LAKE NETTIE

WATER LEVEL CONTROL

PROJECT

Sponsored by the

MCLEAN COUNTY WATER
RESOURCE DISTRICT

Prepared by
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April 1984

Lake Nettie
Water Level Control Project

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LAKE NETTIE WATER LEVEL CONTROL PROJECT

1.0 Introduction

1.1 Scope

This report presents a series of proposals to reduce surface water level in the Lake Nettie area. The major area of concern is west of Lake Nettie in those areas adjacent to Crooked Lake (sections, 19, 20, 29 and 30, T148N R81W) This report has been prepared for the McLean County Water Resource District with assistance of the U.S. Geological Survey, Bureau of Reclamation, SCS, State Water Commission, and the Garrison Conservancy District.

1.2 Purpose

The purpose of this report is two-fold. One, to present background material which will provide a basic understanding of the water problem which exists in the areas adjacent to Lake Nettie. Second, to provide structural and non-structural solutions to the high water in the Lake Nettie area.

The data and proposal developed in this report are intended as a starting point for the formulation of a final plan to reduce the impacts of surface water flooding in the Lake Nettie area. It is important to have in mind that none of the proposed actions in this report are irreversible.

1.3 Location

The Lake Nettie area is approximately five miles west and seven miles north of the city of Turtle Lake in McLean County. The Lake Nettie area is also five miles east of the Lake Audubon. Lake Nettie is located in sections 20, 21, 28 and 29, T148N R81W and Crooked Lake is located in sections 19, 20, 29 and 30, T148N R81W. There are two Crooked Lakes in this area. The one adjacent to Lake Nettie and just described will be called Little Crooked Lake as it is much smaller than the Crooked Lake east of Lake Nettie area.

1.4 History

The Lake Nettie-Crooked Lake area was meandered between July 15-17, 1886 by Charles Bates. The meandered area of Lake Nettie was 409.8 acres and the meandered area of Little Crooked Lake was 501.6 acres. Britton Slough and Mud Lake were not meandered but shown as marsh areas on the original GLO plats, Figure 1.

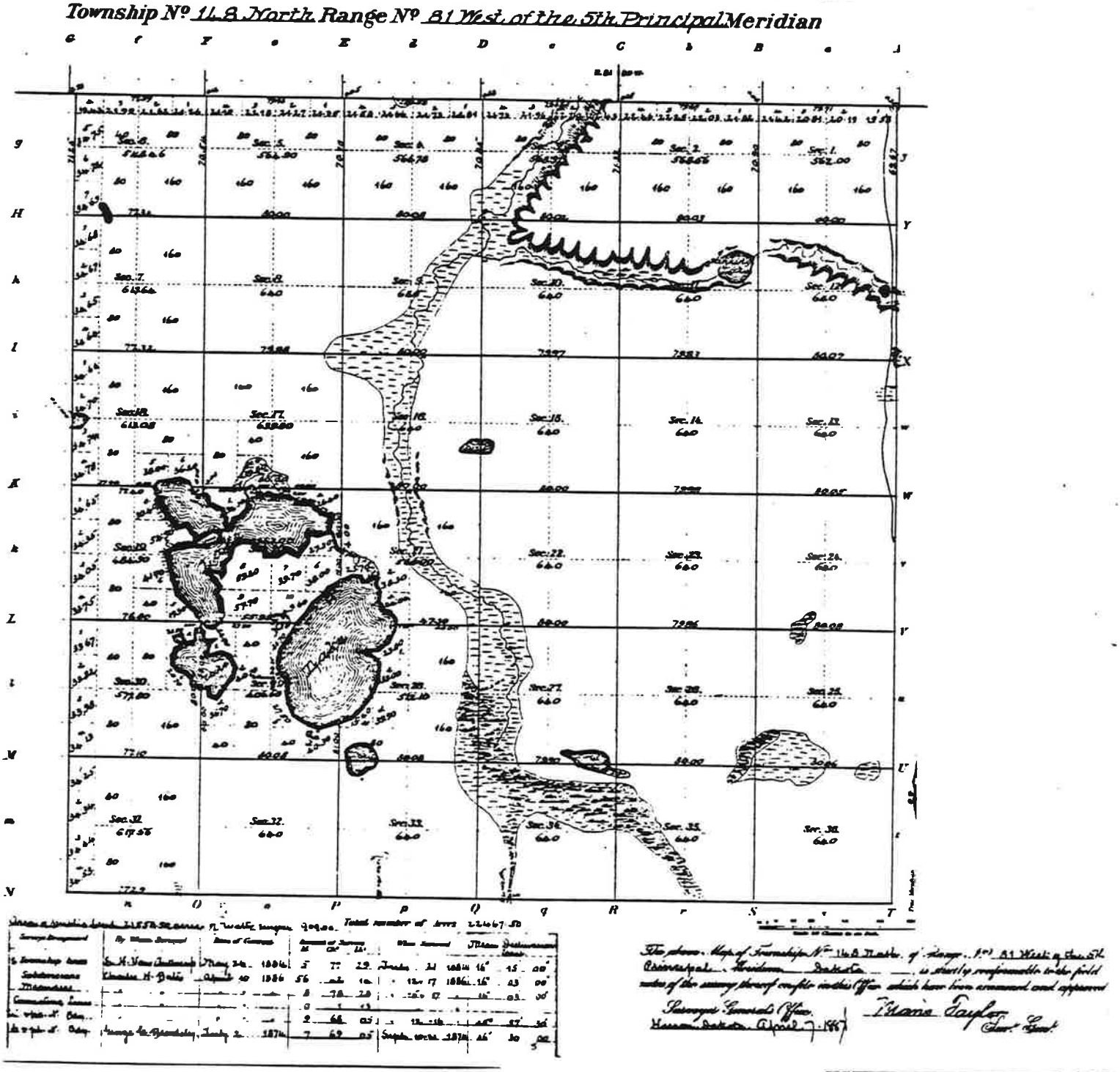
During the 1930's, Lake Nettie and Little Crooked Lake went dry. In order to restore the lake, a dike-diversion system was constructed to divert flows from Turtle Creek in the SW-1/4 of section 21, T148N R81W into the north-east end of Lake Nettie. This was done sometime before 1938. The project appears to have been successful because the 1938 aerial photos show water in Lake Nettie. Sometime between 1950 and 1958 the diversion channel from Turtle Creek was blocked; thereby preventing the diversion of Turtle Creek flows.

Based on the aerial photos and the USGS quadrangle, Lake Nettie and Little Crooked Lake appears to have remained rather stable between 1950 and 1975. The elevation is assumed to have been around 1837 (+) msl. The elevation probably fluctuated with local precipitation and snowmelt runoff, but no major changes in elevations were noted.

In the spring of 1976 a major rise in the surface elevation of Lake Nettie and Little Crooked Lake was noted by area residents and the Fish and Wildlife Service. This occurred after the filling of Lake Audubon in the summer of 1975. At this time, Lake Audubon was raised from 1835 to 1848 msl. The two lakes have continued to rise since 1976 to a high elevation of approximately 1842 msl in the spring of 1983. The current elevation of Lake Nettie is 1840.5 (+) based on Fish and Wildlife Service data. Lake Nettie and Little Crooked Lake are currently inter-connected by water.

The roadway between Lake Nettie and Little Crooked Lake was raised during the summer of 1983 because of the high water conditions in the two lakes. An equalizing culvert was placed through the road. The roadway is located on the section line between 20 and 21. The top of the roadway at the 24 inch CMP is 1845 msl and the invert of the culvert is 1840 msl.

Figure 1.


Township No. 148 North, Range No. 81 West of the 5th Principal Meridian

2.0 Area Description

2.1 Geology

Nearly all the landforms in McLean County that were formed as a direct result of glacial action are of a depositional nature. The Lake Nettie area is just of the western edge of the Missouri Coteau. The majority of the watershed lies to the north and east in the Missouri Coteau. The Lake Nettie area itself is in a glacial outwash area. Most of the surface material is stream sediments deposited by water derived from local precipitation during and immediately following glaciation.

2.2 Soils

The soil data presented in this section of report is taken from 1979 "Soil Survey of McLean County, North Dakota" by SCS. Photo copies of Lake Nettie, Little Crooked Lake, Mud Lake and Britton Slough soil maps are on pages 5 and 6. The soils information is plotted on 1976 ASCS aerial photos.

The following are the major soils found in the Lake Nettie area:

Symbol	Name
AF	Aquolls
Co	Colvin Silty Clay Loam
Dv	Divide Loam
FbB	Falkirk and Max Loam
Hk	Harriet Saline Land Complex
Mf	Marysland Loam
PhB	Parshall Fine Sandy Loam
Ro	Roseglen Silt Loam
RsA	Ruso Coarse Sandy Loam
RtB	Ruso-Manning Complex Sandy Loam
RxB	Ruso-Manning Complex
RzA	Ruso Soils
WbD	Wabek Soils

Description of the above listed soil area:

