintained mostly by run off of rains and snowmelt from surrounding farmlands, and drought had also drawn it down in years past. Still, it had always somehow patched its wounds and recovered. This time it appeared that help was needed.

Luckily, a remedy was at hand — and at willing hands at that.

Meet Challenge

The Central St. Croix rod and gun club had taken the challenge, and its members were appealing to the state for some help. They got little except advice and sympathy that first year because of legal obstacles. The lake was encircled by half a dozen farms, and though fished by the public for many years it had no actual public access. Conservation department policy required such access before help could be given. There was also a ruling that the actual hole plugging would be "a work of internal improvement" and not eligible for state aids.

Undismayed, the club and the township of Hammond established a small public park and boat landing, served by a town road leading to the northwest shore of the lake.

Members of the Baldwin and

...the shallow shore lines should be terrific as they move in to spawn in the spring. We caught bluegills on live bait and artificials — even bass lures — in all parts of the lake.

Bass up to a foot long are already in evidence and at the rate they've been adding length and heft they too promise fine fishing in the near future.

Stocked With Pike

Northern pike also have been stocked in the mile and one-half long lake. The largest reported so far is a 30 inch. About 500 yearling pike and 20 adults were placed in the lake last winter after an initial stocking of fingerlings apparently failed to take.

Pine lake lacks the scenic splendor of many other waters. Despite the name, pines are scarce around its shores. Cattle pasture down to the water in several places.

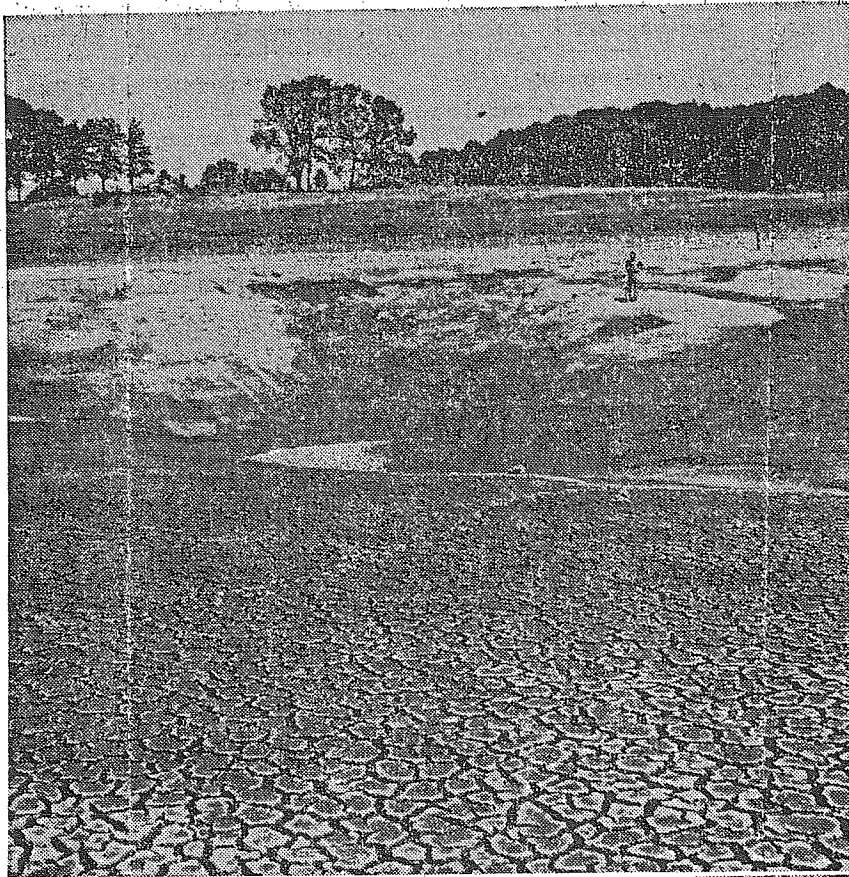
Fixed good as new? Why the cane pole crowd will tell you that the old lake is already better than ever!

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'Rags to Riches'—Story Of Rebuilt Pine Lake



An example of what can be accomplished by determined sportsmen is illustrated in these pictures of Pine lake in St. Croix county. The upper photo shows the great sinkhole into which the lake had disappeared in 1959. Bert Apelgren, district fish biologist for the state conservation department, surveys the lake as it is today, 22 feet deep.

—Sentinel Photos

By **DON L. JOHNSON**
Sentinel Outdoors Writer

Baldwin, Wis. — A bass swirled at my spinner and splashed mightily as it felt the hook. The line doodled designs in the algae laden water for a few moments and the fish surfaced again. It was a large-mouth barely 11 inches long. But then, it was hardly more than a year old. As it turned on its side in defeat it spewed out about a dozen of the tiny bluegills on which it had been feeding.

That told the present story of Pine lake pretty well. That, and the big grin on the face of Bert Apelgren, the district fish manager.

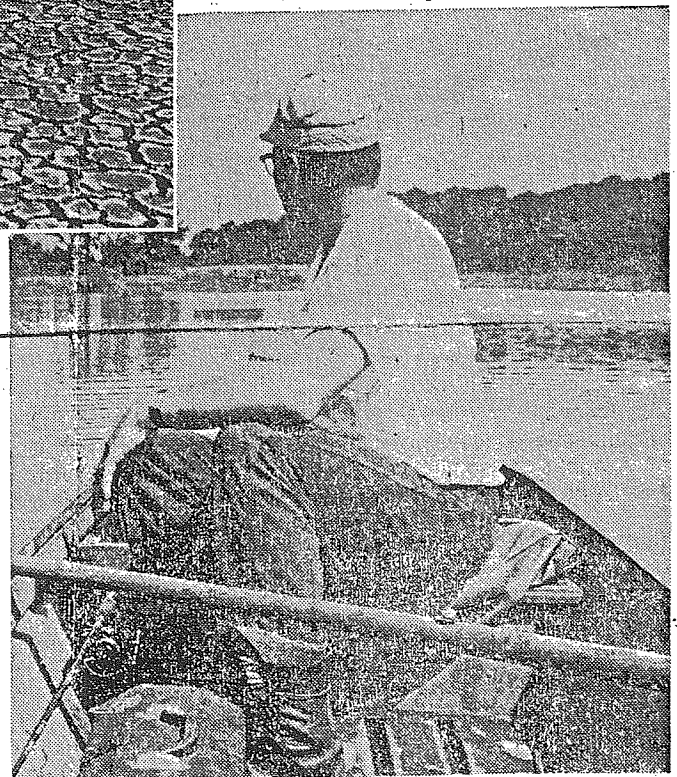
"This lake is going to furnish fantastic fishing next year. It

bulldozer scraped the lake bottom back over the hole after the rocks were dumped, and then the surface was sealed with a material called bentonite. The job cost about \$1,100.

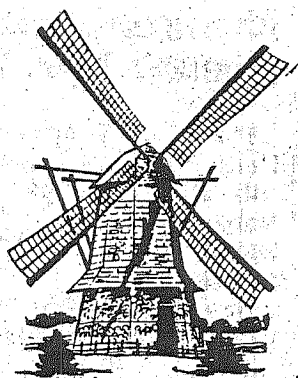
Unwanted Fish Killed

That was in the fall of 1959. By the following spring there was 10 feet of water in the lake, and in July the conservation department treated the water with toxaphene to kill any unwanted fish which had survived in shallow pools.

In the spring of 1961, the lake was stocked with 100 adult bluegills and 9,000 large-mouth bass fingerlings. They thrived. Bluegills hatched in the lake last year already average more than five inches long. Next year they will be



Nov 16 - 1988



BALDWIN
Biggest Little Town In
WISCONSIN

Established in 1874

VOLUME 114 (UPS 040-480) Single Copy 40¢

BALDWIN, WISCONSIN

WEDNESDAY, 1

THE F BUI

Pine Lake sinkhole was plugged Friday



A large bulldozer operated by Bobby Jo Anderson of Anderson Excavating was used last Friday to move lake bed materials to fill the sinkhole at Pine Lake. The construction cloth that was placed over the sink hole area and covered with clay, gravel and sand is visible in the lower left of the photo.

The latest sinkhole to appear at Pine Lake was plugged last Friday with a layer of construction cloth and a mixture of clay, gravel and sand from the lake bed.

The plug was accomplished

through the cooperation of local individuals, lake shore owners, sportsmen groups and the Wisconsin DNR.

According to Marty Engel, DNR Fish Manager in the Baldwin DNR

office, construction cloth is a tough fabric that is also used for road construction projects in wet areas.

He said the cloth would prevent clay from slipping off the sinkhole.

After the construction cloth was in

place, a bulldozer was used to cap the sinkhole with eight feet of fill about 10 yards past the edges of the sinkhole.

Engel said the preferred method of plugging the hole would have been to place rock under the construction cloth, but that was impossible because of the muddy conditions and lack of funds to haul rock to the site.

In addition, Engel said if funds would have permitted, a better solution for plugging the hole would have been to fill an area from four to six times the size of the area that was actually done. He said that if more donations are made for the project, work can continue on filling the large depression in the lake bed as funds become available.

Funds for the lake repair work came from donations by individuals and the Central St. Croix Rod & Gun Club and the St. Croix Sportsman Alliance. Much of the time required for coordinating efforts and applying for permits was donated.

Two permits were needed for the work on the lake bed, said Engel, one from the U.S. Army Corps of Engineers, administered through the DNR, and the other from the St. Croix County Zoning Office.

After meeting with local people concerned with the future of the lake, including Glen Boldt and Jerry Thompson, Engel agreed to help with the project by applying for the permits and using DNR equipment for pumping the water from the depression caused by the sinkhole.

Others who have helped with the project are Randy Paul who built the first dike to keep water from the south end of the lake from draining into the sinkhole; and when the first dike washed away after a heavy rain, Dwight Alwin donated excavating services to build a larger dike. The construction cloth was donated for the project by Boldt Plumbing and a substantial amount of the excavation work for filling the sinkhole was donated by Anderson Excavating.

"The project wouldn't have went anywhere without local support," said Engel. "Glen and Jerry played a significant part in this," he added. Because the DNR is unable to manage every waterway due to financial constraints, Engel said, "co-management" of natural resources is becoming a more important option.

Thompson estimated the expenses thus far for filling the sinkhole at about \$1,000, and only a small

Pine Lake Sinkhole
Continued on Page 8A

Pine Lake Sinkhole

Continued from Page 1A

portion of that amount has been raised through donations. In addition, Thompson said there is clay available and for another \$1,000 to \$1,500 he said about 1,000 yards could be brought in later this fall when the lake bed is frozen. That would raise the level of the depression in the lake bed caused by the sink hole about two feet and would provide a good seal for the bottom.

An account has been set-up at the First National Bank for donations to help with the expenses in the lake repair work, including the cost of applying for permits.

Engel stressed that he is a fish manager, and not a lake manager, but he agreed to be involved in the process of applying for the permits and finding a method to plug the sinkhole because the lake is an important local recreational resource.

"It's not a scheduled project," Engel said, "so it takes away from what I'm supposed to be doing. But it's an issue that needs attention. I thought we did the best job we could under the circumstances."

"Although the DNR can set-up and do these types of projects," said Engel, "it takes years to do" because

DNR budgets are on a two year basis. "If something was going to get done, we realized it would have to be done by local government or individuals."

"It took about a month for people to realize what needed to be done," after the sink hole opened up about mid-August, Engel said. He added that another month was required to organize the effort and another month to gain permit approval.

Engel said the last sink hole in the lake that was filled was in 1985. It was an easier project because when it was done the sink hole was above the water line. That project cost about \$3,000 and was paid for by state and county funds with conservation aids project funds.

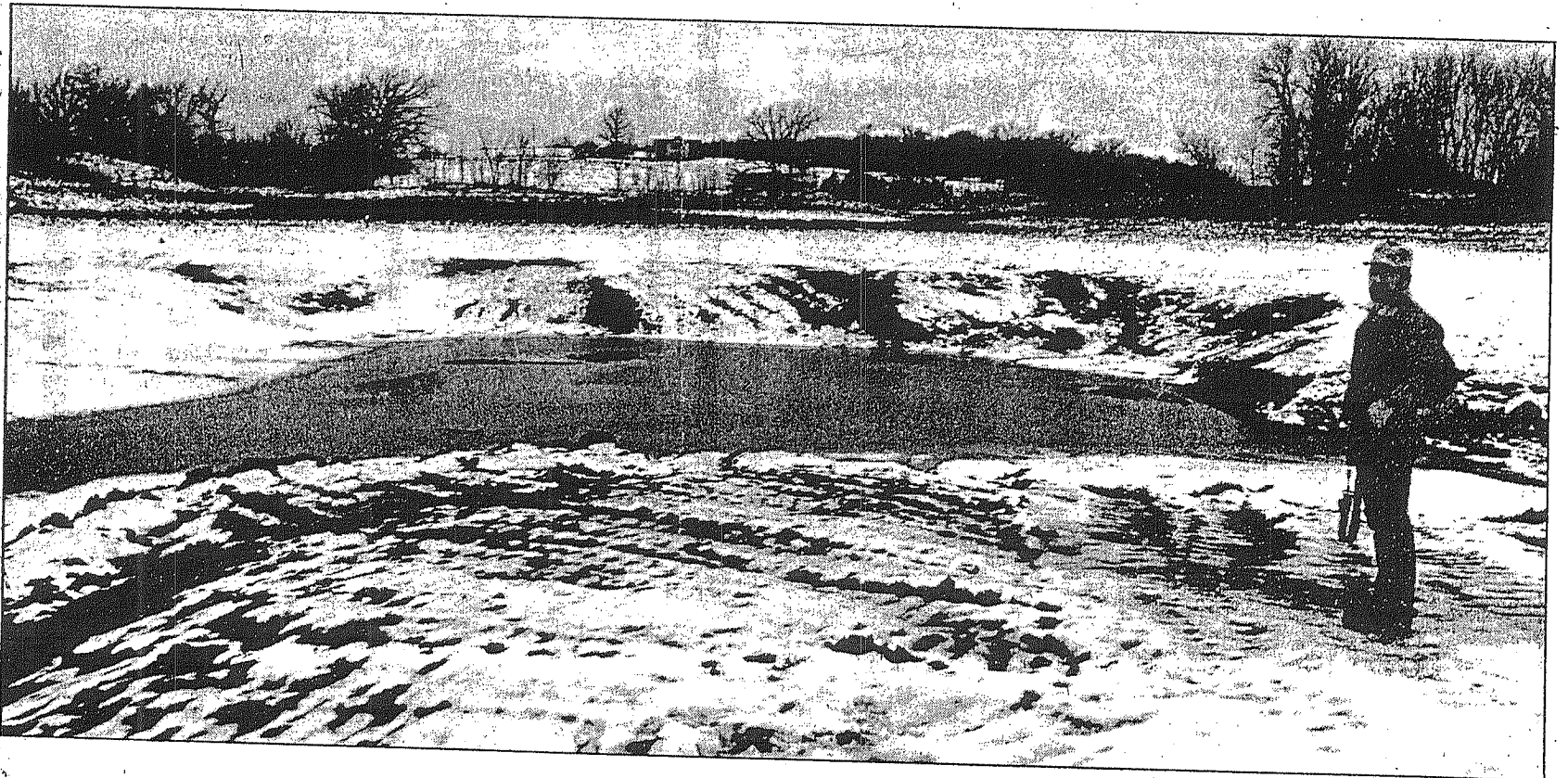
"We stock the lake—that costs money," said Engel. "Pine Lake had a winter kill problem and sink hole problems and we have to re-stock the lake over a several year period. We have an investment there."

If the water rises, Engel said the DNR will begin re-stocking efforts with northern pike, walleyes, largemouth bass and bluegills.

The lake level should rise, said Engel, because of the heavy clay watershed, although it may take two

years or more before it is at a high enough level to serve recreational purposes. He noted that the last five inch rain in this area raised the lake about two feet.

Engel said he is hoping for a good freeze-out of the lake over the winter which would remove oxygen from the existing water in the lake and make it difficult for even bull heads to survive.



Marty Engel, a Department of Natural Resources fish manager based in Baldwin, stands on clay that was moved from the edge of Pine Lake and placed over a natural drain in a sinkhole. Pine Lake, located a few

miles north of Baldwin, is susceptible to periodic drainage because of sinkholes. The DNR and St. Croix County sportsmen's clubs are working to correct the problem.

Staff photo by Jim Daly

Leaky lake causing problems near Baldwin

Sportsmen, DNR work for solution to sinkhole

By Jim Daly
Regional editor

BALDWIN — Local sportsmen and the Department of Natural Resources have taken steps they hope will plug leaky Pine Lake.

Last week, a contractor capped a 12-foot natural drain at the edge of a 155-foot sinkhole in the popular fishing lake four miles north of Baldwin. More work, however, remains to be done, according to a DNR official and a member of the St. Croix County Alliance of Sportsman's Clubs.

Pine Lake has a heavy clay bottom that sits atop a limestone formation. The lake gets its water mainly from runoff in a 3,000 acre watershed, according to Marty Engel, DNR fish manager for most of Dunn and all of St. Croix and Pierce counties.

According to a local newspaper account, Pine Lake has gone dry four times this century, most recently in August.

The formation underlying the lake is susceptible to cracks that apparently caused this year's leak, according to Engel. The same area that drained this year had been patched in 1959. A different sinkhole was patched in 1985, Engel said.

When full, the lake measures about 107 acres and gets up to 21 feet deep, Engel said.

The lake was full in 1987, he said, but last winter water levels started to drop. They continued to drop throughout the summer.

By Aug. 17, water levels were low enough "to show the little hole where the water drained... something collapsed or something washed out from the underneath side," Engel said.

The lake water is now ground water somewhere in the area, he said, adding that nobody reported "a gusher" resulting from more water pressure in the ground.

Fishing naturally went down the drain. Pine Lake is home to bluegills, northern pike, largemouth bass and walleyes, in addition less desirable bullheads.

Engel said people started asking him what the state could do. He said he referred people to the St. Croix County Alliance because the DNR's budget did not call for major work on Pine Lake.

"We had no funding available," he said.

The Alliance comprises local Rod and Gun clubs throughout the county. Baldwin-area members Jerry Thompson and Glen Boldt began an impromptu lake project with Engel's assistance.

The Alliance initially raised \$300 "to get the ball rolling," Thompson said, and the Baldwin Rod and Gun Club contributed \$150. Engel said the funds helped pay for permits required by the U.S. Army Corps of Engineers and St. Croix County to modify a lake bed.

A small berm was built in the lake bed to hold remaining water pumped from the sinkhole, Engel said. The purpose of the pumping was "to inspect the hole to determine a plan of attack," he said.

The strategy was washed out when a six-inch rain about a month ago destroyed the berm.

A local contractor was hired to make a bigger berm. Last week, a DNR crew spent two days pumping 10 feet of water from the sinkhole, Engel said.

On Nov. 11, the contractor capped the hole by bulldozing clay over a fabric placed on top of the hole, Engel said.

The project apparently sealed the hole, but both Engel and Thompson said more clay should be placed over it. Engel said some of the dirt could have been absorbed into a narrow chute at the lower end of the hole that apparently leads to a larger fault below.

If things work out, Thompson said, "Then we'll be able to haul some more of this real hard clay into it."

A fund has been established at the First National Bank of Baldwin to take donations for the project. Thompson said about \$1,000 has been spent and another \$1,500 should be spent.

Engel said the remaining water in the lake is shallow enough that a freeze and lack of oxygen during the coming winter will be enough to kill the remaining bullheads. That's good news for the panfish and game fish that will be stocked in the lake.

"As the water levels return to near normal, the lake will be restocked," he said.

Thompson said dry weather and the sinkholes have hurt fishing in the past, but "it's been a terrific fishing lake in between times."

St. Croix County maintains a small county park at Pine Lake with a boat launch and picnic tables.

CORRESPONDENCE/MEMORANDUM

STATE OF WISCONSIN

Date: August 17, 1988

File Ref:

To: File

From: Marty Engel

Subject: Baldwin Pine Lake Sinkhole

Pine lake just north of the Town of Baldwin has been drained by a sinkhole (see attachment). This sinkhole appeared to be a safety hazard. It first became visible around 8-14-88.

Therefore I contacted legal services on Monday, 8-15-88 for legal advice. Mike Cain and Jim Christianson advised not to post area and notification to legal services was adequate. The State apparently has no liability for such natural events. Cain and Christianson did advise to contact concerned parties.

On 8-15-88 I contacted the Baldwin Police Department and St. Croix County Parks Manager Joe Grant. On 8-17-88 information was sent to Western District and Eau Claire Area staff. Dan Koich was contacted directly by phone. An attempt was made to contact G. Slifer who was on vacation. Notes were left explaining the situation and a message to contact me. St. Croix County's Division of Emergency Government was also contacted.

Joe Grant informed me he would block the landing off and has done so as of 8-16-88.

Lawyers Cain and Christianson had indicated that my notice was sufficient and no other action is needed besides keeping them informed of any new events.

office copy

ST. CROIX NEWS

HAMMOND
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ST. CROIX COUNTY

"Serving the People"

August 17, 1988 35¢

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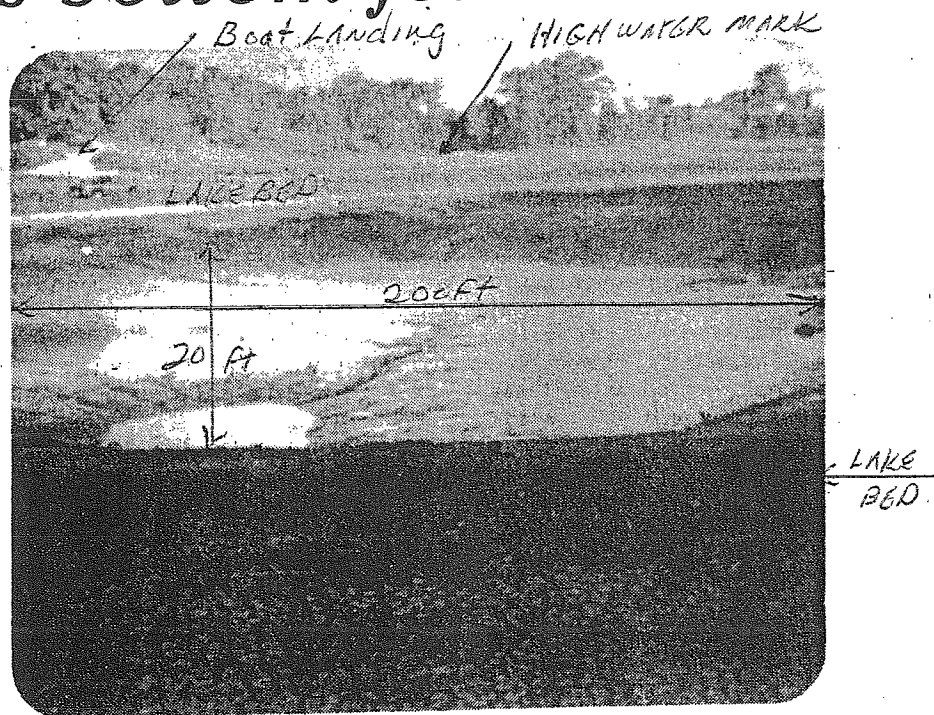
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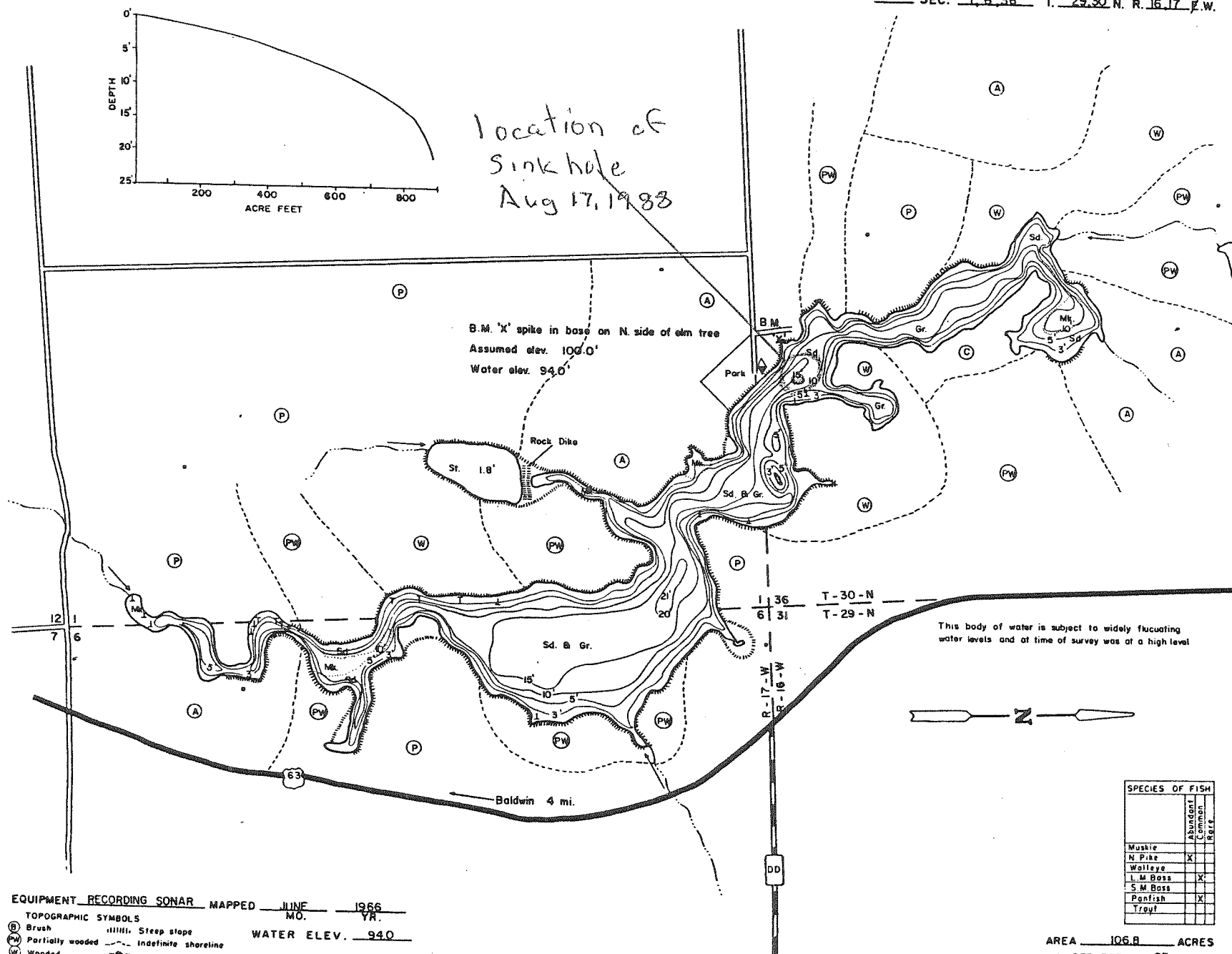
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EQUIPMENT RECORDING SONAR MAPPED JUNE 1966
TOPOGRAPHIC SYMBOLS MO. YR.

| TOPOGRAPHIC SYMBOLS | | MAILED | JUL | 1956 |
|-----------------------|----------------------|---------------------|--------------------------|------------------|
| | | | MO. | YR. |
| (B) Brush | Steep slope | WATER ELEV. 940 | | |
| (PW) Partially wooded | Indefinite shoreline | | | |
| (W) Wooded | Marsh | LAKE BOTTOM SYMBOLS | | |
| (C) Cleared | Spring | P. Peat | G. Gravel | % Stumps & Snags |
| (P) Pastured | Intermittent stream | MR. Muck | R. Rubble | |
| (A) Agricultural | Permanent inlet | C. Clay | Br. Bedrock | |
| BM Bench Mark | Permanent outlet | M. Marl | T. Submergent vegetation | |
| d Dwelling | Dam | Sd. Sand | E. Emergent vegetation | |
| RR Resort | | St. Silt | F. Floating vegetation | |

A horizontal graphic scale bar with tick marks at 500-foot intervals. The labels above the bar are 500', 0', 500', 1000', 1500', 2000', and 2500'. The word "SCALE" is centered below the bar.

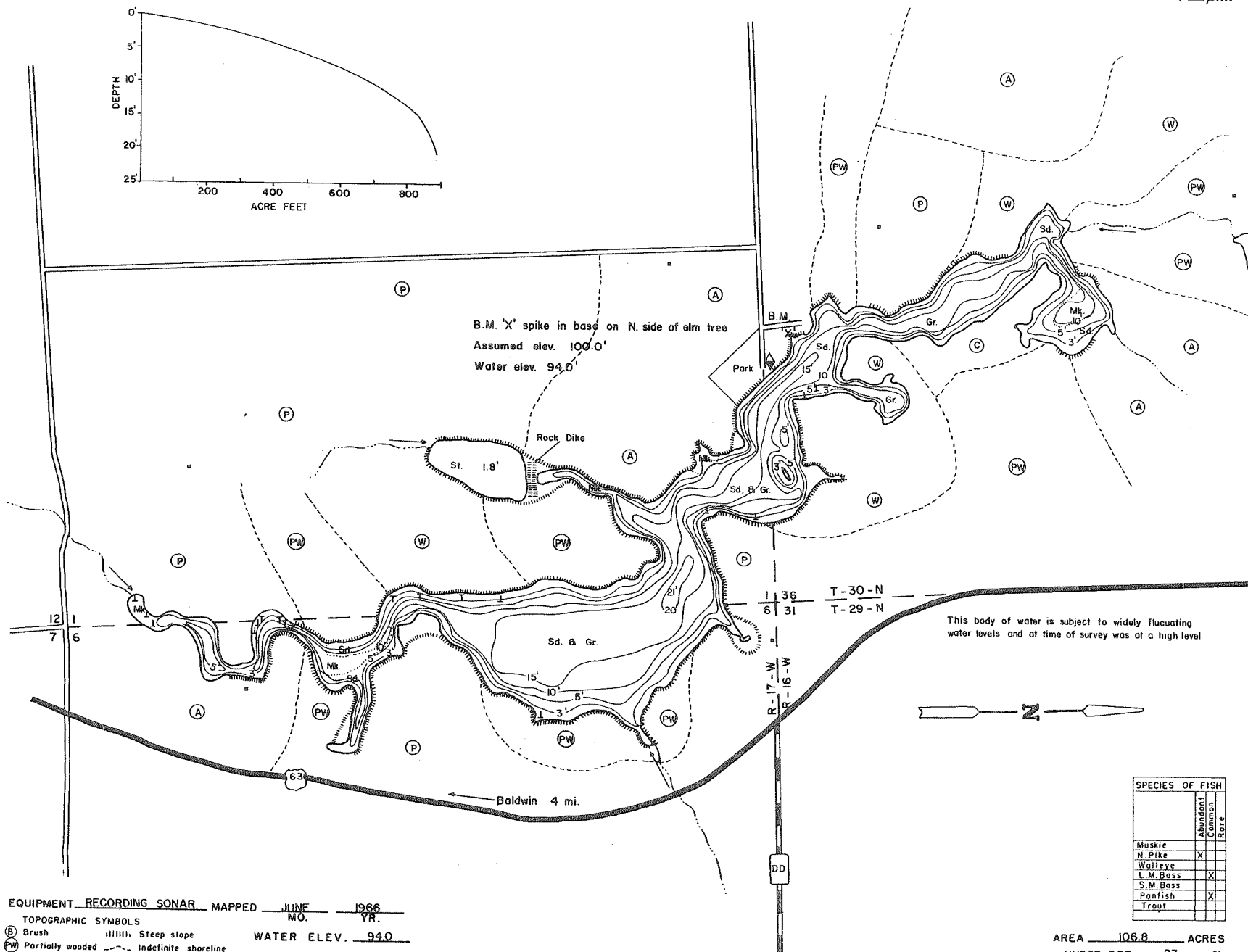
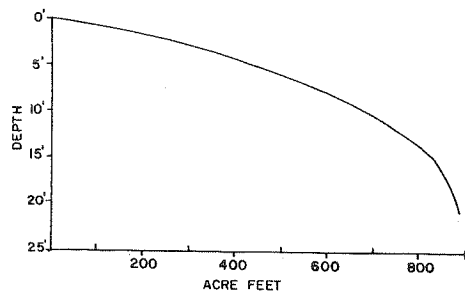
◇ Access ◇ Access with Parking ◇ Boat Livery
Field work by: R Chan Drawn by: C Holt

| SPECIES OF FISH | |
|-----------------|--------------------|
| | Abundant Common |
| Muskie | |
| N Pike | X |
| Walleye | |
| L. M. Bass | X |
| S. M. Bass | |
| Panfish | X |
| Trot | |

AREA 106.8 ACRES
UNDER 3FT. 23 %
OVER 20FT. 11 %
VOLUME 882.9 ACRE FT.
TOTAL ALK. 36 P.P.M.
SHORELINE 5.7 MILES
MAX. DEPTH 21 FEET

PINE LAKE

Judy Hertig



EQUIPMENT RECORDING SONAR MAPPED JUNE 1966
MO. YR.