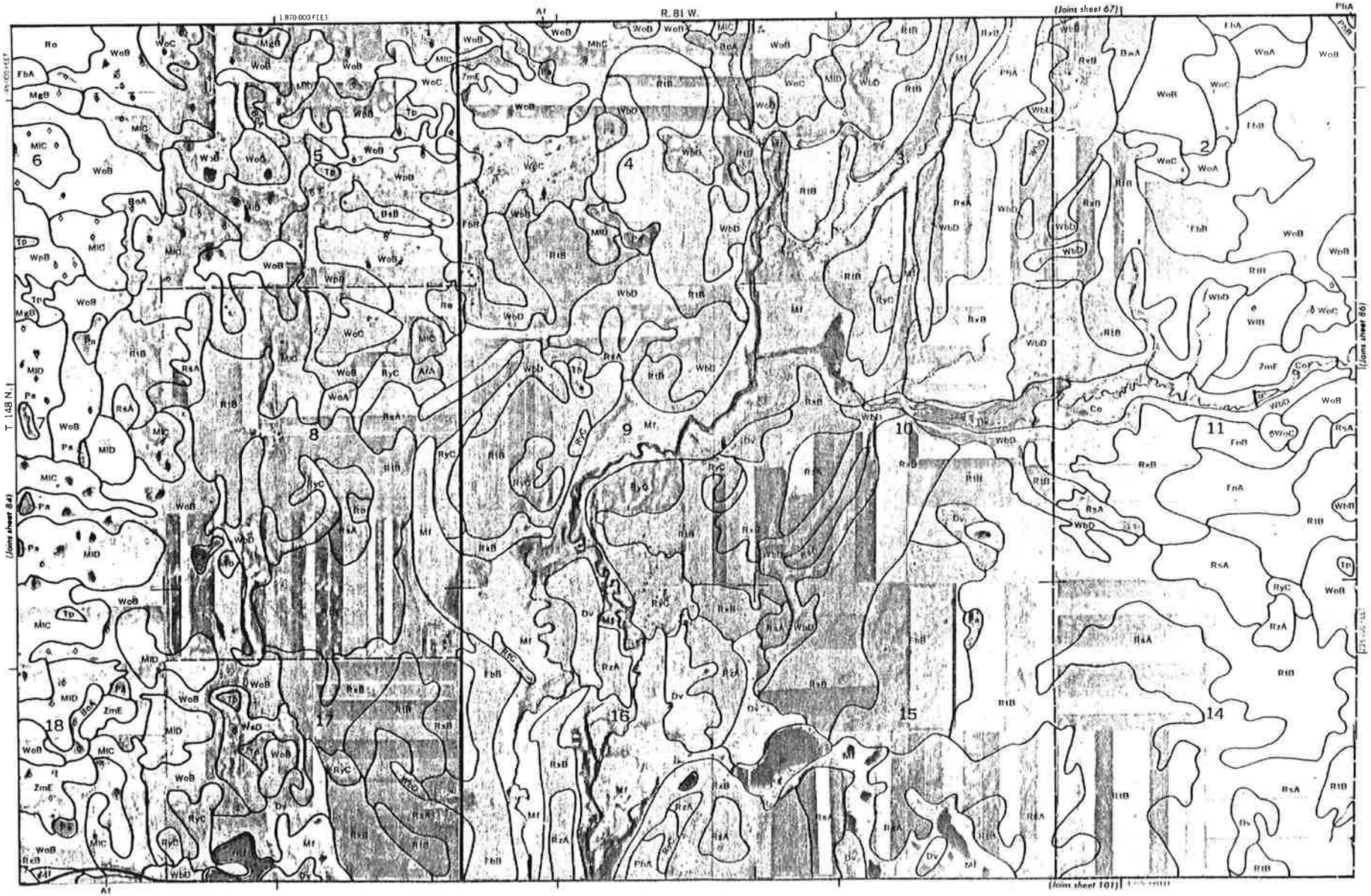
Af - Aquolls are in large, deep closed depressions. The areas are covered by water most of the time, except during periods of prolonged drought. Aquolls have no agricultural value, except to supply water for livestock. Aquolls are important for water-foul and other wildlife.

MC LEAN COUNTY, NORTH DAKOTA NO. 101

This map is compiled on 1970 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

5

McLEAN COUNTY, NORTH DAKOTA — SHEET NUMBER 85



MC LEAN COUNTY, NORTH DAKOTA NO. 85

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Co - Colvin series consists of poorly drained, deep, level calcareous soils. These soils are in shallow depressions or swales, in melt-water channels, and on glacial lake plains and outwash plains. They formed a moderately fine texture melt water deposits and lake sediments. Most of the acreage is used for native range or hay. If drained, these soils are suited for crops.

Dv - Divide loam consists of level. somewhat poorly drained soils that are moderately deep over sand and gravel. These soils formed in loam glacial outwash. This soil is suited to all crops commonly grown in the county. The main management concerns are controlling soil blowing, conserving moisture, and maintaining fertility and tilth. Timely operations because of wet conditions in the spring are also a concern.

FbB - Falkirk and Max loam is well drained and has slow to medium runoff. It is slightly susceptible to erosion. It is suited to all crops commonly grown in the county. Most of the acreage is cropland, the rest is native hay or pasture.

Hk - Harriet-Saline is 50% Harriet very fine sandy loam and 50% saline land. Saline land has such a high concentration of soluble salts that only the most persistent salt-tolerant plants can grow. This unit is poorly drained. Runoff is very slow. In many areas a salt crust commonly appears on the surface during dry periods. Nearly all acreage is in native vegetation and is used for range land.

Mf - Marysland loam occurs in low and slightly concave areas in the glacial outwash plain and is a level soil. The soil is poorly drained and has slow runoff. It is slightly susceptible to erosion. Nearly all the acreage is native pasture with a few drained areas used for crops.

PhB - Parshall fine sandy loam is on terraces and outwash plains and is nearly level soil. This soil is well drained but has slow runoff. It is suited to all crops commonly grown in this area. The chief management needs are controlling wind and water erosion.

Ro - Roseglen silt loam is on smooth glacial lake plains. Permaability is moderate. Available water capacity, organic-matter content, and natural fertility are high. It is slightly susceptible to erosion.

RsA - Ruso coarse sandy loam is a nearly level soil and is on terraces and glacial outwash plains. This soil is well drained. It has slow runoff and is moderately susceptible to erosion. It is suited to irrigated crops.

RtB - Ruso-Manning coarse sandy loam is gently sloping and is on terraces and glacial outwash plains. This well drained soil is moderately deep over sand and gravel. This unit is well drained and somewhat excessively drained. It has slow runoff and is moderately susceptible to erosion. It is suited to irrigated crops.

RxB - Ruso-Manning complex is the same as RtB except on a 3 to 6% slope. This unit is droughty and is suited to irrigated crops.

RzA - Ruso Soils is nearly level and are on terrace, and glacial outwash plains. These soils are well drained. They have slow runoff and are moderately susceptible to erosion. This unit is droughty but suited to irrigated crops.

WbD - Wabek soils are gently rolling soils occupancy ridges and knolls of outwash plains and terraces. They are intermingled with deeper soils on the landscape. They are excessively drained and have slow runoff. Nearly all the acreage is in native range and pasture.

For a more detailed description of the soils, see the "Soil survey of McLean County, North Dakota." There are also maps covering the entire Lake Nettie watershed in this publication.

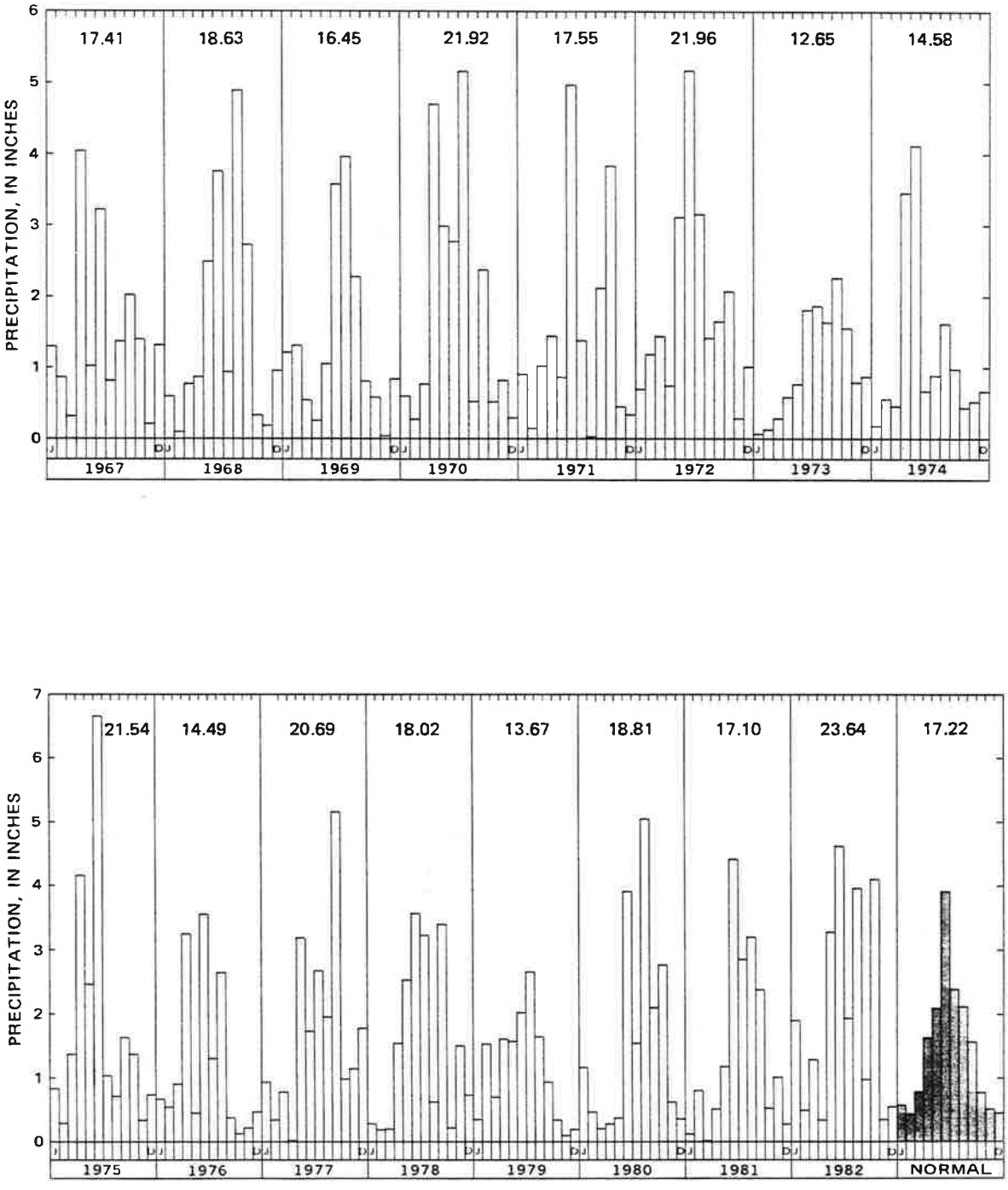
2.3 Climate

The Lake Nettie area has a continental climate -- short summer, and long cold winter with characteristic rapid fluctuations in temperature. It is normal to have several days in the summer with temperature of 90°F - 100°F and many days in the winter when the temperatures are below zero. The average wind speed is about 10 miles per hour. The prevailing winds are very common during the summer months. Wind speeds are usually highest during the afternoon and lowest at night.

The average annual precipitation is 17 inches according to the U.S. Weather Bureau. General and prolonged rains occur in the spring. Summer precipitation is usually from local thunderstorms. Occasionally, several inches of rain may fall in a short period and such rains are about the only ones that will produce any runoff during the summer and fall. Most of the runoff is produce by spring snowmelt. Approximately 55 percent of the average annual runoff is from snowmelt runoff.

As stated previously the average annual precipitation for the Lake Nettie area is 17 inches. In 1982 a record 23.64 inches of precipitation was recorded at Turtle Lake, North Dakota. Figure 2.3 shows the annual precipitation by month from 1967 through 1983. Note that since 1975, only in 1976 and 1979 did the area receive less than average precipitation. However, 1979 was a year of record snowmelt runoff due to extremely fast warming conditions.

Figure 2.3



—Monthly and annual precipitation at Turtle Lake.

The mean annual evaporation from a shallow lake in the Lake Nettie area is 34 inches (U.S.W.B.; TP-37). The distribution of this evaporation is as follows:

Month	% of Mean	Evaporation in inches
January	0.75	0.25
February	0.95	0.32
March	2.30	0.81
April	5.85	1.99
May	10.33	3.51
June	13.57	4.61
July	18.59	6.32
August	20.16	6.85
September	14.95	5.08
October	8.53	2.90
November	3.00	1.02
December	1.02	0.34

The net loss to evaporation on an average year would be 17 inches (gross evaporation 34" minus 17" of direct precipitation equals 17 inches). Therefore local runoff or ground water recharge must makeup the 17 inches lost to evaporation. Seepage was not considered as a loss because of the affect of ground water recharge in the Lake Nettie area.