TOPOGRAPHIC SYMBOLS

- (B) Brush
(PW) Partially wooded
(W) Wooded
(C) Cleared
(P) Pastured
(A) Agricultural
B.M. Bench Mark
Dwelling
Resort
- Steep slope
Indefinite shoreline
Marsh
Spring
Intermittent stream
Permanent inlet
Permanent outlet
Dam

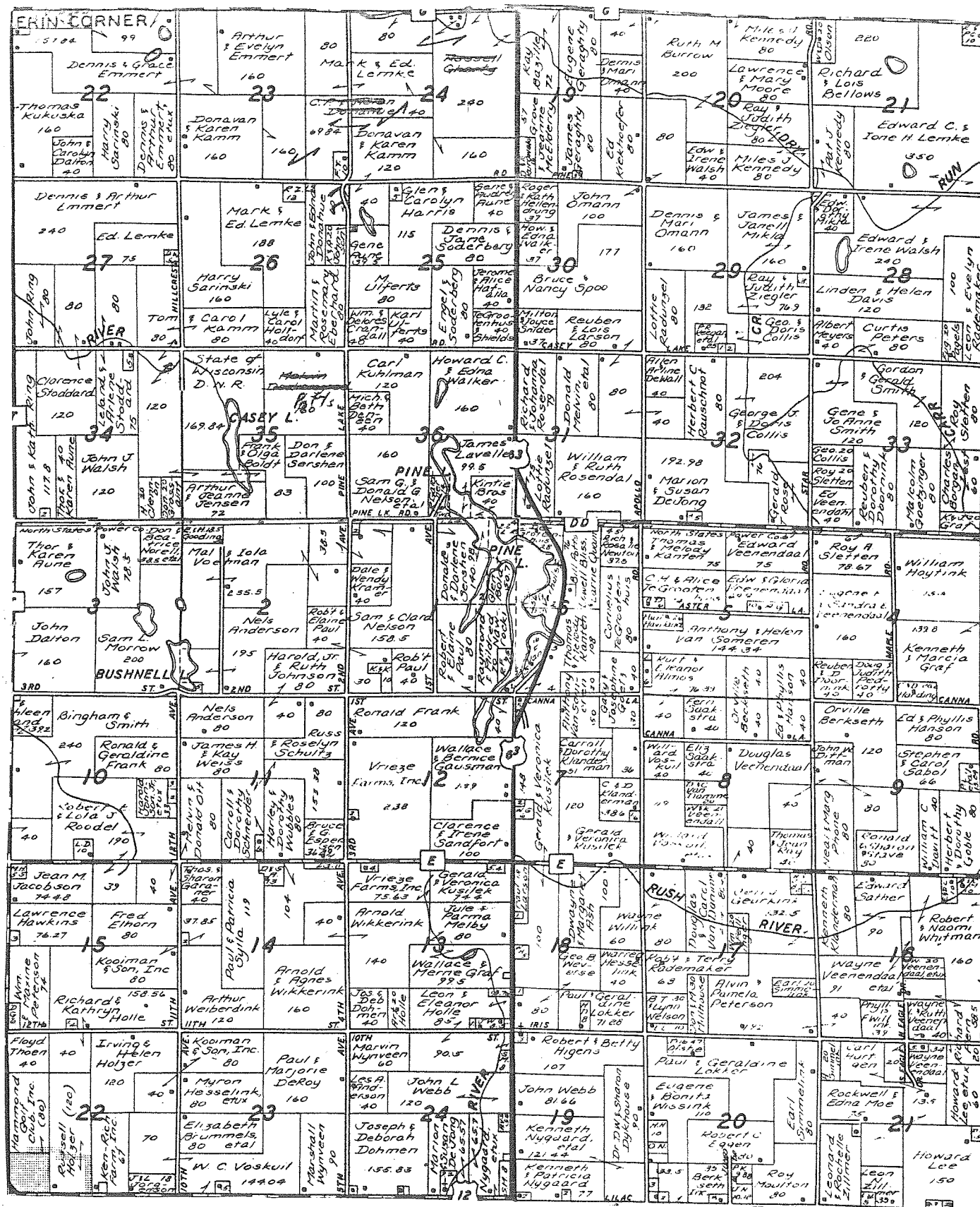
WATER ELEV. 94.0

LAKE BOTTOM SYMBOLS

- P. Peat Gr. Gravel Stumps & Snags
Mk. Muck R. Rubble
C. Clay Br. Bedrock
M. Marl T Submergent vegetation
Sd. Sand Emergent vegetation
St. Silt Floating vegetation

| SPECIES OF FISH | | | |
|-----------------|----------|--------|------|
| | Abundant | Common | Rare |
| Muskie | | | |
| N. Pike | X | | |
| Walleye | | | |
| L. M. Bass | X | | |
| S. M. Bass | | | |
| Panfish | X | | |
| Trout | | | |

AREA 106.8 ACRES
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VOLUME 882.9 ACRE FT.
TOTAL ALK. 36 P.P.M.
SHORELINE 5.7 MILES
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ABSTRACT

The water level of Pine Lake has extreme fluxuation. This may be due to its lake bottom which is limestone, consisting of several sinkholes, and/or to climatical data because the lake has no inlet or outlet in which a river or stream may influence the water level. Because the low water extreme of Pine Lake kills game fish and is esthetically unpleasing, people living around the lake, as well as other concerned citizens, would like to see something done to the lake, such as trying to fill the troublesome sinkholes or damming the northern end of the lake, keeping the sinkholes on the southern end of it. This dam must allow the watershed water of the southern end to drain into the northern part because the northern part has only a very small watershed of its own. However, it is questioned whether these proposals will help retain a desirable average lake level, and whether the cost of it all is worth it.

Pine Lake is a water table fed lake setting upon Prairie du Chien limestone bedrock. A well drilling near the lake, on Glen Boldt's land, indicated a static water level at 100 feet, a clay hardpan at 135 feet, and limestone at 167 feet.⁹ It is also known that sandstone can be found in several locations. Because of the poor cooperation I received from such well drillers as Thor Aune and Bill Wishard, I was not able to gather information on the underlying geology of the lake. There just may be a possible fault somewhere. The lake has 3 watersheds located in the eastern end, and a small one on the south-western and northern ends; together they make up an approximate drainage area of 3000 acres. Water also reaches the lake through 3 small springs located on somewhat high land on the northwestern shoreline. The water from at least one spring is stored by a farmer to use for drinking water for his cattle. The seepage of these springs is very minute, but, all in all, pertinent, to Pine Lake's water level. The acreage of the lake varies. In 1958 it was approximately 66 acres, in 1965 it was approximately 124 acres, and in 1973 it was approximately 116 acres.

Pine Lake is known for its extremely fluxuating water level. It has been said to go completely dry in 1919⁷, 1936⁶, and 1959^{6&7}. Orval Lokker's father lived on the lake in 1919, thus passing the information on to his son. In February of 1939 it was said that the ice cracked into a bowl shape and one could hear the water drain into a large sinkhole. And in July of 1959 the lake was dry all summer, allowing the sinkholes to be filled. High water is especially remembered during the late spring of 1965 due to a blizzard in March which left approxi-

mately 10-15 feet high snow banks. Water is usually high in the springs, and at one time led a waterway into a road ditch in which the fish swam. Here quantities of fish were killed, so metal wires were put up, keeping the fish from entering this road ditch.

The summer of 1959 was very important to Pine Lake's history because it allowed work to be done to the lake's sinkholes located on both the northern and southern ends of the lake. The largest sinkhole, on the northern end, was said to be 100-150 feet across and 51-75 feet deep with a shape like that of two funnels being placed neck to neck on top of one another. With the help of the SCS of Baldwin, the Rod and Gun club, the St. Croix highway department, and the farmers, whose funds paid to haul away their field rock from their fields helped pay for the project, the work was underway. In a successful attempt to plug the neck of the sinkhole, a large boulder, about 8 feet in diameter, was dumped into the hole along with field rock. Concrete was then poured into the hole with a final top cealer of bentonite over that. all in all, the hole must of been filled 1/3 to 1/2 full. Thereafter, the main body of the lake was never lost. However, the southern sinkhole did not work out as well. For it plus a few additional sinkholes are still a problem. These have been partially filled with fieldrock, plastic, and then soil twice since 1959, there is also a slight possibility that the main hole has also been dynimited. During low water one can notice the plastic all shreaded up into pieces.

It is unfortunate to the fish and the fishermen that the

water level problem was not solved during the summer of 1959. Before the big dry up of 1959, Pine Lake was known to be an excellent walleye lake which also contained some Northern Pike and pearch along with a few bullhead. After the water level was allowed to recover a few years after '59 it was discovered that the bullhead had taked over the lake's fish population. Therefore, the lake was poisoned out. Dead bullheads with only a few northern and pearch were floating belly-up everywhere. This allowed the lake to be freshly restocked with 50 pair of sunfish. This occured somewhere between 1962 and 1966. Later, fishing was so good that people came all the way from Illinois to fish the wonderfully large and plentiful sunfish of Pine Lake. However, low water occured during a winter of the early 1970's, leaving a very small amount of sxygen for the high population of fish. Luckily to a quick discovery of this, the majority of the fish were saved after pumping oxygen into the lake with four pumps for three days and nights. But, as all good stories must come to a close, Pine Lake is now a major bullhead lake once more. The water of the lake is not at a constant enough high to allow the survival of any game fish.

In order to try and save the northern end of the lake, a dam was proposed to be buildt north of the southern sinkholes. This would have a flat, concrete chute which would allow the runoff entering the southern end of the lake to drain into the northern end once a specific level was reached. Then, it is suspected that the water level will only go down on the southern part of the dam because the sinkholes only exist there, leaving

the northern part open for recreation. Yet there are people who feel that the northern end may still go down from such things as evaporation and transpiration. The ACS recieved a permit for the dam from the DNR in 1976 with a restriction on it stating that no lake bottom could be used in the structure. Together, the DNR and the SCS placed a 3-4 acre park on the shore of the northern part of the lake to provide public access to the new forthcoming recreational lake. However, after the plans to the dam were all drawn up a lack of funds brought the project to a halt. Because there was no advertisement about the plans for Pine Lake's future, there were a very low amount of donations to aid the project along.

Another thought of some people was to try and fill the southern holes once more. There is not much hope with this, however, because they broken so many times already.

Questions now arise to the proposals to try and repair Pines Lake's water problem. Will the dam actually assure the northern part of the lake a higher, less fluxuable water level? Is the cost of the dam worth the effort? What really are the causes of the extremely low water level Pine Lake has been experiencing so often? To answer these problems one must look at the water budget of the lake.

WATER ACCOUNTING

The water budget which I put together came from a model located in the Hydrology Engineering Handbook, section 4 which was given to me for reference from the Soil Conservation Service of Baldwin.

Having to choose from the precipitation data of either the Marshfield Experimental Farm or the River Falls Straton/Moshure file, River Falls data was chosen because its climate is more closely related to the Pine Lake area than that of Marshfield. Because the lake had supposedly gone dry in 1919, 1939, and 1959, I supplied data from 1918 to the most recent available information (1975).

Evaporation data in the Straton/Moshure file was few and far inbetween. Thus, I gathered an average evaporation rate from another SCS engineering handbook titled Mean Monthly Evaporation from Shallow Lakes and Reservoirs. Its information being updated in comparison to that of Marshfield's.

Transpiration was given a constant amount of 20 inches per year. This was given to me by Samm Huffman and Rodger Swanson. While talking to the SCS personnel in Baldwin, we calculated a monthly rate of 2 inches for evaporation plus transpiration water loss during the winter season. Thus explains the way in which I got my monthly values for transpiration. All the other months were assumed to be equal in transpiration.

The average water holding capacity of the soils in the Pine Lake drainage area was calculated by the average of the average of the values given in the Soil Survey of St. Croix County.

I calculated this water holding capacity to a depth of 2.0 feet, which is considered to be the zone of intensive root growth.⁴ Thus, the runoff was any precipitation that could not be absorbed by the soil or that was not evapotranspired.

Not included in this runoff chart, but important to the water budget of the lake are two facts. There is 1.15 inches of precipitation which falls directly into the lake acreage. And there is a small spring located on the northern portion of Pine Lake. This spring is considered quite small, but it does add to the overall lake level.

After going through all my calculations and concluding with the given water accounting data, I discovered how unrealistic this chart is. I am more than certain that over 0.41 inches runs off from the drainage area into the lake. There are many factors which influence surface runoff.

Be it rain or snow, precipitation is a major influence to surface runoff. Rain runoff depends on such things as the amount of rainfall, the intensity of rainfall, and the duration of the rainfall. For example, an intense rainfall will have more runoff than a light drizzle, which is easily absorbed by the soil. My runoff chart assumes that all the rainfalls are light; all the precipitation that can possibly be held by the soil will be soaked into it. And snowfall runoff depends on the amount of snow and the type of snowmelt: is it gradual throughout the end of winter or is it a quick melt leading directly into spring. Only parts of this were taken into consideration on my chart.

The moisture condition of the soil has to do a lot with the surface runoff rate. Are the soils mainly in a dry condition,

in average moisture condition, or saturated condition? The way in which I decided this is discussed as a footnote on the water accounting chart.

There are four basic hydrolic soil groups in which a soil may be classified. These hydrolic groups explain the infiltration and transmission rates of the soil.⁵ They are:

- " A. (Low runoff potential). Soils having high infiltration rates even when thoroughly wetted.. These consist chiefly of deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission in that water readily passes through them.
- B. Soils having moderate infiltration rates when thoroughly wetted. These consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
- C. Soils having slow infiltration rates when thoroughly wetted. These consist chiefly of soils with a layer that impedes downward movement of water or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.
- D. (High runoff potential). Soils having very slow infiltration rates when thoroughly wetted. These consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission."

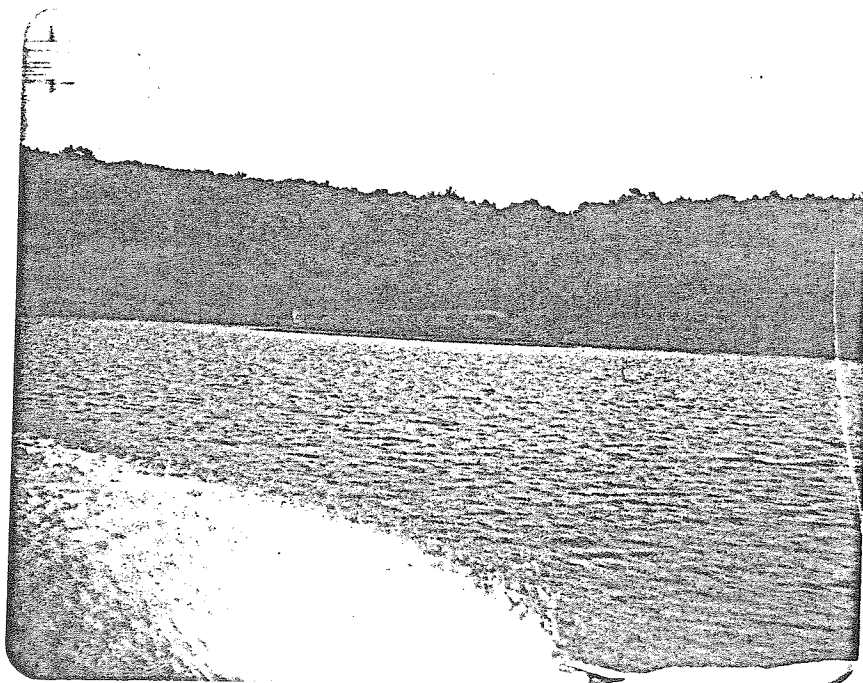
In addition to these soil groups, the hydrolic conditions such as the moisture content at the time of the storm, the organic matter content of the soil, the temperature, and the state of the soil, whether it be frozen or not frozen, influence runoff.

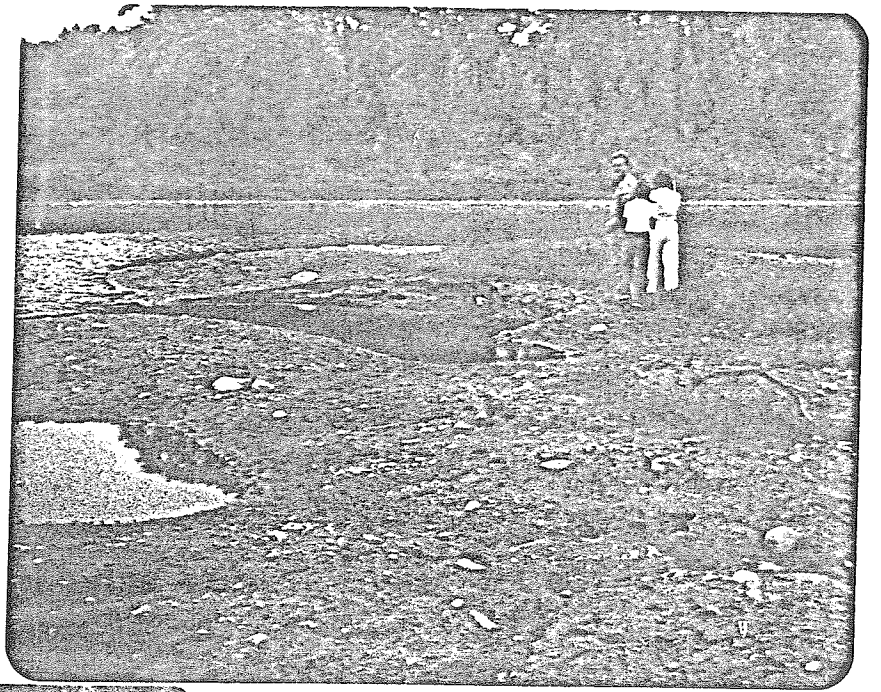
Obviously, vegetation plays its part in surface runoff, too. Plants can increase the chance of evaporation by the precipitation retained on the vegetation. And plant transpiration makes voids in the soil to be filled and also uses a deeper water supply during dry times by capillary action.

Finally, topography greatly effects the rate of runoff by the steepness of its slopes.

So, I conclude that my water accounting method for runoff is only a crude model which leaves many factors untouched.

Additionally, there were a few guesstimated values when considering the water budget of Pine Lake by Samm Huffman. These were that the annual runoff is approximately 21 inches and that 9 inches is the approximate yearly infiltration rate of precipitation. Taking this into mind, the lake level has been calculated to go down 34.25 inches per year, not including the water added to the lake from its small spring. The water level of the lake does go down drastically as indicated in the following pictures. Keep in mind that these were taken in July, and do not show the extreme low that the lake reaches.





| <u>Name</u> | <u>Symbol</u> | <u>Acres</u> | <u>Hydrogroup</u> |
|-----------------------------------|------------------|--------------|-------------------|
| Adolf silt loam | AdA | 134 | D |
| Amery sandy loam | AmB ₂ | 21 | B |
| Amery loam | AmB | 27 | B |
| Amery loam | AmC ₂ | 98 | B |
| Amery loam | AmD ₂ | 36 | B |
| Amery loam | AmE ₂ | 23 | B |
| Antigo silt loam | AoB | 2 | B |
| Auburndale silt loam | AuA | 43 | D |
| Brill silt loam | BpA | 6 | B |
| Clyde silt loam | CyA | 78 | D |
| Floyd silt loam | FdA | 15 | C |
| Fluvaquents | Fe | 19 | C |
| Freeon slit loam | FnB | 732 | B |
| Freeon silt loam heavy substratum | FoB | 448 | B |
| Freeon silt loam heavy substratum | FoC ₂ | 11 | B |
| Halder silt loam | HaA | 22 | C |
| Jewett silt loam heavy substratum | JsB | 102 | B |
| Lawler silt loam | LcA | 7 | C |
| Magnor silt loam | MaB | 320 | C |
| Orion silt loam | OrA | 11 | C |
| Renova silt loam | ReB | 11 | B |
| Rib silt loam | RhA | 49 | D |
| Santiago silt loam | SaB | 178 | B |
| Santiago silt loam | SaC ₂ | 78 | B |
| Santiago-Anigo complex | ScC ₂ | 33 | B |
| Santiago-Anigo complex | ScD ₂ | 7 | B |

| <u>Name</u> | <u>Symbol</u> | <u>Acreage</u> | <u>Hydrogroup</u> |
|----------------------|------------------|----------------|-------------------|
| Saprista and Asvents | Se | 15 | D |
| Sattre loam | ShC ₂ | 11 | B |
| Sattre silt loam | SlB | 33 | B |
| Seelville muck | Sm | 31 | D |
| Skyberg silt loam | SrA | 186 | C |
| Vlasaty silt loam | VaB | 90 | B |
| Vlasaty silt loam | VaC ₂ | 7 | B |

| <u>Symbol</u> | <u>Slone(%)</u> | <u>Available Water Holding Capacity(in./2ft.)*</u> |
|------------------|-----------------|--|
| AdA | 0-3 | 4.8 |
| AdD ₂ | 12-25 | 3.6 |
| AmB | 2-6 | 3.6 |
| AmC ₂ | 6-12 | 3.6 |
| AmD ₂ | 12-25 | 3.6 |
| AmE ₂ | 20-30 | 3.6 |
| AoB | 2-6 | 4.08 |
| AuA | 0-3 | 5.28 |
| BpA | 0-3 | 5.04 |
| CyA | 0-3 | 5.04 |
| FdA | 0-3 | 5.04 |
| Fe | 0-2 | too variable |
| FnB | 2-6 | 4.8 |
| FoB | 2-6 | 4.8 |
| FoC ₂ | 6-12 | 4.8 |
| HaA | 0-3 | 4.8 |
| JsB | 2-6 | 4.08 |
| LcA | 0-3 | 4.56 |
| MaB | 1-6 | 4.8 |
| OrA | 0-3 | 5.04 |
| ReB | 2-6 | 5.04 |
| RhA | 0-3 | 4.8 |
| SaB | 2-6 | 4.8 |
| SaC _c | 6-12 | 4.8 |
| ScC ₂ | 6-12 | 4.8 |
| ScD ₂ | 12-25 | 4.8 |

* Assumed depth of intensive root zone.

| <u>Symbol</u> | <u>Clone(%)</u> | <u>Available Water Holding Capacity(in./2ft.)*</u> |
|------------------|-----------------|--|
| Se | 0-2 | too variable |
| ShC ₂ | 6-12 | 4.56 |
| SlB | 2-6 | 4.56 |
| Sm | 0-2 | 0.72 |
| SrA | 0-3 | 5.04 |
| VaB | 2-6 | 4.56 |
| VaC ₂ | 6-12 | 4.56 |

* Assumed depth of intensive root zone.

Annual Average Temperature of River Falls; WI(F°)¹

| <u>Year</u> | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sep</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Average</u> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|----------------|
| 1941 | -- | -- | 36.0 | 40.8 | 58.0 | 62.2 | -- | 67.4 | 51.8 | 48.6 | 36.1 | 26.2 | -- |
| 1942 | 21.4 | 19.0 | -- | -- | 53.4 | -- | 68.5 | 64.0 | -- | 43.3 | 27.0 | 8.0 | -- |
| 1943 | 5.5 | 13.7 | 29.4 | 37.6 | 54.4 | 65.6 | 65.4 | 65.5 | 62.1 | 53.7 | 36.0 | 21.9 | 42.6 |
| 1944 | | | | | | | | | | | | | |
| 1945 | | | | | | | | | | | | | |
| 1946 | | | | | | | | | | | | | |
| 1947 | | | | | | | | | | | | | |
| 1948 | | | | | | | | | | | | | |
| 1949 | | | | | | | | | | | | | |
| 1950 | | | | | | | | | | | | | |
| 1951 | 22.3 | 28.1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1952 | | 17.3 | -- | 43.5 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1953 | -- | -- | -- | 43.6 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1954 | -- | -- | -- | 43.0 | -- | -- | -- | -- | -- | -- | -- | 11.2 | -- |
| 1955 | 7.2 | 21.4 | -- | -- | -- | 62.5 | 77.0 | 67.9 | -- | 47.2 | 27.2 | 16.0 | -- |

information not available

| <u>Year</u> | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sep</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Average</u> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|----------------|
| 1935 | 0.8 | -4.0 | 28.5 | 38.2 | 62.1 | 65.7 | 79.2 | 73.9 | 64.1 | 43.7 | 28.6 | 19.9 | 41.7 |
| 1937 | 3.6 | 10.2 | 24.7 | 42.8 | 58.6 | 64.8 | 74.0 | 75.0 | 62.0 | 45.8 | 30.5 | 16.0 | 42.3 |
| 1938 | 11.8 | 21.2 | 37.5 | 46.2 | 56.1 | 66.6 | 71.8 | 72.4 | 60.9 | 54.1 | 32.0 | 18.6 | 45.7 |
| 1939 | 20.0 | 11.4 | 28.4 | 42.8 | 63.0 | 67.4 | 72.5 | 69.4 | 63.0 | 47.8 | 36.0 | 27.2 | 45.7 |
| 1940 | 5.2 | 18.0 | 21.8 | 43.1 | 54.4 | 65.8 | 72.8 | 67.6 | 63.8 | 52.0 | 28.1 | 20.9 | 42.8 |
| 1941 | 16.8 | 14.5 | 25.4 | 52.0 | 62.3 | 67.3 | 72.4 | 70.9 | 62.6 | 50.1 | 36.2 | 26.4 | 46.4 |
| 1942 | 19.0 | 19.7 | 35.6 | 51.5 | 55.2 | 65.8 | 69.4 | 69.0 | 57.0 | 48.3 | 32.8 | 14.9 | 44.8 |
| 1943 | 7.6 | 16.6 | -- | 43.5 | 54.4 | 68.6 | 72.2 | 70.2 | 56.6 | 47.4 | 28.2 | 23.9 | -- |
| 1944 | 25.6 | 20.5 | 26.2 | 41.4 | 61.3 | 68.4 | 68.8 | 71.6 | 60.9 | 50.0 | 38.6 | 20.0 | 46.1 |
| 1945 | 11.4 | 17.6 | 38.8 | 44.2 | 52.0 | 60.2 | 67.9 | 68.5 | 59.0 | 47.2 | 31.8 | 13.8 | 42.7 |
| 1946 | 15.9 | 17.0 | 41.8 | 48.9 | 54.5 | 68.2 | 71.4 | 66.7 | 59.2 | 51.5 | 33.1 | 20.8 | 45.7 |
| 1947 | 20.4 | 14.4 | 28.0 | 41.0 | 51.6 | 62.3 | 70.0 | 76.2 | 61.6 | 57.9 | 26.0 | 16.4 | 43.8 |
| 1948 | 7.4 | 14.4 | 25.6 | 49.0 | 55.8 | 65.0 | 72.7 | 70.3 | 65.2 | 49.1 | 34.8 | 18.1 | 43.9 |
| 1949 | 14.9 | 13.7 | 29.5 | 45.4 | 60.6 | 70.1 | 75.0 | 71.7 | 56.2 | 51.7 | 35.4 | 19.6 | 45.3 |
| 1950 | 7.6 | 13.0 | 21.7 | 36.2 | 54.2 | 63.7 | 66.8 | 63.5 | -- | 52.0 | 27.1 | 10.9 | -- |
| 1951 | 7.7 | 16.1 | 20.5 | 40.9 | 59.8 | 62.4 | 68.4 | 65.7 | 56.3 | 48.6 | 24.9 | 16.2 | 40.6 |
| 1952 | 13.3 | 21.7 | 24.7 | 47.9 | 56.6 | 67.5 | 70.6 | 67.1 | 61.4 | 42.3 | 34.2 | 22.1 | 44.1 |
| 1953 | 16.7 | 16.8 | 29.8 | 39.9 | 57.2 | 68.3 | 69.3 | 70.7 | 60.1 | 55.6 | 37.4 | 21.2 | 45.2 |
| 1954 | 10.7 | 30.9 | 27.1 | 45.2 | 51.8 | 69.0 | 71.6 | 67.9 | 59.0 | 46.4 | 36.9 | 22.4 | 44.9 |

| <u>Year</u> | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sep</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Average</u> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|----------------|
| 1955 | 12.2 | 13.0 | 25.4 | 52.3 | 61.4 | 67.3 | 76.7 | 73.8 | 61.2 | 49.9 | 26.9 | 12.8 | 44.4 |
| 1956 | 12.8 | 13.3 | 24.3 | 40.3 | 56.8 | 70.8 | 67.6 | 68.6 | 57.9 | 56.6 | 33.2 | 22.9 | 43.8 |
| 1957 | 9.1 | 19.9 | 30.0 | 45.6 | 56.5 | 66.2 | 74.4 | 68.9 | 58.1 | 46.7 | -- | 24.3 | -- |
| 1958 | 21.4 | 14.1 | 31.6 | 46.6 | 58.9 | 60.9 | 68.3 | 69.4 | 61.7 | 52.3 | 35.1 | 14.7 | 44.6 |
| 1959 | 9.3 | 15.5 | 31.9 | 46.1 | 60.5 | 68.8 | 71.3 | 73.3 | 61.6 | 43.5 | 25.2 | 29.0 | 44.7 |
| 1960 | 17.8 | 18.9 | 20.9 | 46.4 | 57.4 | 63.9 | 71.0 | 71.4 | 62.5 | 49.4 | 36.0 | 18.7 | 44.5 |
| 1961 | 14.9 | 20.0 | 34.1 | 40.0 | 55.6 | 67.4 | 70.5 | 71.3 | 60.4 | 51.1 | 34.0 | 17.5 | 45.1 |
| 1962 | 9.2 | 14.8 | 27.1 | 43.9 | 62.4 | 66.4 | 68.6 | 69.2 | 57.5 | 51.8 | 36.8 | 20.4 | 44.0 |
| 1963 | 4.4 | 14.1 | 34.9 | 48.5 | 56.6 | 70.5 | 73.3 | 68.9 | 62.7 | 59.1 | 39.4 | 10.2 | 45.2 |
| 1964 | 20.5 | 24.5 | 28.0 | 48.0 | 62.4 | 68.4 | 75.6 | 68.7 | 59.5 | 49.0 | 36.0 | 14.4 | 46.3 |
| 1965 | 10.0 | 11.8 | 19.5 | 42.7 | 60.9 | 67.0 | 70.1 | 68.1 | 54.2 | 50.7 | 33.4 | 27.8 | 43.0 |
| 1966 | 3.1 | 15.7 | 35.6 | 42.2 | 53.8 | 67.9 | 75.0 | 67.5 | 59.7 | 48.1 | 31.4 | 19.5 | 43.3 |
| 1967 | 16.0 | 10.3 | 31.0 | 45.7 | 52.5 | 66.9 | 69.2 | 66.5 | 60.0 | 47.7 | 31.4 | 22.2 | 43.3 |
| 1968 | 13.9 | 14.6 | 39.2 | 49.9 | 54.3 | 67.1 | 70.4 | 70.0 | 60.0 | 51.3 | 34.3 | 17.6 | 45.2 |
| 1969 | 9.6 | 20.5 | 24.3 | 48.7 | 60.0 | -- | 71.1 | 72.3 | -- | 46.1 | 32.8 | 20.5 | -- |
| 1970 | 5.8 | 15.9 | 25.1 | 45.4 | 59.3 | 69.1 | 73.5 | 70.0 | 59.6 | 49.4 | 31.8 | 18.2 | 43.6 |
| 1971 | 6.4 | 16.8 | 26.9 | 46.5 | 54.7 | 71.0 | 67.6 | 67.4 | 61.5 | 54.0 | 33.3 | 19.1 | 43.8 |
| 1972 | 6.7 | 11.5 | -- | 41.8 | 61.7 | 65.5 | 68.9 | 68.9 | 60.6 | 45.0 | 32.7 | 12.9 | -- |
| 1973 | 16.8 | 21.1 | 39.9 | 44.6 | 54.4 | 68.7 | 71.6 | 71.7 | 59.3 | 54.8 | 34.8 | 17.5 | 46.3 |

| <u>Year</u> | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sep</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Average</u> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|----------------|
| 1974 | 13.5 | 16.4 | 30.4 | 47.0 | 54.9 | 64.4 | 75.6 | 67.2 | 56.4 | 50.2 | 34.4 | 25.0 | 44.6 |
| 1975 | 15.1 | 17.3 | 23.2 | 38.9 | 60.4 | 67.1 | 73.5 | 69.7 | 56.5 | 52.2 | 36.9 | 20.3 | 44.3 |