3.0 Hydrology

3.1 Ground Water Hydrology

A complete description of the ground water regime is given in the U.S.G.S. Water-Resource Investigation Report 83-4242. The U.S.G.S. report will be made a part of this report when it is available. The State Water Commission is working on a proposal to do a three year ground water study in the Lake Nettie-Turtle Lake area. The state does have on file unpublished data on the Strawberry aquifer north of the Lake Nettie area.

3.2 Surface Water Hydrology

The Lake Nettie area is part of the Turtle Creek watershed. The watershed extends from Mud Lake on the south to Ruso, North Dakota in the north. Strawberry Lake, Long Lake and Big Crooked Lake are within the Turtle

Creek watershed. These lakes are non-contributing except during periods of high flow; such as the spring runoff of 1983. Based on the topographic maps, the head water of Turtle Creek are in middle portion of the Horseshoe Valley approximately 6 miles north of the Lake Nettie area. Turtle Creek leaves the Horseshoe Valley in S-1/2 of section 9, T148N R81W and then flows through the Lake Nettie National Wildlife Refuge in sections 16, 21, 28 and 34. Britton Slough and Mud Lake are water bodies located on the mainstream of Turtle Creek in sections 21, 27, 28 and 34. Lake Nettie and Little Crooked Lake are located just west of Mud Lake as shown in Figure 3.1 and are located in a closed basin. The water surface of Lake Nettie would have to rise to approximately elevation 1845.5 before it would discharge into Mud Lake and Turtle Creek. There is no record of water having discharge from Lake Nettie.

As previously mentioned, Turtle Creek Diversion was constructed during the 1930's to bring water into a then dry Lake Nettie. A deflector dike was constructed across Turtle Creek in the SE-1/4 NW-1/4 of section 21 which diverted water into a man-made channel leading to Lake Nettie. Based on the aerial photos this channel remained operational until the mid 1950's at which time it was blocked. The channel and deflector dikes are still in place.

The Turtle Creek watershed to the outlet of Mud Lake, S-1/2 NW-1/4 Section 34 T148N R81W has a total drainage area of 134 square miles of which 93 square miles are classified as non-contributing. The watershed is outlined on Figures 3.1. Table 3.1 lists the subwatersheds and their drainage areas.

Table 3.1

Watershed		Drainage Area
Strawberry Lake	Direct Contributing	2,480 acres
	North Valley	4,970 acres
	Non-contributing	16,860 acres
Long Lake	Direct Contributing	2,040 acres
Big Crooked Lake	Direct Contributing	2,410 acres
Crooked Lake Outlet Channel	Direct Contributing	2,215 acres
Horseshoe Valley South	Direct Contributing	1,970 acres
Horseshoe Valley Central	Direct Contributing	1,565 acres
Horseshoe Valley North	Direct Contributing	4,150 acres
Subtotals	Contributing @ Mud Lake	25,250 acres
	Non-Contributing @ Mud Lake	43,795 acres

TABLE 3.1 (Continued)

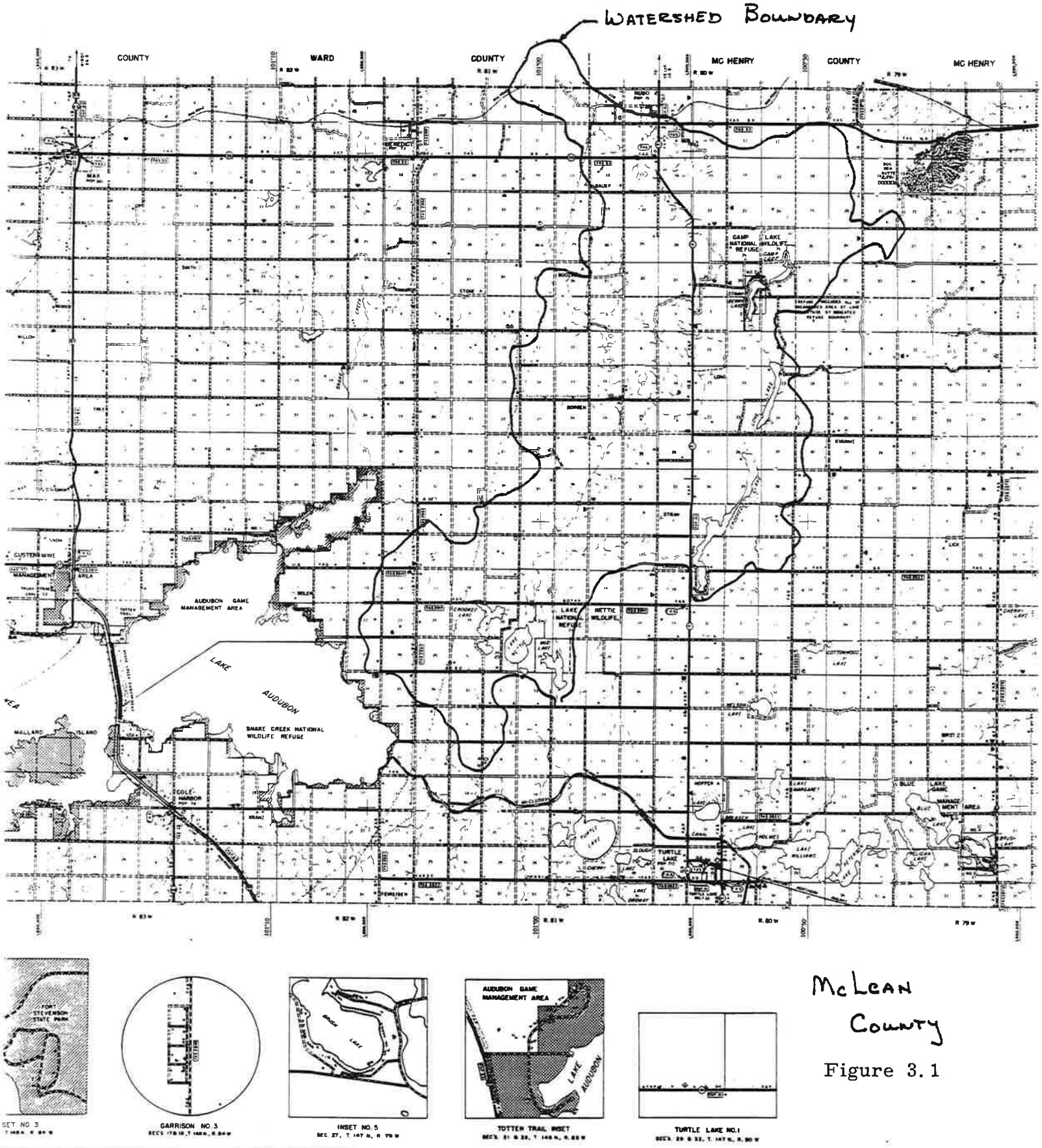
Lake Nettie	Direct Contributing	1,870 acres
Little Crooked Lake	Direct Contributing	5,245 acres
Nettie-Crooked	Non-Contributing Watershed	8,605 acres
	Total Contributing Watershed @ Mud Lake	25,250 acres
	Total Non-Contributing Watershed	59,515 acres
	Total Watershed	85,765 acres

It is important to note that under certain conditions portions of the flows from the Turtle Creek maybe diverted into Lake Nettie, because of topographic conditions and vegetative build-up in section 16 T148N R81W. There are two inter-related channels in the northern half of this section which can be interconnected during periods of high runoff.

The Horseshoe Valley portion of the watershed is very steep and has the potential to generate large volumes of runoff. The glacial lake plain around the lake area has a very gently rolling topographic which would generate smaller peaks and less runoff than the valley system.

The soils within the watershed have been classified by the SCS in hydrologic group "B". These soils have moderate infiltration rates when thoroughly wetted. They consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately course textures. Group B soils have a moderate rate of water transmission (minimum infiltration rate of 0.15 to 0.30 inches per hour).

The average annual runoff into the Lake Nettie area is 35 acre-feet per square mile of which approximately 55 percent occurs as snowmelt runoff. The 80 percent chance runoff produce a runoff of 15 acre-feet per square mile of which approximately 55 percent occurs as snowmelt runoff. These are percentage figures and local rainfall events can produce varying amounts of runoff. The precipitation records (section 2.3) show that since 1975 the area has experienced above normal precipitation. Thunderstorms have been reported that have produced in excess of four inches of rain in a 24 hour period. These types of storms are capable of producing between 1 and 1.5 inches of direct runoff. Table 3.2 lists the amount of runoff into the Nettie-Crooked Lake System, which would be produced by various events.



McLean County

Figure 3.1

Table 3.2

Runoff Volumes Into:

Event	Little Crooked Lake	Lake Nettie
80% chance runoff	123 acre-ft	44 acre-ft
50% chance runoff	262 acre-ft	93 acre-ft
1 inch direct runoff	437 acre-ft	155 acre-ft
1.5 inches direct runoff	656 acre-ft	233 acre-ft

One inch of direct runoff would produce a rise of approximately 9 inches in the Nettie-Crooked Lake complex and the 1.5 inches of direct runoff would produce a 12 inch rise. The actual volumes of runoff into the Nettie-Crooked Lake complex would depend on the event and ground conditions at the time of event.

4.0 High Water Impacts

4.1 Original Meander

The Lake Nettie area was meandered in 1886 by Charlie H. Bates. As previously stated the meandered area of Little Crooked Lake is 501.6 acres and Lake Nettie is 409.8 acres. The G.L.O. plate indicates that Nettie and Crooked Lake were connected by a channel between sections 20 and 21, but the north and south portions of Little Crooked Lake were not connected. The combined meandered area of Lake Nettie and Crooked Lake is 911.4 acres which is less than the area of the two lakes at the 1840 contour line (960 acres). It should be noted that the north and south portions of Little Crooked Lake are not connected by 1840 contour line and were meandered as two separate bodies of water. Also a portion of Lake Nettie in the NW-1/4 of Section 21 laying below the 1840 contour line was not meandered. Based on these two facts and that the area originally meandered was less than the area within the 1840 contour line; the elevation of the two lakes at the time the area was meandered was less than the elevation 1840 msl.