Annual Precipitation of River Falls, WI (inch)¹

| | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sep</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Annual</u> |
|------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 1900 | .92 | .81 | 1.71 | .88 | 5.52 | 5.31 | 3.78 | 9.26 | 2.59 | 3.49 | 3.12 | 1.93 | 37.93 |
| 1901 | .83 | 1.98 | 1.71 | 2.41 | 3.92 | 4.75 | 6.00 | 2.20 | 2.39 | 2.00 | 1.65 | .38 | 25.88 |
| 1902 | 1.62 | .61 | 3.37 | 2.37 | 3.68 | 9.51 | 2.19 | 1.96 | 2.03 | 2.50 | 1.43 | .75 | 29.23 |
| 1903 | .86 | .42 | 2.24 | 1.90 | 5.00 | 4.66 | 3.79 | 2.91 | 3.90 | .47 | 1.66 | .78 | 29.23 |
| 1904 | .92 | 3.87 | 2.00 | 2.91 | 4.06 | 5.52 | 2.11 | 2.20 | 2.00 | 1.22 | 4.14 | .16 | 33.07 |
| 1905 | 1.34 | .35 | 1.25 | 1.53 | 2.00 | 5.59 | 3.71 | 2.84 | 4.87 | 1.24 | .27 | .53 | 26.32 |
| 1906 | .92 | .65 | 1.83 | 3.83 | 1.79 | 5.38 | 2.77 | 3.59 | 4.72 | 1.87 | .56 | .98 | 28.89 |
| 1907 | .51 | .56 | .57 | 1.32 | 2.37 | 9.17 | 4.89 | .86 | 4.71 | 1.15 | .65 | .87 | 26.83 |
| 1908 | .65 | .68 | 1.23 | 1.33 | 6.48 | 4.42 | 4.16 | 3.31 | 5.65 | 2.06 | 1.66 | 1.33 | 32.98 |
| 1909 | .64 | .31 | 2.96 | 2.17 | 2.35 | 3.61 | 1.47 | 1.79 | 5.36 | 1.97 | 2.18 | 2.09 | 26.90 |
| 1910 | .33 | .82 | .62 | 3.32 | 2.64 | 4.25 | 5.45 | 6.86 | 2.72 | 3.41 | .31 | .62 | 31.55 |
| 1911 | 1.75 | .86 | 1.28 | 3.67 | 1.78 | 5.48 | 3.36 | 1.15 | 4.82 | 1.93 | .46 | .45 | 26.83 |
| 1912 | 1.21 | .98 | 1.52 | 1.11 | 3.04 | 5.58 | 1.79 | .97 | 2.77 | 2.74 | 1.67 | .32 | 24.02 |
| 1913 | .15 | .72 | 1.36 | 2.03 | 1.38 | 3.02 | .42 | 3.78 | 3.67 | 3.88 | 3.76 | .84 | 24.13 |
| 1914 | 1.76 | .93 | 1.12 | 3.88 | 2.37 | 2.81 | 2.56 | 2.99 | 1.22 | .94 | 2.58 | 1.99 | 24.27 |
| 1915 | 1.42 | 1.16 | 2.21 | 1.53 | 5.11 | 2.14 | 2.56 | 1.89 | 7.75 | 1.28 | .95 | .68 | 28.74 |
| 1916 | .99 | .23 | .84 | 2.82 | .62 | 2.96 | 2.59 | 1.58 | 6.46 | 3.63 | 1.98 | 1.76 | 26.38 |
| 1917 | 1.74 | .12 | 1.23 | 2.74 | 4.16 | 3.71 | 3.39 | 3.48 | 1.68 | 2.52 | 1.67 | .87 | 27.23 |

| <u>Year</u> | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sen</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Annual</u> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 1926 | .65 | 1.55 | 2.12 | 1.82 | 3.27 | 1.95 | .83 | 2.92 | .82 | .58 | .76 | 2.15 | 17.82 |
| 1927 | 1.44 | .82 | .67 | 2.31 | 4.29 | 2.66 | 2.61 | 3.94 | 3.18 | 1.71 | .99 | .93 | 25.25 |
| 1928 | .85 | .68 | 2.83 | 3.98 | 11.89 | 5.43 | 3.51 | 3.54 | 5.18 | 1.11 | 2.27 | .88 | 41.25 |
| 1929 | 1.56 | 1.88 | .88 | 2.14 | 3.10 | 5.34 | 3.64 | 6.46 | 3.64 | 2.52 | .17 | 1.42 | 32.85 |
| 1930 | .42 | 1.89 | 3.13 | 1.98 | 2.89 | 8.38 | 5.52 | 4.92 | .25 | 2.68 | 3.95 | 1.73 | 36.78 |
| 1931 | 1.88 | 1.15 | 1.77 | 1.26 | 4.14 | 3.61 | 3.82 | 3.48 | 3.85 | 4.97 | .91 | 1.31 | 38.47 |
| 1932 | .28 | .30 | 2.07 | 3.49 | 10.16 | 4.96 | 6.14 | 2.44 | 10.58 | 1.26 | .79 | 1.55 | 43.86 |
| 1933 | 1.52 | .54 | 1.32 | 1.97 | 5.76 | 4.48 | 3.74 | 2.88 | 2.11 | 1.18 | 1.15 | .88 | 26.65 |
| 1934 | .51 | .93 | 1.84 | 1.85 | 5.14 | 5.54 | 2.28 | 3.19 | 1.48 | .58 | 2.19 | .41 | 25.78 |
| 1935 | .67 | 1.46 | 3.87 | 4.89 | 2.88 | 6.27 | 4.93 | 3.43 | 1.93 | .48 | 1.45 | 1.28 | 31.86 |
| 1936 | 1.74 | 1.34 | 1.92 | .76 | 3.15 | 8.44 | 3.44 | .74 | 6.72 | 5.92 | 1.31 | .72 | 36.20 |
| 1937 | .98 | .27 | .85 | 4.89 | 2.64 | 5.46 | 1.32 | 3.18 | 4.35 | 1.85 | 2.25 | .74 | 27.18 |
| 1938 | .21 | 1.83 | .69 | 1.88 | 1.45 | 3.35 | 3.98 | 4.16 | 1.89 | .72 | 2.52 | .81 | 22.59 |
| 1939 | 1.43 | .16 | 3.92 | 1.56 | 2.89 | 4.68 | 10.84 | 1.25 | 2.68 | 2.05 | 5.78 | 1.39 | 37.75 |
| 1940 | 2.34 | .66 | 2.59 | 2.71 | 2.20 | 2.73 | 3.89 | 2.54 | 2.14 | 2.77 | .94 | 2.51 | 28.82 |
| 1941 | .72 | 1.56 | 2.92 | 3.30 | 3.33 | 9.21 | 5.42 | 3.89 | 4.97 | 1.81 | 2.31 | 1.46 | 39.38 |
| 1942 | 1.86 | .84 | 2.26 | 1.17 | 3.86 | 4.30 | 2.94 | 4.61 | .72 | .82 | 1.15 | .58 | 23.51 |
| 1943 | .65 | 1.27 | 1.38 | 2.50 | 3.17 | 6.63 | 4.92 | 3.68 | .78 | .05 | 1.79 | 1.33 | 28.15 |
| 1944 | .26 | .45 | 2.22 | 6.51 | 5.55 | 5.65 | 4.18 | 3.48 | 4.41 | 2.15 | .93 | .89 | 36.42 |
| 1945 | .83 | 1.-3 | .61 | 2.14 | 1.78 | 3.63 | 4.93 | 2.81 | .96 | 3.32 | 1.29 | 1.13 | 24.38 |

| <u>Year</u> | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sep</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Annual</u> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 1946 | .49 | .19 | 3.39 | .92 | 3.23 | 8.56 | 4.47 | 5.12 | .91 | 1.47 | 1.66 | .26 | 30.67 |
| 1947 | .54 | .78 | 1.24 | 1.56 | 4.23 | 8.92 | 7.17 | 6.83 | 1.96 | 1.66 | 3.15 | .58 | 36.66 |
| 1948 | .48 | .84 | .39 | 2.82 | 1.35 | 2.61 | 6.38 | 2.88 | 1.61 | 1.61 | 1.83 | .25 | 21.37 |
| 1949 | .13 | .48 | .64 | .93 | 4.30 | 3.89 | 3.97 | 6.49 | 4.00 | 3.77 | .68 | 1.49 | 30.67 |
| 1950 | .44 | .33 | .32 | 2.73 | 5.83 | 4.02 | 1.55 | 3.19 | 5.33 | .84 | 1.12 | .78 | 26.48 |
| 1951 | .12 | .85 | 2.59 | 1.88 | 5.15 | 2.86 | 3.29 | 2.71 | 4.86 | 3.08 | 1.57 | 1.07 | 29.15 |
| 1952 | .66 | 1.27 | 1.43 | 1.71 | 6.47 | 3.30 | 6.36 | 5.54 | 3.16 | 1.76 | .46 | .41 | 32.53 |
| 1953 | .54 | .61 | 1.30 | 2.26 | 4.14 | 2.47 | 2.84 | 2.27 | 3.71 | .63 | 1.13 | .75 | 21.85 |
| 1954 | .51 | .04 | 1.45 | 5.32 | 4.06 | 2.24 | 2.15 | 5.52 | 5.17 | 1.09 | 1.11 | 1.00 | 29.66 |
| 1955 | .78 | 1.48 | 2.86 | 3.45 | 5.38 | 9.45 | 4.99 | 2.90 | 5.67 | 1.86 | 2.07 | 1.91 | 42.00 |
| 1956 | .81 | .91 | 2.82 | 1.37 | 1.36 | 3.29 | 3.30 | 3.99 | 2.68 | 2.76 | 1.27 | .99 | 25.55 |
| 1957 | 2.92 | 1.49 | .44 | 4.70 | 1.14 | 6.63 | 3.05 | 1.25 | 1.16 | 2.18 | .19 | .27 | 24.52 |
| 1958 | .77 | .13 | 1.94 | 3.58 | 5.82 | 7.74 | 4.39 | 1.61 | 7.60 | 5.24 | .72 | 3.19 | 42.84 |
| 1959 | 1.84 | .25 | 1.11 | 1.07 | 2.40 | 4.17 | 3.20 | 1.25 | .93 | 3.52 | .98 | 1.99 | 22.64 |
| 1960 | .68 | .20 | 2.05 | 1.83 | 5.22 | 3.21 | 4.00 | 2.25 | 5.52 | 7.11 | 3.99 | .67 | 36.73 |
| 1961 | 1.24 | 1.20 | .91 | 1.83 | 3.94 | 4.71 | 4.30 | 2.43 | 4.15 | 4.46 | 2.68 | 1.06 | 32.91 |
| 1962 | .99 | .28 | 1.17 | 1.91 | 1.98 | 2.84 | 6.54 | 5.44 | 2.82 | 2.51 | 1.50 | 1.09 | 29.07 |
| 1963 | 1.27 | .95 | 1.84 | 2.60 | 6.14 | 2.67 | 3.20 | 5.17 | 3.36 | 1.74 | 1.72 | 1.53 | 32.19 |
| 1964 | .06 | .82 | 1.14 | 2.56 | 2.59 | 4.20 | 1.10 | 3.64 | .83 | 1.25 | .82 | .40 | 19.41 |
| 1965 | 1.74 | .65 | 1.22 | 4.45 | 4.98 | 8.37 | 1.14 | 8.98 | 1.82 | 1.19 | 4.01 | .20 | 38.67 |

Monthly Values For Precipitation and
Evaporation in Wisconsin 3

| Month | Ave. Precip. (Inches) | Ave. Evap. (Inches) | Net (Inches) |
|-----------|--------------------------|------------------------|-----------------|
| January | 0.98 | 0.3 | 0.63 |
| February | 0.83 | 0.3 | 0.53 |
| March | 1.68 | 0.7 | 0.98 |
| April | 2.41 | 1.5 | 0.91 |
| May | 3.88 | 2.3 | 1.58 |
| June | 4.92 | 3.6 | 1.32 |
| July | 3.69 | 5.0 | -1.31 |
| August | 3.41 | 5.1 | -1.69 |
| September | 3.42 | 4.0 | -0.58 |
| October | 2.09 | 2.6 | -0.51 |
| November | 1.68 | 1.5 | 0.18 |
| December | 1.04 | 0.5 | 0.54 |
| Annual | 29.87 | 27.4 | 2.47 |

Water Accounting Method for Runoff⁴

| (All units in inches) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Seasonal Runoff | Annual |
|-----------------------|------|------|------|------|------|------|------|------|------|------|------|------|--------------------|--------|
| Precipitation | 0.98 | 0.83 | 1.68 | 2.41 | 3.88 | 4.92 | 3.69 | 3.41 | 3.42 | 2.09 | 1.68 | 1.04 | | 29.87 |
| Initial Soil Moisture | 2.22 | 4.45 | 4.45 | 4.45 | 4.45 | 3.33 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | | 3.24 |
| Final Soil Moisture | 3.20 | 5.28 | 6.13 | 6.86 | 8.33 | 8.25 | 5.91 | 5.63 | 5.64 | 4.31 | 3.90 | 3.26 | | 33.11 |
| Transpiration | 1.70 | 1.70 | 1.30 | 0.50 | 2.13 | 2.13 | 2.13 | 2.13 | 2.13 | 2.13 | 0.50 | 1.50 | | 20.00 |
| Evaporation | 0.30 | 0.30 | 0.70 | 1.50 | 2.30 | 3.60 | 5.00 | 5.10 | 4.00 | 2.60 | 1.50 | 0.50 | | 27.40 |
| Final Avail. Moisture | 1.20 | 3.28 | 4.13 | 4.86 | 3.90 | 2.52 | 1.22 | 1.60 | 0.49 | 0.42 | 1.90 | 1.26 | | 19.32 |
| Initial Soil Moisture | 1.20 | 3.28 | 4.13 | 4.45 | 3.90 | 2.52 | 1.22 | 1.60 | 0.49 | 0.42 | 1.90 | 1.26 | | 18.91 |
| Runoff | 0.00 | 0.00 | 0.00 | 0.41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.41 | 0.41 |

Initial Soil Moisture is assumed to be at saturation during the snow thaw months (4.45 is the calculated average water holding capacity of the drainage area). Also, it is assumed to be at 50% its capacity during the other months except for the transition month of June.

Transpiration is assumed to be 20 inches per year.

Model of Assumed Given Values

| Item | value in inches |
|---|-----------------|
| runoff | 21.0 |
| infiltration | 9.0 |
| precipitation draining to lake | 12.0 |
| evaporation | 27.4 |
| transpiration | 20.0 |
| precipitation added di- rectly to lake | 1.15 |
| water loss from lake | 34.25 |

CONCLUSION

The fluctuating water level of Pine Lake seems to be associated to more than the fact that sinkholes exist on the lake-floor. During periods of warm temperature, low precipitation, and thus high evaporation, the water can go down tremendously for basically those reasons along with transpiration. Precipitation in 1919 was lower than that of the years around it, but its temperature was somewhat cooler. In 1939 precipitation was lower than that in 1938, 1940 and a few more following years. But it was higher than the years preceding 1938 all the way back to 1927. The temperature was at an average rate. Furthermore, in 1959 precipitation was on the average whereas the year preceding and following it lower in precipitation. Temperature stayed at an average rate. There is no real pattern to these values, and the level of the lake was not known for 1918 and 1938 but was known to be very low in 1958 (66 acres). If the lake was also at a low in 1918 and 1938, it is possible that the sinkhole caps were weakened; the sides of the lake were unable to retain part of the water pressure due to low water. All the water pressure then had to be concentrated on the lake bottom, causing the sediment caps to weaken. Then the following year these weakened caps would break through.

All in all, a lot of water is gained and lost each year with an overall result of low water. Whether this can only be associated to active sinkholes is questionable. However, one must consider the fine results which occurred after successfully filling the sinkhole on the northern end of the lake. The questions still

exist: Would a dam help save Pine Lake? Are the sinkholes on the southern part of the lake repairable without a threat of opening up new sinkholes?

FOOTNOTES

1. Straton/Moshure file
2. Soil Survey of St. Croix County, WI. 1978.
3. Mean monthly evaporation from Shallow Lakes and Reservoirs from a deleted section of SCS National Engineering Handbook, section 4. Precipitation from Straton/Moshure file.
4. Hydrology from a deleted section of SCS Engineering Handbook, section 4.
5. Engineering Field Manual, chapter 2.
6. Orval Olson.
7. Orval Lokker.
8. Glen Boldt and family.
9. Martell well drilling.

BIBLIOGRAPHY

Boldt, Glen and family. (landowner near Pine Lake)

Huffman, Sam.