4.2 Water Area

Table 4.2 shows the areas covered by water based on A.S.C.S. and Bureau aerial photography. Reproduction of the original aerial photos are on pages 16 through 19. These photos have been reduced from the original and should not be used for photo interpretation. Table 4.2 shows that the water area of Lake Nettie has been approximately equal to the original meandered area of the Lake. This is mainly due to the steep-sided nature of the lake. The only area flood beyond the meandered line on Lake Nettie is in the NW-1/4 of Section 21. However, between 1938 and 1974 approximately 100 less acres than the original meandered area of Little Crooked Lake were not covered by water. This area has been traditionaly used for hay and pasture land. The 1982 photo shows that 546.8 acres in the Little Crooked Lake area were covered by water. This places 46 acres of non-meandered land under water and puts the water edge up to cropland. This edge affect causes additional loses due to wet ground adjacent to the Lake. It would appear from the data that between 100 and 146 acres of traditional crop and pasture land have been affected by the high water in the Little Crooked Lake area.

4.3 High Water Affect on Roadways

Two major county roads are affected by the high water in Nettie-Crooked Lake area. The roadway between section 20 and 21 was raised in 1983, as it was impassable. However, the roadway currently has standing water on both sides which may cause problems in the future. The roadway between sections 20 and 17 also has water laying on both sides of it and maybe come water logged in the future. At the south end of Little Crooked Lake, between section 20 and 29, the water has flooded the trail which the farmer (farmstead SW-1/4 section 20) has always used as access to his west fields. This area was not meandered and has always been used by local residents to travel east and west.

TABLE 4.2

Water Areas

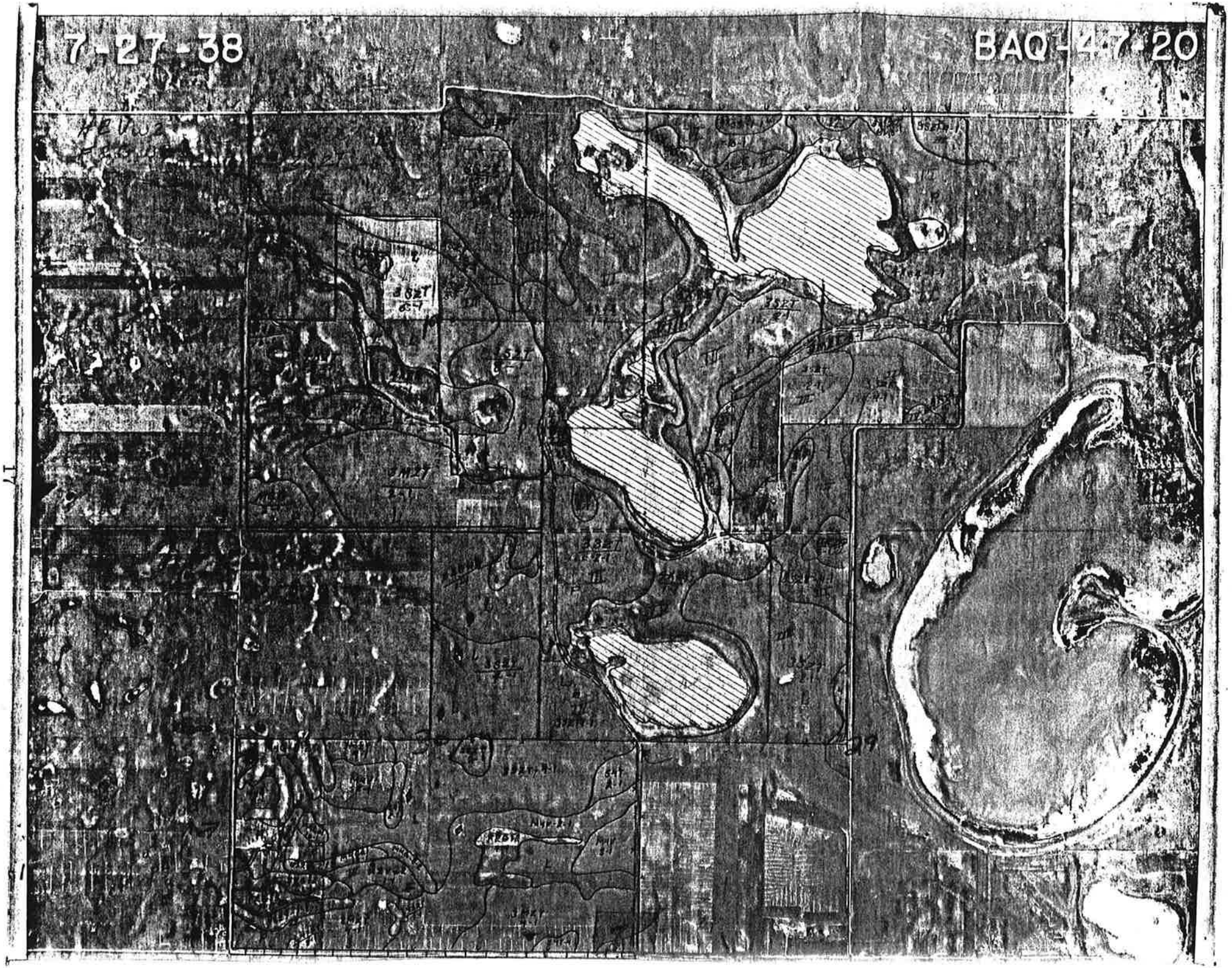
(Areas are in Acres)

Little Crooked Lake - T148N R81W

Area	1886 Meander	1938 (7/27)	1950 (10/11)	1958 (5/24)	1966 (8/16)	1970 ---	1982 (6/3)
Section 18 SE-1/4	5.8	-0-	1.0	3.4	-0-	1.9	5.3
Section 19 NE-1/4	76.5	17.5	42.3	49.8	20.7	64.2	87.9
Section 19 SE-1/4	59.0	25.5	48.8	42.6	30.7	47.8	61.3
Section 20 W-1/2	167.5	85.8	131.9	136.4	111.3	152.1	175.2
Section 20 NE-1/2	96.8	14.1	22.3	75.6	19.9	95.5	113.2
Section 20 SE-1/4	0.3	-0-	-0-	-0-	-0-	-0-	1.6
Section 30 NE-1/4	37.8	9.8	32.3	25.8	17.9	30.4	42.5
Section 29 NW-1/4	54.6	31.7	46.4	40.2	29.1	47.2	54.1
Section 29 SW-1/4	3.3	-0-	0.3	1.7	-0-	0.6	5.7
Total	501.6	184.4	367.5	375.5	229.6	439.7	546.8

Lake Nettie - T148N R81W

Area	1886 Meander	1938 (7/27)	1950 (10/11)	1958 (5/24)	1966 (8/16)	1970 ---	1982 (6/3)
Section 20 SE-1/4	32.4	11.3	33.3	27.5	30.5	29.4	32.2
Section 21 SW-1/4	74.0	27.9	74.2	85.2	75.9	83.8	91.0
Section 21 NW-1/4	-0-	-0-	-0-	19.2	-0-	19.0	38.6
Section 28 NW-1/4	103.2	61.5	119.6	91.0	90.8	93.9	100.1
Section 28 SW-1/4	24.7	7.6	20.3	24.7	22.1	22.5	27.5
Section 29 SE-1/4	52.2	29.7	57.0	51.9	49.0	47.4	51.1
Section 29 NE-1/4	123.3	92.2	132.9	116.8	121.7	123.4	123.6
Total	409.8	230.2	437.3	416.3	390.0	419.4	464.1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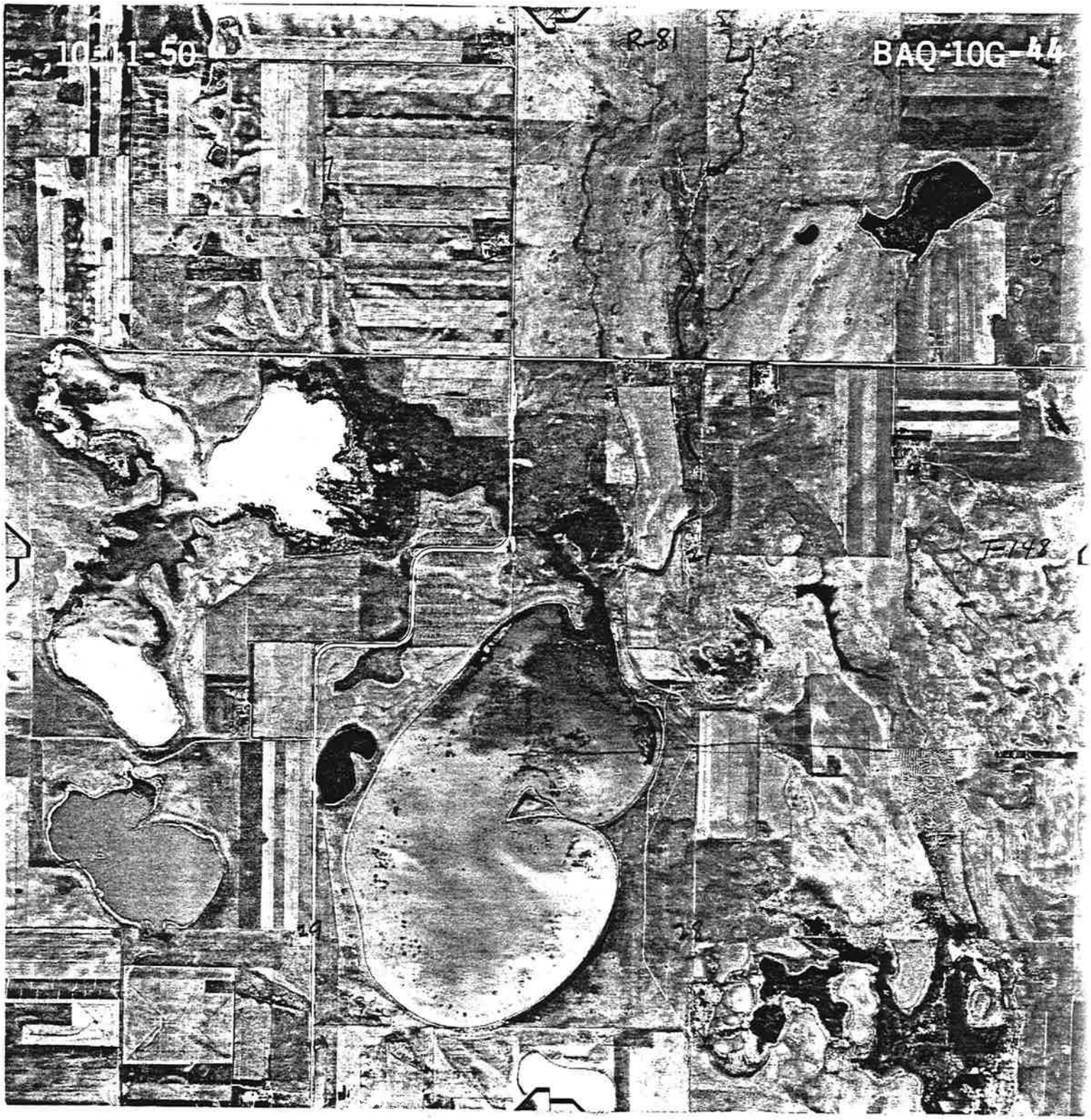
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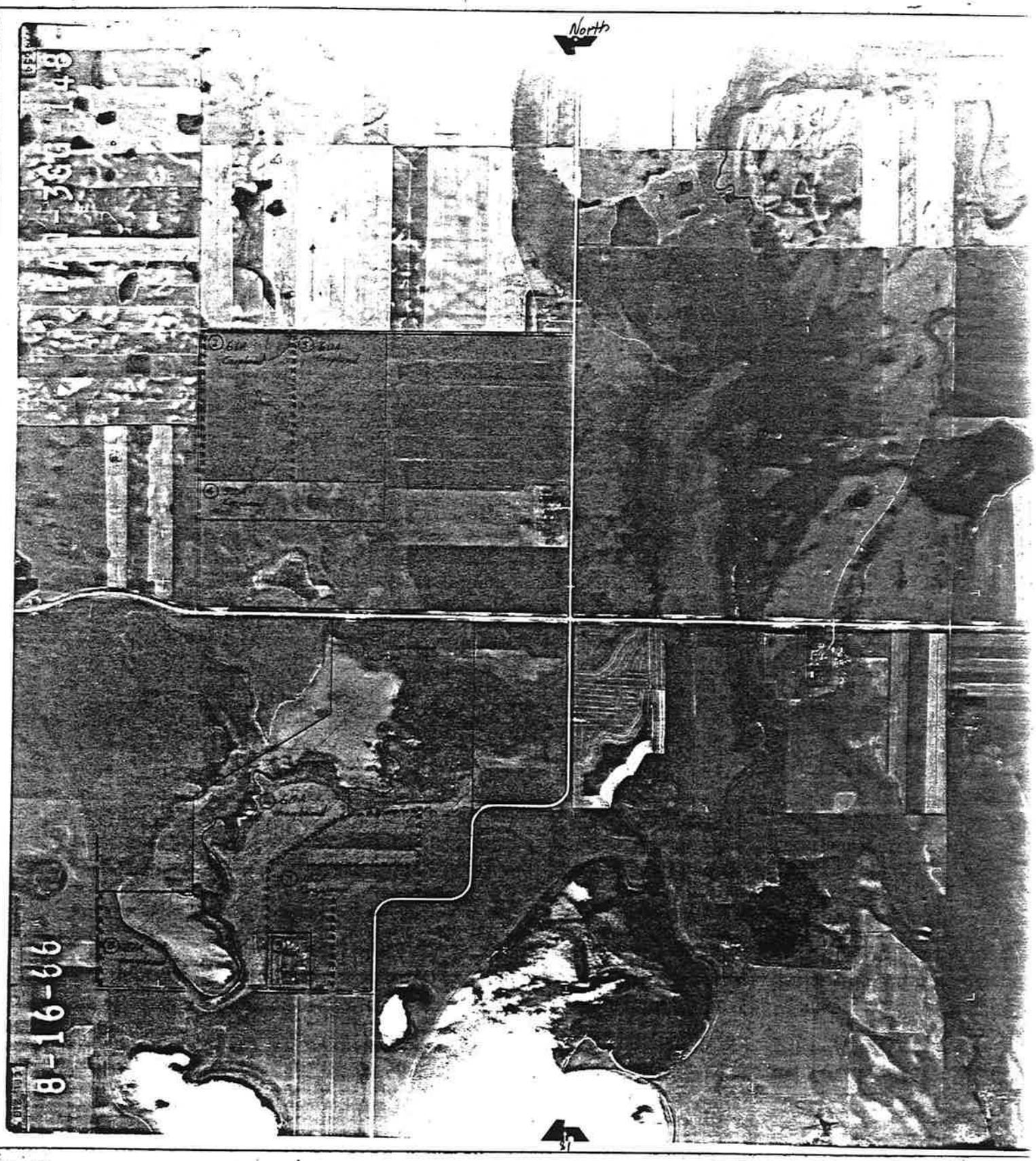
North
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5.0 Proposed Solutions to the High Water Conditions