Lokker, Orval. (landowner near Pine Lake)

Martell. (a cooperating well driller)

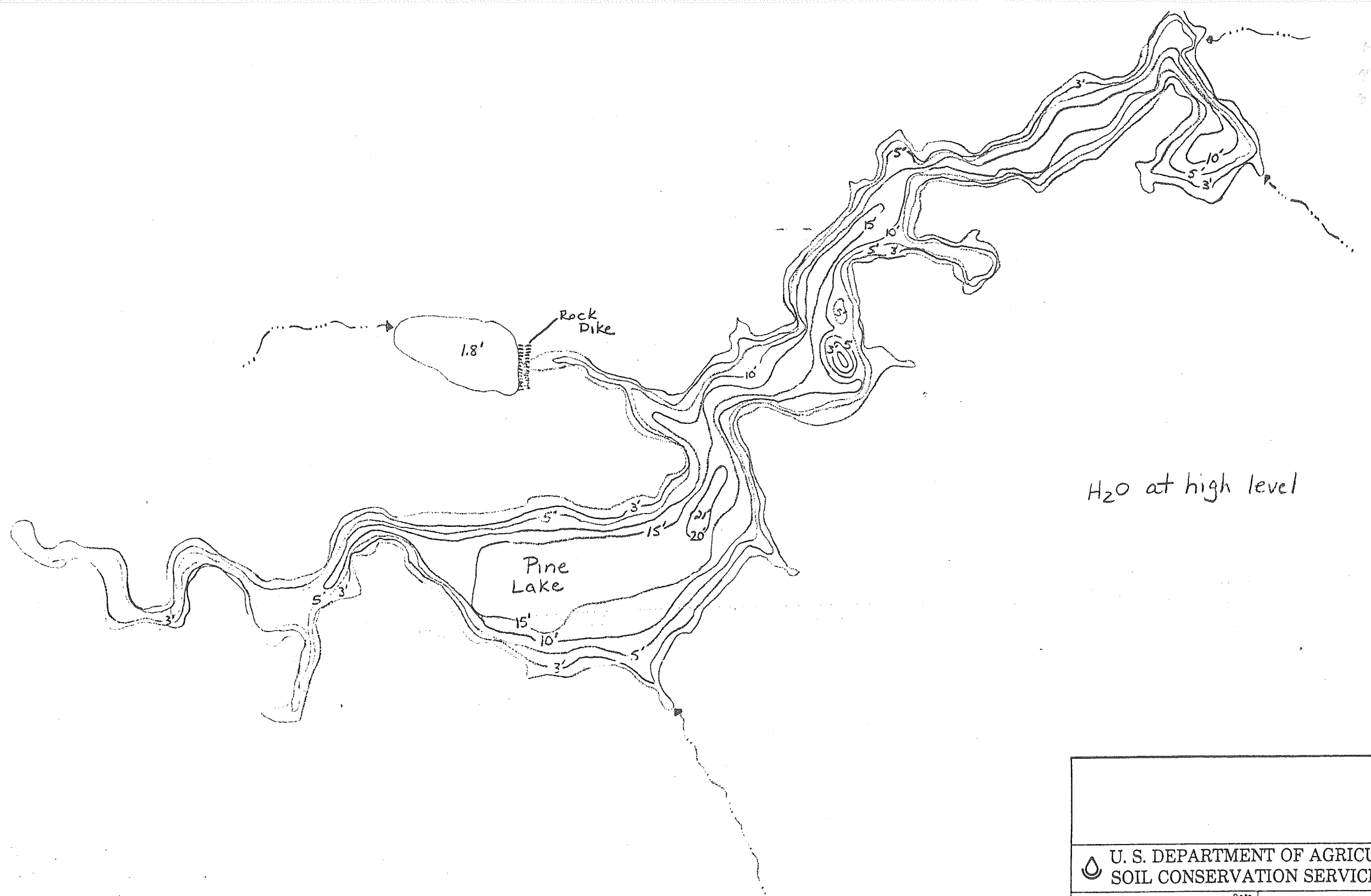
SCS personnel of Baldwin.

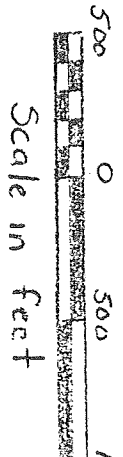
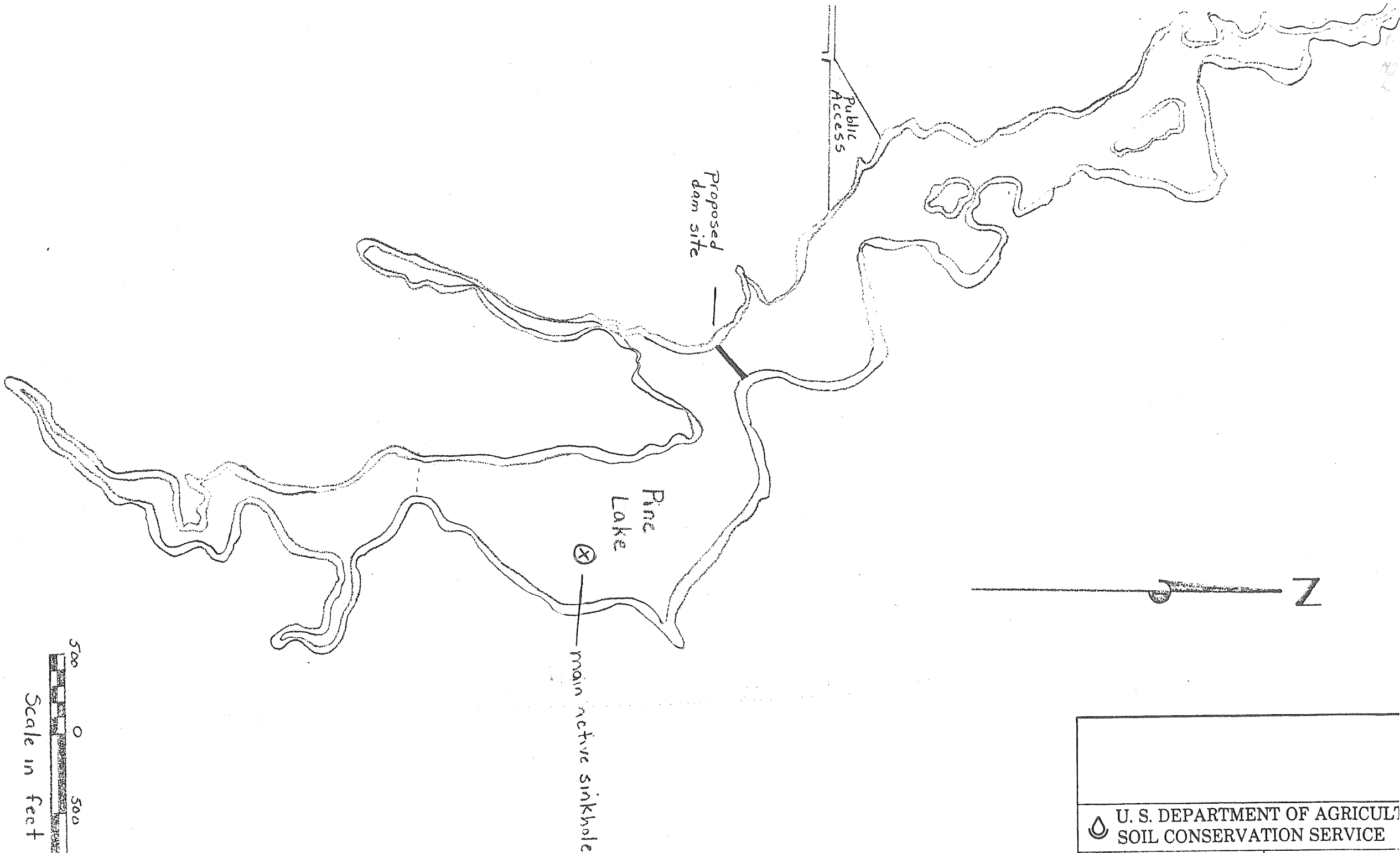
SCS Engineering Field Manual, chapter 2.


SCS Hydrology, section 4.

SCS Shallow Lakes and Reservoirs, section 4.

Straton/Moshure file. Archives MX10-10 River Falls.





| | |
|--|------------|
|  U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE | |
| Designed | Date |
| Approved by | |
| Title | |

Hawkins Site

Date: September 18, 1989
To: Helen Holm, Weston Corp.
From: Jack Eslien, Wisconsin DNR
Re: Hawkins Site - PRP

The following potential responsible parties list is generated from several hazardous waste files. The Rosen Metals plant is implicated as contributors to the hazardous waste load (battery cases) found in the Hawkins sink hole. Barrels, many of which had a portion of their top removed, were observed in the sink hold. Some industries have been linked to other hazardous waste sites in St. Croix County. These same industries may have sent some of there barrels to the Hawkins site. There is a need for closer scrutiny of the Hawkins barrels, inquiries into any shipping manifests and interview with Mrs. Hawkins, her sons and area residents, in order to determine potential hazard and were the barrels originally came from.

| Suspected Product | Company |
|-------------------------------------|---|
| paint sludge | Mr. Roland Sundbland United Refrigerator Company 1009 West Madison Chicago, IL 60607 |
| possibly solvents possibly PCB's | Randy Gullixson, transporter 1080 Florence St. Baldwin, WI 97150 684-4429 |
| lead | Rosen Metals (closed) Seymore Rosen co-owner and vice-president of Rosen Metals 1898 Highland Parkway Stillwater, MN 55116 (612) 698-7963 |
| | Isadore Rosen (deceased) co-owner and president of Rosen Metals |
| | Marty Rosen Isadore's son & co-owner of Phoenix Metals 880 Sibley Memorial Highway |

Mendota Hts., MN 55118
(612) 455-5865

Other potential responsible parties:

Jones Chemical of Hudson, WI may have used the Hawkins site as they are alleged to have dumped barrels of chemicals in the Hudson landfill which is currently being abandoned. Jones manufactured pool sanitizing products (chlorine bleaches) and they were a storage facility for many other chemicals.

Jones Chemical Co.
Mr. Larry Schongar, Corp. Dir. (716) 768-6281
for Environmental Affairs
80 Munson St.
LeRoy, N.Y. 14482

Jon Eaton past plant mgr. (715) 386-5655
820 5th (612) 774-9604 work
Hudson, WI

Anderson Window Co.
Bay Port, MN 55003

3M Company
McKnight Rd.
St. Paul, MN

Doug Van Sumerin
Volrath, IN

Well & Subsoil Information for Wells Installed
Near Hawkins Site

T29N, R17W:

Sec 10, NE SE

Carl Ballard

0-2' topsoil

2-50' clay & gravel

50-74' layers of rock & lime

74-140' lime rock

105' to water

1971

Sec 15

Albert Hines

0-47' topsoil

47-144' lime

120' to water

1960

Sec 16

Clifford Medes

0-60' clay

60-158' sand rock

115' to water

1959

Sec 16 SE

Walter Krizan

0-8' clay

8-103' loose sand rock

103-124' hard sand rock

74' to water

1971

Sec 16 N1/2, NE SE

Kenneth Peterson

0-113' clay

113-146' lime rock

103' to water

1987

Sec 16 SW SW

Halle Builders

0-10' clay

10-40' sand rock

40-105' lime

35' to water

1986

Sec 21 SW SW
Terry Hopkins
0-15' clay
15-155' lime
100' to water
1988

Sec 21 NW
Glen Sather
0-75' sand
75-155' lime rock
95' to water
1987

Sec 21
Roger Lindquist
0-4' topsoil
4-52' sand
52-108' lime rock
87' to water
1958

Sec 22 NE
E.J. Kooiman
0-91' sand & gravel
91-116' limestone
85' to water
1974

Sec 22
Mrs. John Brummels
0-102 current depth of old well
drilled deeper to 132' which was through lime rock
85' to water
1960

Sec 22
Floyd C. Thoen
0-53' brown clay
53-64' blue lime rock
64-75' gray lime
60' to water
1955

General Geology of Area About Hawkins Site

Topsoil, which is primarily outwash sand and windblown loess, is moderately permeable (0.2 to 0.8 inches per hour).

I reviewed our well logs for the general vicinity and spoke to some of the well owners when collecting water samples last month with the Weston crew. Thin drift contains small amounts of saturated sand and gravel locally in the valley. It appears there are numerous clay deposits which run from 0-15 ft. thick in section 21 to 0-113 ft. thick in section 16. These are probably depositional moraine deposits. I'm afraid we don't have complete nor very accurate well logs.

I would think the ground water flow would be to the WSW to SW direction from the Hawkins sink hole. The sink hole itself could be an old esker which channeled glacial waters and eventually caved in. The area is part of the Cary ground moraine, part of the River Falls formation, Woodville Member. Glacial drift is over sandstone and dolomite. Groundwater is considered to be 151- 200 mg/l total hardness (CaCO_3). Average depth to water is 89 ft. (derived from well log information).

Bedrock geology is of the Prairie du Chien group, is undifferentiated and includes Shakopee Dolomite, New Richmond Sandstone and Oneota Dolomite.

Names of Residents Whose Wells Were Sampled

| | |
|---|---|
| Kappers, Robert Rt. 1 Hammond, WI 54015 | (715) 796-8860 this is old Hawkins homestead, small S35 house on north side of Hawkins well |
| Sauerman, Jim Rt. 1 Hammond, WI 54015 | (715) 796-5296 this house is newer Hawkins residence & S35 and S39 is on south side of Hawkins well |
| Birr, Marvin Rt. 1 Hammond, WI 54015 S37 | (715) 796-2401 this house is the cedar-sided home & is located in the NE, NE of Sec. 16 |
| Peterson, Kenneth J. Rt. 1 Hammond, WI 54015 S36 | (715) 796-2644 this house is located slightly north of the Hawkins houses and across the road, NE, SE, NE of Sec. 16 |
| Torton Rt. 1 Hammond, WI 54015 S38 | no phone this house is located SW of the Hawkins homes, old farmhouse, NE, SW Sec 16 |

September 23, 1994

Mrs. Mary Hawkins
719 Sommers Pl. Rd.
North Hudson, WI 54016

SUBJECT: Remedial Status of Hawkins Battery Site

Dear Mrs. Hawkins:

My supervisor, Dave Lundberg, asked me to write you this letter advising you and any potential purchaser of the remedial action status on property you own in the SW1/4 of the NW1/4, Section 15, T29N, R17W, St. Croix County.

At one time, a sink hole on the property was illegally used as a waste disposal site for battery waste, paint containers, and refuse. In 1992 the U.S. Environmental Protection Agency (EPA), Region V, Emergency Removal Section inspected the site and removed barrels, battery waste, and other refuse from the sink hole.

Groundwater samples were collected from residences adjacent to the site. Laboratory results of those water samples indicate that the water is not contaminated from any inorganic or organic constituents.

However, the general geology of this site indicates that there is a potential for contaminants to enter the groundwater. Please refer to the enclosure entitled, General Geology of Area About Hawkins Site.

I can only confirm that to the best of our knowledge, the EPA removed all visible battery and other potentially hazardous waste from the sink hole. Due to the general nature of sink holes, they sometimes offer a more direct conduit to aquifers. Since there were no monitoring wells constructed on-site adjacent to the sink hole, I am unable to state with any assurance that groundwater in the immediate area of the sink hole has not been contaminated by wastes which were dumped at the site.

Please call me at (715) 839-3738 if there are any questions

concerning this matter.

Sincerely,

Jack Eslien
Environmental Repair Specialist

c: Dave Lundberg, WD Solid and Hazardous Waste Supervisor

Enclosure

General Geology of Area About Hawkins Site

Topsoil, which is primarily outwash sand and windblown loess, is moderately permeable (0.2 to 0.8 inches per hour).

Thin drift contains small amounts of saturated sand and gravel locally in the valley. It appears there are numerous clay deposits which run from 0-15 ft. thick in section 21 to 0-113 ft. thick in section 16. These are probably depositional moraine deposits. I'm afraid we don't have complete nor very accurate well logs.

I would think the ground water flow would be to the WSW to SW direction from the Hawkins sink hole. The sink hole itself could be an old esker which channeled glacial waters and eventually caved in. The area is part of the Cary ground moraine, part of the River Falls formation, Woodville Member. Glacial drift is over sandstone and dolomite. Groundwater is considered to be 151- 200 mg/l total hardness (CaCO_3). Average depth to water is 89 ft. (derived from local residential well log information).

Bedrock geology is of the Prairie du Chien group, is undifferentiated and includes Shakopee Dolomite, New Richmond Sandstone and Oneota Dolomite.

WISCONSIN INTERAGENCY KARST FEATURE REPORTING FORM 2000-1

This form is used to report the locations of "karst" features such as caves, sinkholes, enlarged fractures, disappearing streams or other surface drainage, and springs. Old/abandoned mine shafts are also included.