5.1 No Action Alternative

The no action alternative would allow the existing conditions to continue. If hydrologic conditions remain about constant, the area would continue to have high water. This means that continue flooding of 46 acres adjacent to Little Crooked Lake and reduced productivity adjacent to the Lake. The continued flooding would cause a further deteriation of already strained landowner relations with Fish & Wildlife Service and Bureau. The roadway and access problems would not be addressed by this alternative.

5.2 Purchase Little Crooked Lake Area

If approximately 990 acres adjacent to and including Little Crooked Lake were purchased by the Fish & Wildlife Service; the entire flooded area would be within the Lake Nettie National Wildlife Refuge. Therefore the flooding of private land would be eliminated. A potential for future roadway problems would still exists. It is not known if the landowner adjacent to the lake would be willing to sell there land to the U.S. Government. The estimated cost of the land is approximately $420,000. The purchase of this land would enhance the value of the existing refuge.

5.3 Pumped Lowering of the Lake Nettie Complex.

In order to reduce the levels of both Lake Nettie and Little Crooked Lake a pumping station would be set-up on the east side of Lake Nettie in the SE-1/4 SW-1/4 of Section 28 to pump into Mud Lake. Approximately 2000 ac-ft of water would have to be removed to lower the Lake from 1841 to 1839 msl. At pumping rate of 9,000 gpm (20 cfs) it would take approximately 50 days to remove 2000 acre-ft from the Lake Nettie complex. The pumping operation would be continuous (24 hr/day). The operation of diesel power pumps may be disruptive to wildlife and local homeowners. The continuous discharging of water into Mud Lake may cause erosion problems at the outlet area of the pump and may have an adverse affect on the marsh in the area of the discharge. The

need to pump the lake system down would depend on yearly hydrologic cycle. The estimated cost of removing 2000 acre-ft from the Lake Nettie system on an annual basis is $72,000. The estimated cost includes pumps and engine rental plus operation and maintenance during pumping.

5.4 Lake Nettie Outlet and Turtle Creek Improvements

The following plan was submitted in the original report of the McLean County Water Resource District. The report is item 1 in the appendix. Detail and cost estimates have been added to the original proposal.

Area "A": SE-1/4 SW-1/4 Section 9 T141N R81N
The area is adjacent to the north boundary of the refuge. The work consists of mowing or spraying approximately 800 feet of channel. The area mowed or sprayed would be approximately 20 feet left and right of channel center line.

Area "B": E-1/2 NE-1/2 and W-1/2 SW-1/4 Section 16 T148N R81N
The work consists of mowing or spraying an area 20 feet left and right of the center line of Turtle Creek through the refuge in section 16. The major obstructions to flows down Turtle Creek are in the NE-1/4 NE-1/4 SW-1/4 of section 16 and just upstream of the south section line. The channel area in the NE-1/4 NE-1/4 SW-1/4 of the section is overgrown with cattails which catch snow and reduce the capacity of the channel. The work would also include the removal of cottonwood trees and willows immediately upstream of the culverts under the south section line road. No channel excavation would be done along this reach of the channel.

Area "C": Section line between Section 16 and 21
The work consists of placing a gate on the upstream side of the 24 inch concrete culvert under the section line road between section 16 and 21. The culvert is approximately 1200 feet east of the section corner common to sections 16, 17, 20 and 21. This gate would control the inflows to Lake Nettie from north watershed and prevent diverted flows from Turtle Creek from reaching Lake Nettie. The gate will backup water and force in down the cleaned (improved) portions of the Turtle Creek. Operation plan: The gate would only be closed during spring snow melt periods (December 1st to 15 days after snowmelt begins). After the runoff from the spring snowmelt has occurred the gate would

remain open. Survey data will have to be obtained to determine the extent of backup water behind the culvert. The water impounded behind the culvert would only be temporary, approximately 10 to 15 days and then released into Lake Nettie. The tail-water from this impoundment would force majority of the water down the main channel of Turtle Creek.

Area "D": E-1/2 NW-1/4 Section 21 T148N R81W
The work consists of removing the dead and live cottonwood trees, willows and vegetative growth from the main channel of Turtle Creek. This reach of the channel has a very heavy growth of trees, cattails and grasses which greatly reduce the movement of water through this reach of channel. This vegetative growth also causes a high tail water condition on the culverts under the road between sections 16 and 17; thereby, reducing their efficiency.

Area "E": SE-1/4 SE-1/4 NW-1/4 Section 21 T148N R81W
The work consists of removing the eastern most 250 feet of the old WPA deflector dike. The dike was part of the original WPA diversion works into Lake Nettie. The dike is an obstruction during periods of high flows in Turtle Creek and cause water to back-up north of the dike.

Area "F": Main Channel Turtle Creek South of the Refuge
Selected portion of the channel south of the refuge would be mowed and cleared. The work would extend downstream to the McClusky Canal. The channel through this reach is quite wide but has a very shallow slope (0.0005 ft/ft). No excavation would be done on this reach of the channel, however, one farm crossing would be up graded.

Area "G": NW-1/4 SE-1/4 NW-1/4 Section 28 T148N R81W
The area cross-hacked on the map would be surveyed as the location for the Lake Nettie control structures. The control structure would be designed to permit Lake Nettie to be drawn down to elevation 1839 msl. The control would be two 24" by 18" gated steel pipe-arch culverts or a 5 foot wide stop-logged structure. Either of these structures would allow for controlling the elevation of Lake Nettie above elevation 1839.0 msl. In addition to the structure, an inlet and outlet channel would have to be constructed. The structure would discharge into Mud Lake. The area farms had originally requested 1837 msl; however, this would require a major channelization of Turtle Creek which would result in damages to wildlife interest in the Mud Lake area of the refuge.

Current plans do not anticipate channel mowing or spraying in the areas of Britton Slough or Mud Lake. Some selected mowing or spraying would improve flow condition through these portions of the refuge.

It is important to remember that discharges from Mud Lake currently stop at elevation 1839 msl. The F.W.S. have stated that this appears to be a good operating level for Mud Lake. Therefore, with Mud Lake elevation set at elevation 1839 msl. it would be extremely costly to lower Lake Nettie and Crooked Lake below the 1839 msl elevation.

The estimate cost of the improvement area as follows:

Area A & B -	Mowing (ALT)	$ 640 annually
	Spraying (ALT)	200 annually
Area B -	Tree removal	400
Area C -	Gate Installation	900
Area D -	Channel Clearing (Tree Removal)	1,300
Area E -	Dike Removal	950
Area F -	Channel Improvements	3,000 to 5,000
Area G -	Control Structures	
	a) Arched pipe	3,900
	b) Stop log structure	2,500
	Channel excavation & seeding	7,300

5.5 South Outlet to Lake Nettie

This proposal was to construct an outlet channel from the south end of Lake Nettie in the SE-1/4 SE-1/4 of section 29 T148N R81W. The channel would have run for 14,000 feet southeast to Turtle Creek. The channel would have had some cuts in excess of 20 feet with the average cuts between 5 and 6 feet. With the deep cuts and the length of the channel it was determined that this alternative was not feasible.

Note: The costs presented in this section are only preliminary estimates and would be refined when one of the alternatives is selected.

6.0 Recommended Course of Action

The McLean County Water Resource District is recommending that alternative 5.4 be implemented. This alternative involves the improvement of the main channel of Turtle Creek and the construction of an outlet to Lake Nettie. The construction of the Lake Nettie outlet would allow the Nettie-Crooked Lake system to be drawn down to 1839 msl. The District believes that this alternative allows a degree of flexibility in the operation of the system and proved reliefs to area landowners. It restores Turtle Creek to its original condition and provides for the movement of water through the area. The District also believes it is extremely important to make some progress toward a solution of this problem. The District has prepared an application to the State Engineer to set a level on Lake Nettie and Little Crooked Lake. The actions proposed by the District are not irreversible and would go a long way toward solving the problems associated with the high water in the Lake Nettie system.

APPENDIX

PRELIMINARY PROPOSAL

LAKE NETTIE PROJECT

Sponsored by the

MCLEAN COUNTY WATER
RESOURCE DISTRICT

Prepared by
Stephen M. Hoetzer, P.E.

January 1984

PRELIMINARY PROPOSAL
LAKE NETTIE PROJECT

The following plan has been formulated to reduce surface water flooding in the Lake Nettie area. The plan is put forward as a starting point to begin discussion with all parties involved in the area. This project in being proposed by the McLean County Water Resource District with the hope that a sound project can be developed and work begun on the project in 1984. The project as proposed stresses minimum structural and earth moving work with the main emphasis on channel clearing and restoration.

Over the past five or six years various reasons for the rise in Lake Nettie and Crooked Lake have been talked about. The U.S.G.S. has just completed a study which gives some indications as to the causes of the high water problems in the Lake Nettie area. The rising of Lake Audubon appears to have had an affect on the lake levels but another cause for the rises appears to be direct precipitation and surface water runoff. The Lake Nettie area since 1975 has experienced higher than average precipitation and large amounts of surface water runoff. Crooked Lake and Lake Nettie have a large drainage area; granted much of it is non-contributing but the watershed is still large enough to cause significant rises in the lake system. It is important to remember that Lake Nettie and Crooked Lake is a closed system. Once the water enters the lakes there is no outlet except through seepage and evaporation.

Therefore, the major thrust of this propose is to prevent some of the water from the main channel of Turtle Creek from entering Lake Nettie. The District believes that a large quantity of water is naturally diverted into Lake Nettie just north of the refuge in the SE-1/4 SW-1/4 of Section 9 T148N, R81W. This diversion is brought about by farming practices, mainly haying, and the heavy vegetative growth on the main channel of Turtle Creek on both private and refuge land. The ideas set forth in this proposal are an attempt to improve the existing channel, prevent water from reaching Lake Nettie and to set a permanent control elevation on Lake Nettie.

The proposed project consists of seven (7) work areas. The approximate location of these seven areas are shown on the attached map.

Area "A" Location: SE-1/4 SW-1/4 Section 9 T148N R81W

The area is adjacent to the north boundary of the refuge. The work consists of mowing and clearing approximately 800 feet of channel and removing any obstructions in the channel. It appears that there may be an obstruction at the section line between sections 9 and 16. Obstruction to be removed would be rock piles or the remains of old dugouts or waterholes.

Area "B" Location: E-1/2 W-1/2 Section 16 T148N R81W

The work consists of mowing and clearing the main channel of Turtle Creek through the refuge in Section 16. It also includes the removal of an obstruction and the removal the cottonwood trees immediately upstream of the culverts under the section line between sections 16 and 21. No channel excavation would be done along this reach of the channel.

Area "C" Location: Section line between Section 16 and 21

The work consists of placing a gate on the upstream side on the culvert under the section line road between section 16 and 21. The culvert is approximately 1000 feet east of the section corner common to section 16, 17, 20 and 21. This gate would control the inflows to Lake Nettie from Turtle Creek and prevent diverted flows from Turtle Creek from reaching Lake Nettie. The gate will backup water and force in down the cleaned (improved) portions of the Turtle Creek. Operation plan: The gate would only be closed during spring snow melt periods (December 1st to 15 days after snowmelt begins). After the runoff from the spring snow melt has occurred the gate would remain open. Survey data will have to be obtained to determine the extent of backup water behind the culvert. The water impounded behind the culvert would only be temporary, approximately 10 to 15 days and then released into Lake Nettie. The tail water from this impoundment would force the majority of the water down the main channel of Turtle Creek.

Area "D" Location: E-1/2 NW-1/4 Section 21 T148N R81W

The work consists of removing the dead and live cottonwood trees and vegetative growth from the main channel of Turtle Creek. This reach of the channel has a very heavy growth of trees, cattails, and grasses

which greatly reduce the movement of water through this reach of channel. This vegetative growth also causes a high tail water condition on the culverts under the road between sections 16 and 21 thereby reducing their efficiency.

Area "E" Location: SE-1/4 SE-1/4 NW-1/4 Section 21 T148N R81W

The work consists of removing the eastern most 500 feet of the old WPA deflector dike. The dike was part of the original UPA diversion works into Lake Nettie. The dike is an obstruction during periods of high flows in Turtle Creek and cause water to back-up north of the dike.

Area "F" Location: Main Channel Turtle Creek South of the Refuge

Selected portion of the channel south of the refuge would be mowed and cleared. The work would extend downstream to the McClusky Canal. The channel through this reach is quite wide but has a very shallow slope (0.0005 ft/ft). No excavation would be done on this reach of the channel, however, one farm crossing would be up graded.

Area "G" Location: NW-1/4 SE-1/4 NW-1/4 Section 28 T148N R81W

The area cross-hacked on the map would be surveyed as the location for the Lake Nettie control structures. The control structure would be designed to permit Lake Nettie to be drawn down to elevations 1839 msl. The area farms had originally requested 1837 msl; however, this would require a major channelization of Turtle Creek which would result in damages to wildlife interest in the Mud Lake area of the refuge.

Current plans do not anticipate channel mowing or clearing in the areas of Britton Slough or Mud Lake. Some selected mowing would improve flow condition through these portions of the refuge.

It is important to remember that discharges from Mud Lake stop at approximately elevation 1839 msl. The F.W.S. have stated that this appears to be a good operating level for Mud Lake. Therefore, with Mud Lake elevation set at elevation 1839 it would be extremely costly to lower Lake Nettie and Crooked Lake below the 1839 elevation.

These proposal are presented as a starting point to begin discussions on the Lake Nettie problem. The District believes it is extremely important to

make some progress toward a solution of this problem. None of the proposed actions in this plan are irreversible and would go a long way toward solving the problems associated with high water in the Lake Nettle area.

-- HOETZER --

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

GARRISON DIVERSION UNIT

NORTH DAKOTA

D. Monitoring Program

Monitoring program should include, but not be limited to, the following components:

1. Quantify continued loss of islands (numbers and acres) and bank shoreline erosion. This can be documented by aerial or 35mm photography.

2. Quantify and qualify hydrological changes to wetlands lying adjacent to Lake Audubon.

3. Quantify and qualify wildlife production and use on Lake Audubon NWR.

4. Conduct a limnological study of Lake Audubon. This study should evaluate existing conditions (i.e., turbidity, algae growth, temperature, etc.) as it relates to the existing sports fishery. This study should also be expanded to include post-GDU operational conditions.

Lake Nettie NWR

A. Background Data - This refuge is located in McLean County in central North Dakota (Figure 4). It was established in 1939 as an easement refuge. The refuge now includes 2,261 acres owned in fee title and 634 acres protect by easement. Wetlands consist of Lake Nettie, a 390-acre, Type V marsh, and 1,060 acres of Type I, II, II, and IV wetlands. Waterfowl concentrations during migration average several thousand ducks, geese, and swans each spring and fall. Additionally, over 12,000 sandhill cranes utilized Lake Nettie in October 1975. The refuge also provides cover for many of the white-tailed deer in the area.

B. GDU Impact Analysis - The pools at the refuge are maintained by runoff from surrounding land, direct precipitation and the Lake Nettie aquifer that extends north and east from Lake Audubon (Figure 5). Water level readings taken by FWS employees from 1962 to 1975 indicate that lake levels had remained stable for several years. However, surface water levels in Lake Nettie and Mud Lake (marsh pool) have risen steadily since 1975. The result is flooding of adjacent county and township roads, and wildlife habitat existing on the refuge. Lake Nettie is approximately 3 to 4 feet