Please mail or FAX completed form to:

Karst Information File
WISCONSIN GEOLOGICAL & NATURAL HISTORY SURVEY
3817 MINERAL POINT RD
MADISON WI 53705-5100 fax: (608) 262-8086 phone: (608) 262-1705

WGNHS use only: 4-29-02
Form Received Date: 4/29/02
Database Entry Date: _____

↑ THESE THREE SECTIONS MUST BE COMPLETED ↓

County: St. Croix T. 29 N R. 17 E or W SW ¼ of NW ¼ of Sec. 15 Gov Lot: _____
Fire #/Street Address: _____
City/Town/Village: Hammond Zip Code: _____
Topographic Quad/Map Name: Hammond

Landscape Area (✓ all that apply)
☒ rural ☐ industrial
☐ urban ☐ highway
☐ other (describe)

Reporter Name (Last, First): ESLIE, JACK Reporter Phone: (715) 839-3738
Employer/Occupation: WDNR Hydrogeologist Reporter Email: esliej@dnr.state.wi.us
Field Observation Date: 1990 Reporting Date: 4/25/02
Property Owner Name: Mary K. Hawkins
Property Owner Address: 719 Sammers Pl. Rd. Owner Phone: (715) 386-9486
North Hudson, WI 54016

Feature Arrangement (✓ all that apply)
☐ isolated features
☐ cluster of features

total # of features = _____

Feature Type (✓ all that apply)
☒ sinkhole
☐ enlarged fracture
☐ cave
☐ spring
☐ mine
☐ other (describe)

Concern (✓ all that apply)
☐ soil loss/erosion
☐ water quality
☐ collapse/safety
☐ endangered species
☐ flooding
☐ other (describe)

Karst Classification* (enter one from list on back of this form): _____

Shape (✓ one)

☒ circular
☐ elongate
☐ linear
☐ other (describe)

Size (enter all that apply & circle unit)

length: _____ feet / meter
width: _____ feet / meter
depth: _____ feet / meter
diameter: ~130 feet / meter

Feature orientation (compass): _____

Is feature open? ☒ Y ☐ N

Is feature filled? ☐ Y ☒ N

fill material: _____

Evidence of surface drainage into feature? ☐ Y ☒ N

Feature may receive polluted drainage? ☒ Y ☐ N

Drainage Area Size in Acres (✓ one)

☐ < 1 ☒ 1 - 10 ☐ > 10

Nearby Land Use & Estimated Distance (✓ all that apply, then enter distance & measurement unit)

☐ high capacity well - municipal: _____ ☒ house: 500' ☐ landfill: _____
☐ high capacity well - agricultural: _____ ☒ building: 500' ☐ dam: _____
☐ high capacity well - industrial: _____ ☒ septic field: 500' ☒ farm field: within
☐ high capacity well - other: _____ ☐ quarry: _____ ☐ parking lot: _____
☐ gasoline service station: _____ ☐ gravel pit: _____ ☒ livestock pen: 500'
☐ animal waste lagoon: _____ ☒ potable well: 500' ☐ irrigation ditch: _____
☐ sanitary plant lagoon: _____ ☐ salt storage shed: _____ ☐ cemetery: _____
☐ storm water detention pond: _____ ☐ highway/street pavement: _____
☐ chemical storage: _____ ☐ other (describe): _____

WISCONSIN INTERAGENCY KARST FEATURE REPORTING FORM 2000-1

This form is used to report the locations of "karst" features such as caves, sinkholes, enlarged fractures, disappearing streams or other surface drainage, and springs. Old/abandoned mine shafts are also included.

Feature mapped as ... (✓ one) See attached map
☐ point ☐ line ☐ area

X-coordinate
(e.g., Long., Easting)

Y-coordinates
(e.g., Lat., Northing)

Referencing System: Terra Server
(e.g., WTM, Lat/Long, State Plane, UTM, county system)

Datum (or Spheroid for Lat/Long): _____
(e.g., datums = NAD91, NAD27; spheroids = WGS84, GRS80)

(see note* below)

* **Attach another sheet or a diskette with an ASCII file of coordinates or ArcView shapefile, if more than four x-y coordinates are collected for the karst feature(s) described on this form.**

Comments: sink hole A - In 1990, EPA removed most waste + barrels from this sink hole. Questions remain as to whether ground water was contaminated.
sink hole B - was in wooded area, was shallower (about 10' deep) + contained farm waste (old implements)

Feature Drawing: Plan view sketch should include: nearby landmarks (e.g., roads, fences, buildings), approximate scale, north arrow, cross-section (if appropriate). Attach photos or other reference maps as needed.

See attached photos

Sink hole A was about 30.-40' deep

Sink hole B was never examined close enough as to what may have been buried there.

There are a number of streams or dry runs which fill with water during an event + the water disappears into the stream bed + muddy water shows up in downgradient wells.

Karst Classification List:

Sinkhole: a topographic depression (unless filled) in which bedrock is dissolved or collapsed. Sinkholes may be open, covered, buried, or partially filled with soil, field stones, vegetation, weathered bedrock, water or other miscellaneous debris. Sinkholes are usually circular, funnel-shaped, or elongated. Sinkhole dimensions vary by region. Wisconsin sinkholes generally range between 20 to 30 feet in diameter and 4 to 10 feet deep, although some can be wider and/or deeper.

Enlarged Fracture: solution enlarged or widened bedrock fracture that usually narrows with depth.

Pavement: extensive bare areas of exposed bedrock surfaces with many enlarged fractures or sinkhole features.

Fracture Trace: linear feature, including stream segment, vegetative trend and soil tonal alignment.

Spring/Seep: intermittent or permanent seepage of water from ground surface or bedrock outcrop or karst area.

Cave: natural cavity, large enough to be entered, which is connected to subsurface passages in bedrock.

Karst Pond: closed depression in a karst area containing standing water.

Swallet: a place where surface or storm water drainage disappears underground.

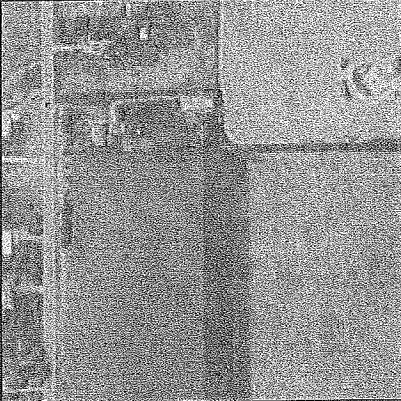
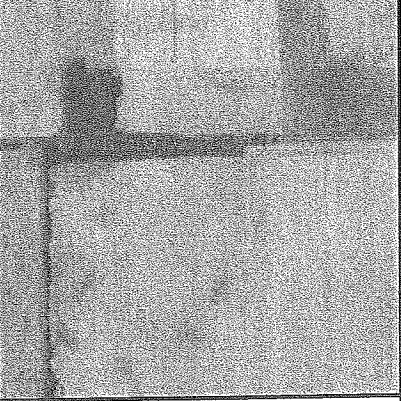
Karst Fen: marsh formed by plants overgrowing a karst lake or seepage area.

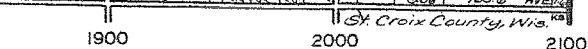
Mine Feature: a man-made shaft, tunnel, cave, hole, or other feature created for mining purposes.

The USGS DOQ below is projected in Universal Transverse Mercator (UTM) Zone 15 on the North American datum of 1983. The latitude and longitude in degrees, minutes, and seconds and the UTM coordinates in meters are shown for each image tile.

Loaded on 5/19/1999 7:19:14 AM from I:\usgstape132

\B.baldwin_west_Wl.ver_1.O4409205.NES Tape 132 Job doq-Tape132.

| 66 km E of Minneapolis, Minnesota, United States | | | |
|--|---|--|----------------------------|
| | 92W 26' 12" 544,400.0 | 92W 25' 54" 544,800.0 | 92W 25' 35" 545,200.0 |
| 45N 00' 03" 4,983,200.0 | | | 45N 00' 03" 4,983,200.0 |
| |  |  | |
| 44N 59' 50" 4,982,800.0 | | | 44N 59' 50" 4,982,800.0 |
| | 92W 26' 12" 544,400.0 | 92W 25' 54" 544,800.0 | 92W 25' 36" 545,200.0 |



HIGHWAY 12 EAST — BALDWIN

66 km E of Minneapolis, Minnesota, United States 07 May

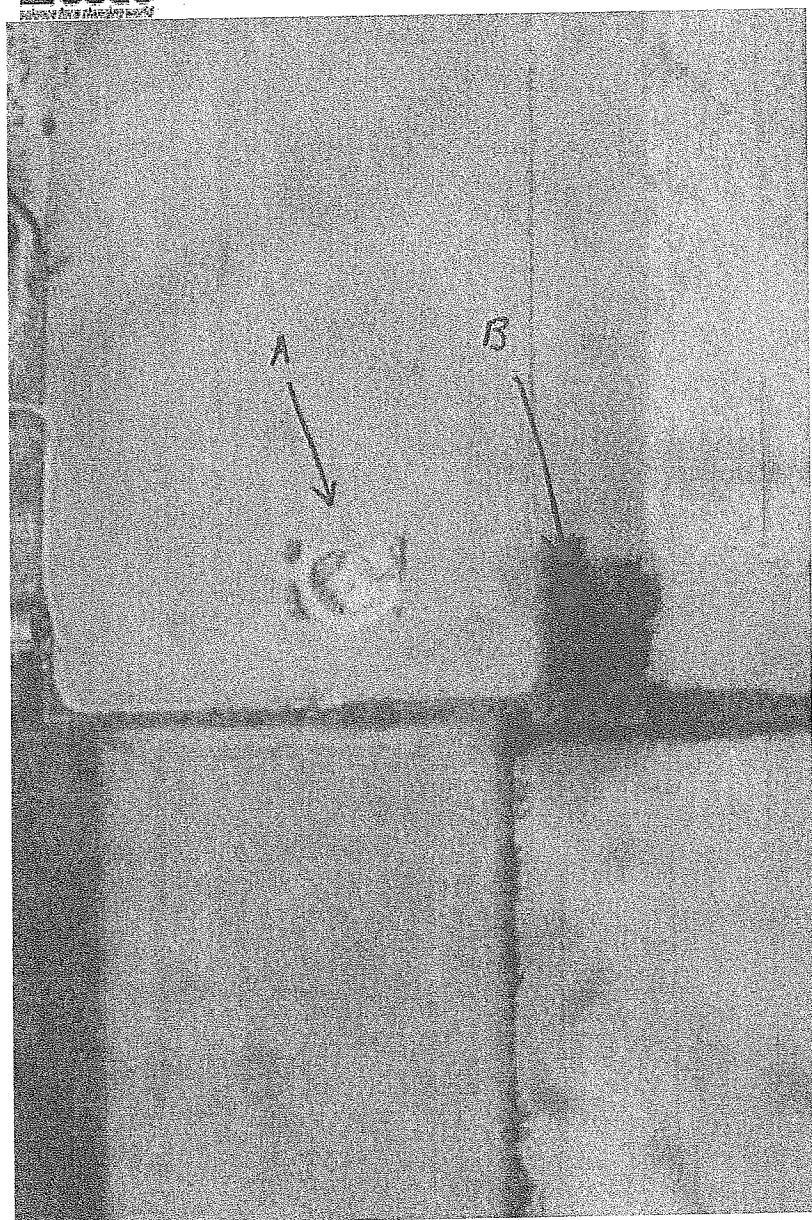


0 200M

0 200yd

Image courtesy of the US Geological Survey.

66 km E of Minneapolis, Minnesota, United States 07 May



0 100M

0 100yd

Image courtesy of the US Geological Survey.

Pierce County.

October 16, 1992

Sinkhole Formation on Isabelle Creek
Caused by Flooding

Situation

During the evening and early morning of Sept. 15-16, 1992 a series of heavy rainstorms fell in western Wisconsin causing severe flooding. Observations indicated that approximately 7" of rain fell during this time period.

As a result of the flooding a sinkhole (termed a swirlhole) formed in the streambed of the Isabelle Creek approximately 3 miles south of Ellsworth in Pierce County, Wisconsin. The sinkhole is approximately 4 ft. in diameter with a visible depth of 3-4 ft. During periods of normal water level the entire stream flow (estimated at several hundred gallons per minute) pours into the sinkhole and disappears underground. Continuous flow on the stream does not resume for one-half mile downstream.

Mr. Dave Johnson, landowner adjacent to the stream, reported that he walked this area a couple of days prior to the rainstorm and the sinkhole was not present. He also walked the same area a couple of days after the flooding and observed the sinkhole formation with the entire stream flow going underground.

Location

The sinkhole is located in the Town of Hartland, Pierce County, Wisconsin at the following legal description: NE 1/4 NW 1/4 of Section 4, T25N-R17W.

Field Observation

On October 16, 1992 and on a previous tour, several local, regional and state officials inspected the sinkhole to make an initial assessment of its impact and possible future actions. Representatives included:

Wisconsin Dept. of Natural Resources

John Grump
Pete Skorseth
Pat Collins
Plus Several DNR Area and District Staff

Wisconsin Geological and Natural History Survey

Bruce Brown
Michael Mudrey

Pierce County Cooperative Extension

Ed Hass
Greg Andrews

Because a navigable stream is involved the Wisconsin Dept. of Natural Resources needs to review plans to assure that the appropriate regulations are followed and approved as necessary.

Implications

Due to the results of the flooding and the current and anticipated impacts on the groundwater resource it would seem prudent to act quickly to mitigate this situation. Winter is approaching making working conditions difficult. Upstream agricultural practices include winter land spreading of animal waste resulting in surface runoff directly into the sinkhole.

The following preliminary steps are being considered:

1. Assemble a project team to proceed with investigation and the development of mitigation plans.
2. Addressing the jurisdictional question to provide authorization to proceed with mitigation.
3. Initiate a project to divert surface water flow around the sinkhole to provide the opportunity to identify the subsurface flow characteristics at the bottom of the sinkhole.
4. Allow scientists and researchers to explore the sinkhole formation to provide the information necessary to develop a mitigation plan.
5. Investigate chemical tracing methods (i.e. dyes, chlorides) to determine the groundwater flow characteristics from the sinkhole until re-emergence of streamflow to assess the area of impact.
6. Contact the appropriate DNR staff to determine the necessary approvals.
7. Based on the findings of the exploration develop a mitigation plan to reduce or eliminate negative impacts on the groundwater resource and the DNR municipal and business permits.

Funding

Pierce County was declared a federal disaster area due to the flooding. The possibility of utilizing federal disaster funds are being investigated along with other state funding sources.

PIERCE CO. HERALD OCT. 6, 1992

Sinkhole caused by storm swallows creek

By Bill Kirk

A sinkhole apparently created by the force of rapidly rising water during this area's Sept. 15-16 rainstorm has left a half-mile dry gap in Isabelle Creek.

The stream is flowing into the hole—measuring three-four feet in diameter and three feet deep—at the rate of several hundred gallons per minute, according to Pierce County Resource Agent Ed Hass. The site is about four miles south of Ellsworth and a mile north of CTH V, near 410th Street.

"The concern is that anything which enters that stream has the potential to contaminate the groundwater," Hass said last Friday. Any bacterial contamination could jeopardize drinking supplies, he added.

He recommended private well owners in the immediate vicinity have their water tested soon for possible infiltration by nitrates or agricultural chemicals. A homeowner's package is available through the extension office in the county office building for \$18, providing tests for seven items. The samples are sent to a lab at UW-Stevens Point for analysis. Another kit for \$17 tests for atrazine.

Both the Ellsworth Cooperative Creamery and the Village of Ellsworth discharge effluent into the creek, but shouldn't have to alter their arrangement, Pat Collins of the Department of Natural Resources (DNR) office in Baldwin said Friday. The former introduces its non-contact cooling water and the latter uses the stream as an outlet for its wastewater treatment plant. Assuming they're meeting DNR requirements, these users have been approved for groundwater discharge anyway, he told.

Dye may be put in the sinkhole to trace the destination of its contents, Hass said. Sometimes efforts are made to plug these holes with concrete or a clay-like material to at least temporarily stop their groundwater impact, although he knew of no such project for this site. He thought a project to address the problem should be eligible for disaster funds like those authorized for this area by the federal government last week because of the storm.