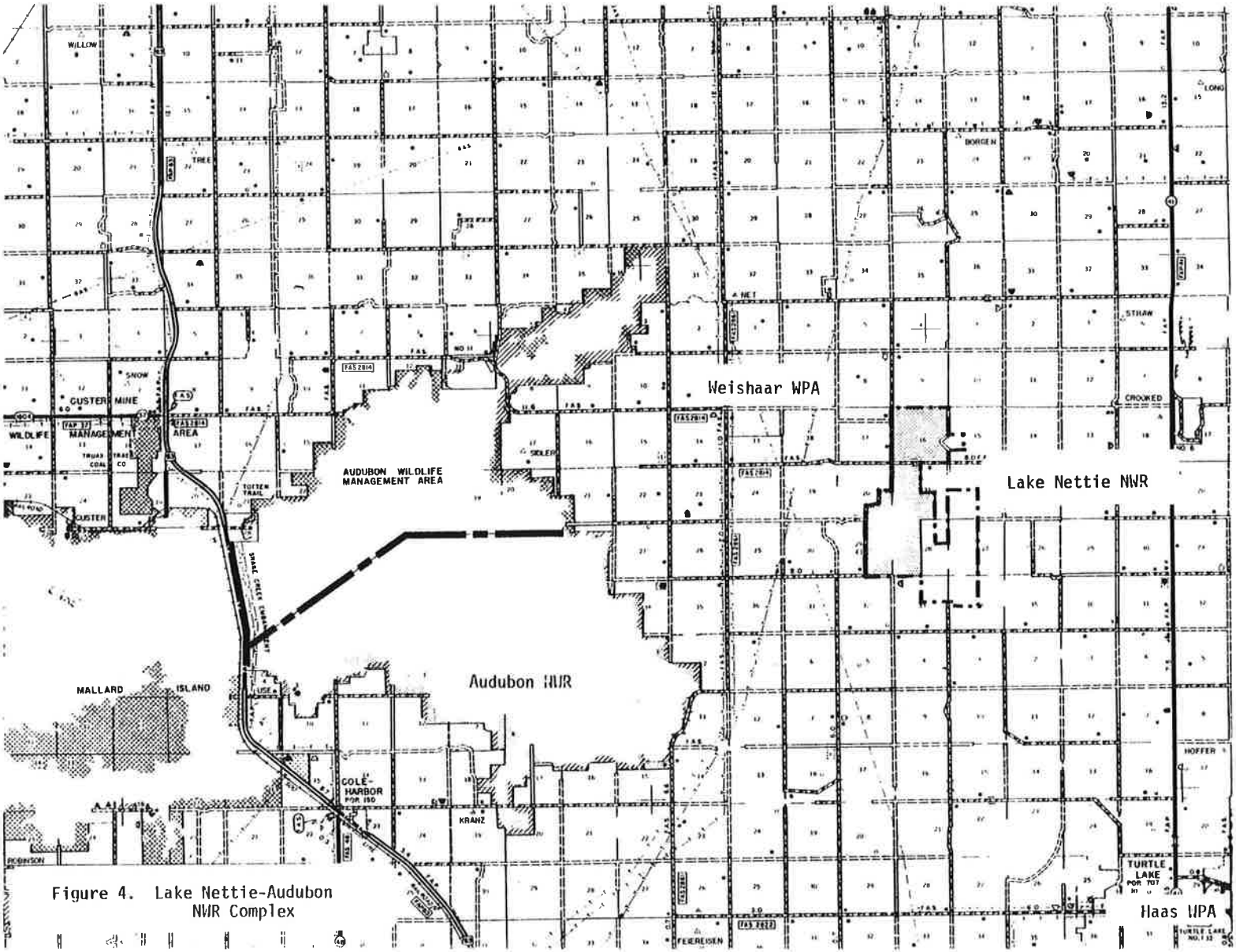

Figure 4. Lake Nettie-Audubon NWR Complex

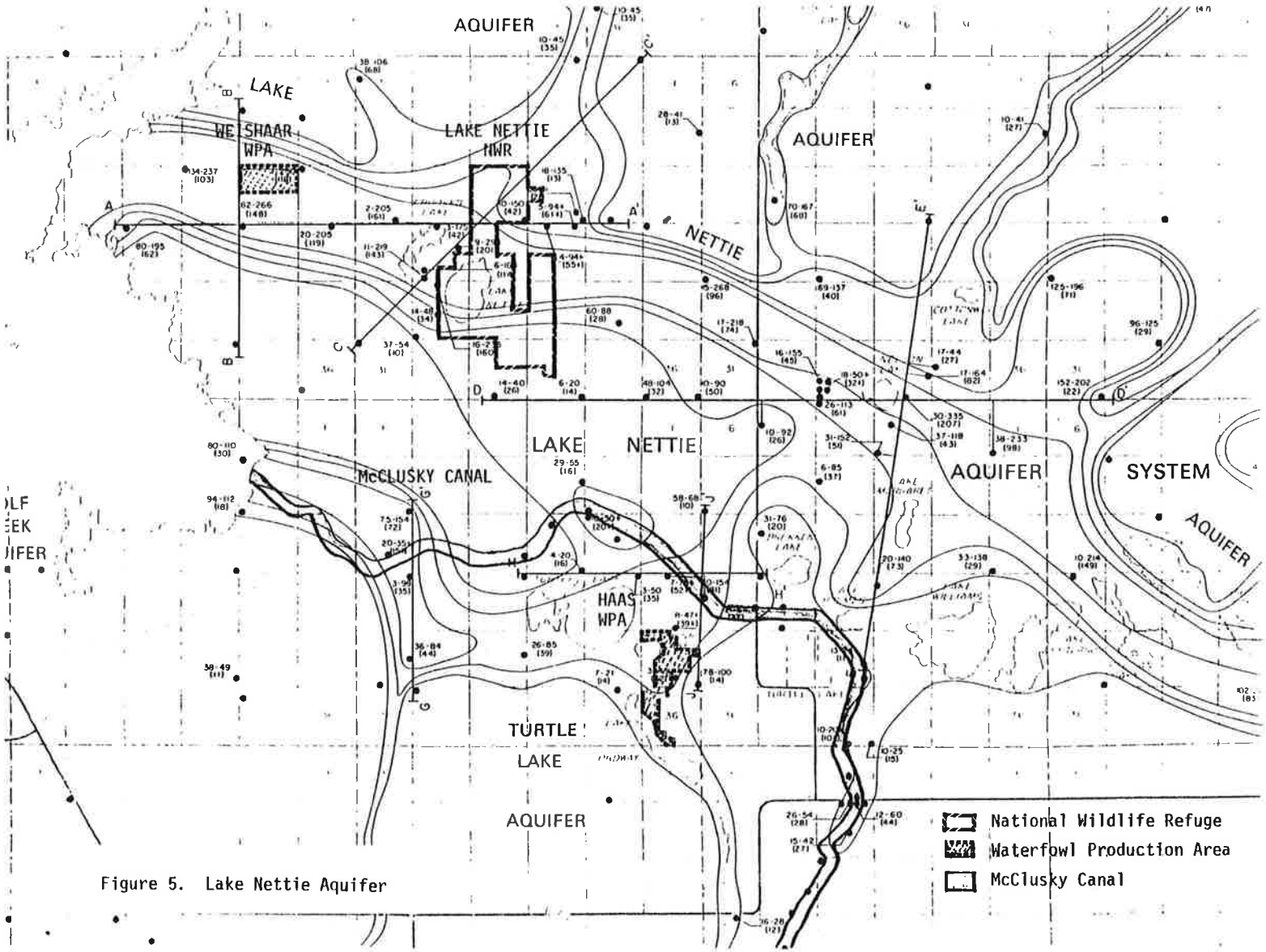

Figure 5. Lake Nettie Aquifer

higher now than recorded during the 1962 to 1975 period. Impacts include the conversion of Type II wet meadow to Type III and Type IV marsh; conversion of Type III and IV marsh to Type V open water; and the loss of upland. The USGS (1983) indicated that the rise at Lake Audubon had contributed up to 2 feet of the rise at Lake Nettie. Abnormal precipitation contributed the remainder of the rise. The 1 and 2 feet can be considered a permanent rise, and may be greater if Lake Audubon is elevated to 1850 feet (msl).

The above description is the FWS's preliminary assessment on the hydrological changes to the Lake Nettie NWR area. We are presently studying available data for the Lake Nettie NWR area. This study will include the Final USGS Audubon-Lake Nettie groundwater study, surface drainage into Turtle Creek and/or Lake Nettie-Mud Lake complex, climatological data and completed management plan(s) for the Lake Nettie NWR complex. When this study is completed the FWS will be better able to quantify (1) non-project and project inflows, and (2) corresponding degrees of impact to wildlife and their associated habitats. Therefore, we have deferred our alternatives until the completion of our analysis.

C. Alternatives (Deferred)

1. If seepage from Lake Audubon can be reduced or eliminated by reducing the elevation of Lake Audubon or by some other means, the cost of acquiring land and/or easements could be avoided.

2. If the water level at Lake Audubon is maintained at 1848 feet, or raised to 1850 feet, the water levels will continue to be a problem at Lake Nettie and surrounding areas. The McLean County Commission recommended that a water control structure be constructed at the south end of Mud Lake to remove excess water from Crooked Lake, Lake Nettie, and Mud Lake. There is a natural drainage from Mud Lake to Turtle Lake. From Turtle Lake the water would be channeled down Turtle Creek to the Missouri River. There would have to be a minimum of three parcels acquired at Lake Nettie and at least a flowage easement between Lake Nettie and Turtle Lake. A structure capable of regulating the water level from completely full to completely empty would be necessary for management purposes. An agreement would have to be arranged between FWS and BR and/or McLean County to provide sufficient water removal capability while preserving the waterfowl management purposes of the refuge. This alternative should be implemented when the GDU authorized plan becomes operational. In the interim, a reduced Lake Audubon 1843 feet (msl) operating level would aid in resolving the current Lake Nettie high-water problems until the authorized 250,000-acre plan is implemented.

D. Monitoring Program

Monitoring program should include, but not be limited to, the following components:

1. Quantify and qualify hydrological changes to wetlands on Lake Nettie NWR.

2. Quantify and qualify hydrological changes to wetlands on Lake Nettie NWR.

3. Compare annual aerial and 35mm photography by season.

4. Quantify and qualify vegetative changes. This can be documented by aerial or 35mm photography.

5. Quantify and qualify wildlife production and use on Lake Nettie NWR.

Sheyenne Lake - Coal Mine Lake NWR

A. Background - This easement refuge complex is located in central North Dakota and was established in 1935. The refuge comprises 799 acres of water, including flowage easements on Sheyenne Lake and Coal Mine Lake and refuge easements on 210 acres of upland habitat surrounding Sheyenne Lake. The main lakes and associated wetlands form the headwaters of the Sheyenne River.

The refuge is used by a variety of nesting and migrant waterfowl (especially canvasback, mallard, redhead and ruddy duck), shorebirds, grebes, pelicans, and other wetland related species of wildlife. Faanes (1982) estimated that about 22,000 breeding bird pairs including 92 species nested in the Sheyenne Lake-Coal Mine Lake region in 1980. Faanes found 34 breeding bird species on his 24.8-hectare sampling area of Sheyenne Lake. That total represents about 37 percent of all breeding bird species on the 8,128-hectare Lonetree Reservoir study area.

B. GDU Impact Analysis - Sheyenne Lake-Coal Mine Lake NWR is located within the proposed boundary of Lonetree Reservoir. Construction of Lonetree Reservoir will inundate the refuge.

C. Alternatives

1. Previous reports have stated that the Johnson Lake Fish and Wildlife Area, located in Sheridan and Wells Counties, would be acquired to replace Sheyenne Lake-Coal Mine Lake NWR.

2. This refuge was included in the 1982 HEP analysis and losses credited in the proposed 1982 wildlife plan. It is suggested that the procedure established to replace FWS wetland easements (see page 12) be considered for the replacement of this easement refuge.

APR 2 0 1983

460

Mr. Roger Branning
Department of Army
Corps of Engineers
P. O. Box 517
Riverdale, North Dakota 58565

Dear Mr. Branning:

In reference to solutions to the high water problems in the Audubon Lake - Lake Nettie areas, enclosed for your information are: (1) a report of the field trips to Lake Nettie Refuge on February 17 and 18, 1983; (2) survey data collected at Lake Nettie Area on February 18, 1983: and (3) Bureau of Reclamation memorandum to Project Manager on the February 22, 1983, McLean County Commissioner's meeting at Washburn.

In addition, on March 7, 1983, Mr. Ron Wagner of the McLean County Highway Department at Washburn (462-3277) informed our office they have located a source of fill material for raising the road along the west side of Lake Nettie. The borrow area is located near the south quarter corner of Section 17, T. 148 N., R. 81 W. This borrow area is within 3/4 mile of the work site, has good access to highway #8, and is gravelly material with some binder.