The resource agent credited nearby property owner Dave Johnson with

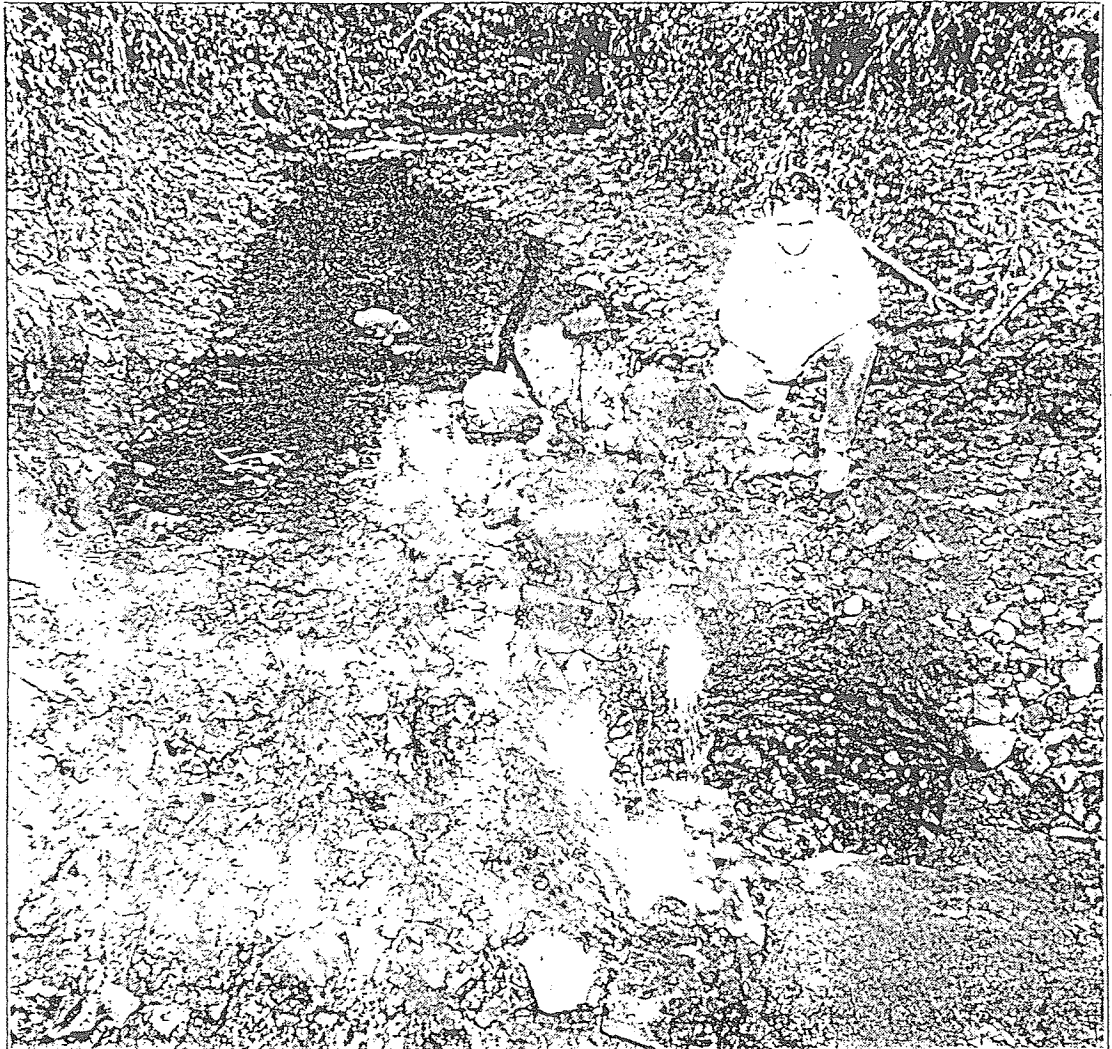


Photo by Steve Dzubay

COUNTY RESOURCE AGENT ED HASS inspected the sinkhole in Isabelle Creek.

notifying his office about the hole's appearance. Johnson had reportedly been in the vicinity shortly before the heavy rains and hadn't seen the depression; two days after the storm, he discovered it.

Hass said he walked downstream for nearly a half mile until the stream's flow resumed, fed by several small springs. In the stretch between, he found several places where water had ponded, but the bed was "bone dry" otherwise.

"This is how Lost Creek got its name originally," the agent understood, saying that its water had once disappeared into a similar sinkhole. Spring Valley's Crystal Cave be-

came known after discovery of a small opening at the surface and Gilman Township farmers deal with several sinkholes in their fields. A couple of years ago, a sinkhole occurring in a farmer's field in St. Croix County's Troy Township caused part of a machine shed to collapse and "swallowed" a combine, he noted. In that case, the occurrence was attributed to freezing and thawing rather than heavy rains.

Hass asked that hunters and others be alert to the holes during their outdoor journeys and report any to property owners, who should notify his office. They may exist but not have been detected in other area

ivers, especially following the storm.

Finding sinkholes in streams isn't unusual because the water action slowly dissolves minerals and rocks over time, Collins explained. The slight acidity of rainwater causes fissured limestone bedrock to break down, enlarging any cracks, Hass said. As cracks in the "roof" of the cavern represented by the sinkhole grow, that covering is eventually undermined and collapses, he added.

Besides the DNR, the Wisconsin Geological Survey and UW-River Falls Geologist Sam Huffman have been contacted for advice about the possible contamination problem, Hass said.



State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Jim Doyle, Governor
Scott Hassett, Secretary
Scott Humrickhouse, Regional Director

West Central Region Headquarters
1300 W. Clairemont Avenue
PO Box 4001
Eau Claire, Wisconsin 54702-4001
Telephone 715-839-3700
FAX 715-839-6076
TTY Access via relay - 711

October 18, 2004

David LePain
Wisconsin Geological and Natural History Survey
3817 Mineral Point Road
Madison, WI 53705-5100

Subject: Karst Feature Reports

Dear Mr. LePain:

Enclosed with this letter are Karst Feature Reporting Forms for 14 karst features observed in the Rush River waterway in Sections 1 and 12, T28N, R17W, Town of Rush River, St. Croix County.

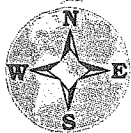
Also enclosed are photographs of the features, a photocopy of a plat book page with the approximate locations of the sinkholes/swallets marked and a memo describing observations.

If you have any questions, feel free to contact me at (715) 839-3726.

Sincerely,

Jim Boettcher
Hydrogeologist

C: Pat Collins - Baldwin
Pete Skorseth - Baldwin



PLEASANT VALLEY/RUSH RIVER PLAT

T-28-N ♦ R-17-W

ST. CROIX COUNTY, WISCONSIN

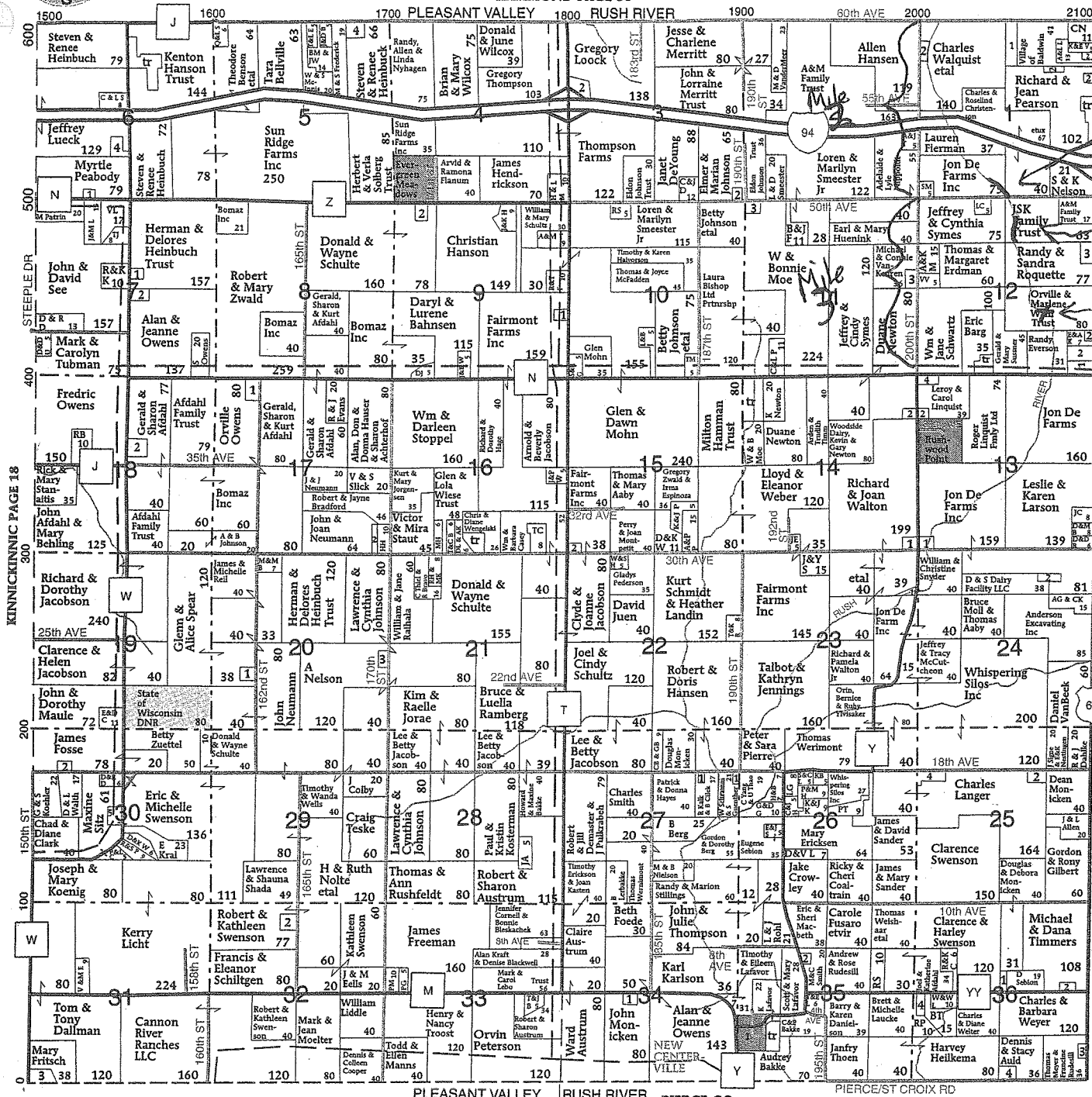
© Farm & Home Publishers, Ltd.

(Landowners)

See Page 112 For Additional Names.

HAMMOND PAGE 36

1700 PLEASANT VALLEY 1800 RUSH RIVER



RURAL INSURANCE
COMPANIES A Farm Bureau Service


Agent
Ken Singerhouse
(715)-796-2207

960 Davis Street • Box 129
Hammond, Wisconsin 54015

ST. CROIX COUNTY FARM BUREAU

"The Voice of Agriculture"

We believe in the future of agriculture and our area youth through sponsoring 4-H and FFA members to leadership training seminars and workshops. We also support numerous agriculture related promotion events, including Farm-City Day, livestock auction at the County Fair and legislative workshops

DATE: October 6, 2004

FILE REF: 3400

TO: File

FROM: Jim Boettcher - WCR

SUBJECT: Baldwin Creek and Rush River Waterway Downstream of Village of Baldwin WWTP

On June 16, 2004 Holly Eaton, Pat Oldenburg, Baldwin wastewater operator Gary Newton and I walked the Baldwin Creek and Rush River Waterways from the Baldwin wastewater treatment plant to County Road N three miles downstream of the Baldwin wastewater treatment plant. On June 17, 2004 Holly Eaton, Pat Oldenburg and I walked the Rush River waterway from County Road N to 30th Avenue one mile downstream of county Road N.

This memo summarizes observations on June 16 and 17.

Mile 1

Schools of minnows were observed in every hole in Baldwin Creek beginning 50 yards downstream of the Baldwin outfall. The minnows ranged in size from about one to three inches in length.

Baldwin Creek discharges to the Rush River waterway about 1000 feet downstream of the Baldwin outfall.

Caddis fly larvae and scud were observed in the Rush River as were Stone Roller (Spotted Sucker) and White Suckers about 3-4 inches in length.

Two species of damsel flies were observed. The larger was about 2 ½ inches in length with an electric green body and black wings. The smaller was about 1 ½ inches long with a light blue body and clear wings.

Many small tadpoles were observed in large quiescent pools and the plunge pool at 200th Street.

The amount of aquatic life observed diminished from about 5-700 feet downstream of 200th Street. In the past the waterway from this location downstream was dry. On June 16 water was present in pools to a point several hundred feet downstream of 60th Avenue on the Wahlquist property.

Mile 1 ends at 60th Avenue.

Mile 2

A 5-inch bullhead was observed in a pool upstream of the Wahlquist cattle crossing.

A snapping turtle was observed in the dry portion of the waterway several hundred yards downstream of the Wahlquist cattle crossing.

The channel of the waterway had a defined bed and banks and gravel to boulder sized rocks on the bed of the stream. As one goes downstream toward 50th Avenue the amount of vegetation in the waterway increases and the size of bed material decreases. Otherwise the waterway is unremarkable until about 3-400 yards upstream of 50th Avenue.

A series of karst features are present in the stream bed near the east line of the SE ¼ of the SW ¼ of Section 1, T28N, R17W, Town of Rush River, St. Croix County. Nine features were documented. I will refer to two of the features as swallets. The swallets were six inches or less in diameter. I will refer to the other seven features as sinkholes. The sinkholes were as much as eight feet in diameter.

The upstream sinkholes are most likely in the SE ¼ of the SW ¼ of Section 1. The sinkholes nearer 50th Avenue are probably in the SW ¼ of the SE ¼. There are no distinguishing features in the field to identify the boundary between the quarter quarter sections.

The locations of the karst features are as follows:

| | | | |
|----|--------------------|------------------------|---|
| #1 | 5 feet in diameter | W92.38558 N44.93569 | Photos 10, 11 |
| #2 | 6 feet in diameter | W92.38545 N44.93562 | Photo 12 50 feet downstream of #1 |
| #3 | Swallet | W92.38520 N44.93556 | Photo 13 |
| #4 | Swallet | W92.38512 N44.93550 | Photo 14 |
| #5 | 5 x 8 feet | W92.38506 N44.93539 | Photos 15, 16 |
| #6 | | W92.38494 N44.93532 | Photos 17, 18 |
| #7 | Group of sinkholes | W92.38486 N44.93522 | Photo 19 |
| #8 | 8 feet in diameter | W92.38446 N44.93459 | Photo 20 Mid Channel north side of bridge |
| #9 | | W92.38446 N44.93459 | Photo 20, 21 North end of east abutment |

Mile 2 ends at 50th Avenue.

Mile 3

Five sinkholes were observed in Mile 3 between 50th Avenue and County Road N.

| | | | |
|-----|------------------------|----------|--|
| #10 | W92.38319 N44.93290 | Photo 22 | 250 yards downstream of 50 th Avenue |
| #11 | W92.38319 N44.93290 | Photo 23 | 30 feet from #10 |
| #12 | W92.38308 N44.93250 | Photo 24 | 50 yards downstream of #11 |
| #13 | W92.38351 N44.93192 | Photo 25 | 80-100 yards downstream of #12 |

Halfway through Mile 3 the size of the channel becomes significantly smaller after a large pool about 100 yards long.

| | | | |
|-----|------------------------|------------|---|
| #14 | W92.38192 N44.92570 | Photos 1,2 | 300 yards south of mid point of Mile 3 |
|-----|------------------------|------------|---|

Water was ponded in a former quarry are immediately upstream of County Road N.

Mile 4

No sinkholes were observed in Mile 4 between County Road N and 30th Avenue.

The northern half of Mile 4 consists of a series of pool areas separated by grassed waterway. The pool areas were sometimes more than 100 yards long and their bottoms were substantially below the adjacent landscape. These pool areas in the northern half of Mile 4 did not contain water.

In the southern half of Mile 4 the waterway had substantially more grass than the northern half. The further south one goes the more the vegetation suggests wet soils – sedges and reed canary.

A pool located at W92.38909, N44.90888 appears to represent the headwaters of the Rush River. This location is immediately downstream of a road crossing located 150 yards southeast of a center pivot located near the center of the SW ¼ of Section 13. Several isolated pools upstream of this location contained minnows. The minnows were probably stranded after recent high water receded. Water in this area appeared dark and tannin stained. Tadpoles and backswimmers were observed.

Flowing water was observed approximately 150 yards upstream of 30th Avenue. The flowing water was much clearer than the dark water upstream.

Comment

It would be inappropriate to consider use of the Rush River waterway for a disappearing stream wastewater effluent discharge in the following reach: From the north line of the S $\frac{1}{2}$ of the SW $\frac{1}{4}$ of Section 1, T28N, R17W to some distance south of County Road N.

The presence of many karst features in the above reach of waterway are likely to pose a threat to groundwater from stormwater.