By copy of this letter, the enclosed information is being forwarded to Mr. Stan Zschomler, Fish and Wildlife Service, Bismarck, and Mr. Ron Shupe, Refuge Manager, Audubon Refuge, Coleharbor, North Dakota.

Please contact Arden Mathison of my staff if you have any questions concerning the enclosed information.

Sincerely yours,

JOHN E. KNOLL

John E. Knoll
Chief, Water and Land
Operations Division

Enclosures

cc: (w/copy of enclosures)

Mr. Stan Zschomler
Field Supervisor-Environment
U.S. Fish and Wildlife Service
1500 Capitol Avenue
Bismarck, North Dakota 58501

Mr. Ronald Shupe
Refuge Manager
Audubon National Wildlife Refuge
R.R. 1
Coleharbor, North Dakota 58531

bc: (w/copy of enclosures)

430
200
230
700
400-File

AEMathison:mbh 4-18-83

FIELD TRIP REPORT
TO LAKE NETTIE REFUGE
February 17 and 18, 1983

A joint field review of the Lake Nettie Refuge area was held on February 17, 1983. In attendance were [redacted].

The purpose of the field trip was to inspect existing water conditions in Crooked Lake, Lake Nettie, Mud Lake and Turtle Creek. The water levels have generally been higher than previously normal since 1976 the same year Audubon Lake was raised from 1835 to 1848 elevation. It is contended that raising Audubon Lake has contributed to the higher water levels in the Lake Nettie area. The high water has been encroaching on about 2,000 feet of the county road along the west side of Lake Nettie hindering traffic. The joint field review was to also identify and recommend a solution (or solutions) to the problem. The USGS quad sheets and USBR aerial photographs taken on June 10, 1982, were used to identify the various features and high water areas along the county road.

The obvious solution to the problem is to raise about 2,000 feet of road about three feet and install a new culvert to equalize the water surface in Lake Nettie and Crooked Lake. A source of fill material nearby would be required.

The CCC dike on Turtle Creek and diversion channel into Lake Nettie was inspected. The channel was plugged off many years ago and the road crossing also acts as a plug with a culvert in it that is nearly plugged. [redacted]

Near the southeast edge of Lake Nettie there is a natural swale that is near Mud Lake with a ridge in between. If it ever became necessary, an overflow channel about 600 feet long and about 6 feet deep at the deepest could be constructed from Lake Nettie to Mud Lake. It was agreed that an overflow channel would only be necessary if Crooked Lake and Lake Nettie raised several feet higher than at present. It was also agreed that if water control structures became necessary, they should be on Turtle Creek and Mud Lake outlet.

Ron Shupe indicated that Mr. Arlo Beggs is willing to sell his land adjacent to Crooked Lake and Lake Nettie for expansion and improvement of the Lake Nettie Refuge. Mr. Albert Klein owns about 160 acres of land surrounded on three sides by the Lake Nettie Refuge and along Turtle Creek. The Fish and Wildlife Service would like to acquire this in-holding to improve Lake Nettie Refuge, but Mr. Klein is apparently not willing to sell at fair market value. The overflow channel if ever constructed would enter Mud Lake downstream of Mr. Klein's property.

Mr. Zschomler preferred that for purposes of the field review, we limit discussions to solutions of the wet road conditions. The Garrison Diversion Unit mitigation plan to acquire land from willing sellers requires development of new criteria and HEP analysis of the property involved. The FWS may acquire additional Lake Nettie refuge lands separate from the Garrison Diversion Unit mitigation plan under separate authorizations.

Mr. Shupe indicated that Crooked Lake and Lake Nettie went down about 3 or 4 inches last summer due to net evaporation. During the summer of 1983, Audubon Lake went down about 5 or 6 inches due to evaporation. This below normal net evaporation is an indication of the above normal precipitation.

Due to the frozen ice conditions and small differences in elevations it was agreed that surveys would be necessary to support any recommendations. Arden Mathison indicated he would arrange to obtain the elevations prior to the County Commissioner's meeting on February 22nd.

Roger Branning proposed that the Corps raise the county road #8 and township road closer to Audubon Lake and the Bureau of Reclamation raise the Lake Nettie road. This was based on the assumption that agency O&M crews would do the work. Another possible option would be to contract out the work.

On February 18, 1983, I called Mr. Dave Sprynczynatyk and briefed him about the plans to recommend raising the road by Lake Nettie and not to recommend any water control structures at this time. Dave was also informed of the February 22nd meeting at Washburn and he indicated he planned to attend. Lake Nettie is a meandered lake that is within the Lake Nettie Refuge.

On February 18, 1983, Al Senger and Arden Mathison surveyed the ice surface elevation of Crooked Lake, Lake Nettie, county road, Mud Lake (near Lake Nettie), CCC diversion inlet channel and plugs, and the ridge between Lake Nettie and Mud Lake. The survey notes and location map are attached to this trip report.

A hole was drilled through about two feet of ice on Crooked Lake. There was no hydrostatic pressure on the water under the ice. The ice surface on Crooked Lake and Lake Nettie was nice and smooth also indicating no hydrostatic pressure under the ice. Turtle Creek was frozen solid to the ground south of Mud Lake indicating no discharge below the ice. This all indicates very little if any ground water leakage upward through the confining layer above the Lake Nettie Aquifer.

On February 18th, the temperature was up to 60°F. and snowmelt runoff filled the area upstream of the CCC dike. The water was overflowing from Turtle Creek to the east-southeast around the dike and into Mud Lake. Water was flowing into Lake Nettie through the natural channel west of and parallel to Turtle Creek. There was less flow in this channel than in Turtle Creek.

Enclosures (Survey Notes & Map)

LAKE NETTIE AQUIFER STUDY
CROOKED LAKE, LAKE NETTIE, MUD LAKE
ICE AND INLET ELEVATIONS
February 18, 1983

B.M. - USBR Staff Gage on Crooked Lake ≈1900'E. of NW Corner of Section 20, T. 148 N., R. 81 W. - Top of Pipe Elev. 1842.15 (Also serves as obs. well).

- Drilled Hole Through ≈2 Ft. of Ice - Water Surface 0.2' Below Ice Surface - No Pressure Under Ice - Tape Reading on Obs. Well 1.4' - Ice in Obs. Well @ 1840.75 Elev.

B.M.	B.S.	H.I.	F.S.	ELEV.	FEATURE
1842.15 Staff Gage	3.8	1845.95	4.8	1841.15	Ice Surface on Crooked Lake
1841.15 I.S. Crooked Lake	5.6	1846.75	4.7	1842.05	Top of Corrugated Pipe Culvert (12" dia.) and Road Surface ≈2400' South of NE Corner of Section 20, T. 148 N., R. 81 W. (Pipe Exposed - Poor Condition)
			5.4	1841.35	Road Surface Elev. at Lowest Point ≈ 2000' South of NE Corner of Section 20, T. 147 N., R. 81 W. (Road 0.2' Above Ice Surface on Crooked Lake)
			5.7	1841.05	Ice Surface on Lake Nettie ≈ 2400' South of NW Corner of Section 21, T. 148 N., R. 81 W. (Ice 0.1' Lower Than Crooked Lake)
1841.05	5.9	1846.95	3.7	1843.25	Refuge Road X-ing on Inlet Top of Culvert - E. End 3/4 Plugged with Dirt Est. Invert 1842.25 of 12" Dia. CMP
			3.2	1843.75	Top of Culvert - W. End Est. Invert 1842.75
			2.1	1844.85	Top of Road Surface Refuge Road ≈ 2850' South, 1750' East of NW Corner of Section 21, T. 148 N., R. 81 W.
			5.1	1841.85	Ice E. of Road Trapped in Inlet Channel (0.8' Higher Than Lake Nettie)

B.M.	B.S.	H.I.	F.S.	ELEV.	FEATURE
1841.85	7.6	1849.45	4.4	1845.05	Top of Plug Inlet Channel (1.3' Freeboard Today)
			5.7	1843.75	Water Surface Upstream of Plug Flowing in Turtle Creek Around East Side of Dike (60°F Melting Today) - 1983 Water ≈ 0.7' Deep on Top of Ice
			6.4	1843.05	Ice Surface Below New Water Assumed to be 1982 Water - ≈ 2 Ft. Higher Than Lake Nettie - Top of CCC Dike Est. 1846± (Too Wet to Survey Without Boots) - Water Flowing Thru Both Culverts - One on Turtle Creek and Another 1100' West Flowing into Lake Nettie - More Flow in Turtle Creek - No Flow Out of Mud Lake Today
1841.05 I.S. Lake Nettie	7.7	1848.75	3.3	1845.45	Ground Surface on Top of Ridge Between Lake Nettie and Mud Lake at Possible Overflow Outlet Site
			7.9	1840.85	Ice Surface on Mud Lake - 3700' North, 2100' East of SW Corner of Section 28, T. 148 N., R. 81 W.

SUMMARY:

Ice Elevations - February 18, 1983

Crooked Lake -	1841.15		
		Diff. - 0.1'	
Lake Nettie -	1841.05		
		Diff. - 0.2'	
Mud Lake -	1840.85	(Approx. Overflow Elev.)	
Inlet Channel @ CCC Dike on Turtle Creek	1843.75	W.S. ('83)	Diff. + 3.7'
	1843.05	I.S.	Diff. + 3.0' Above Nettie And 3.9' and 3.2' Above Mud Lake

Lake Nettie will Overflow at Elev. 1845.05 at Inlet Plug, or Elev. 1845.45 at Overflow Outlet Site.

Raising Road 3 ft. Would Provide Top of Road Elev. of 1844.4 at Lowest Point and 1845.0 at Existing Culvert. Road Should Probably be Raised to Elev. 1845.0.

Raising Road 4 Ft. Would Provide Elev. of 1845.4 and 1846.0 on Road Top.

UNITED STATES GOVERNMENT

memorandum

DATE: April 18, 1983

REPLY TO ATTN OF: Chief, Drainage Branch

SUBJECT: Meeting with McLean County Commissioners and Other Local, State and Federal Officials at Washburn on February 22, 1983, Regarding Proposed Solutions to High Water Problems on County Roads in the Vicinity of Audubon Lake and Lake Nettie

TO: Project Manager

Thru: 400

The subject meeting was arranged as per minutes of the January 21, 1983 meeting with the Corps of Engineers. The County Commissioners meeting was called to order at 8:30 a.m. by Chairman Nordquist. Others present represented the McLean County Water Resource District, State Engineer's Office, Corps of Engineers, Fish and Wildlife Service, the Bureau of Reclamation, and the Washburn McLean County Journal. Jack Knoll and Arden Mathison represented the Bureau. (Official minutes of the meeting were taken by the County Auditor.)

Arden Mathison was called upon to brief those in attendance. A brief report of the November 3, 1982 and January 21, 1983 meetings was given for background. Most of those present were well acquainted with the wet road problems being discussed. The USGS quad sheet map and the June 10, 1982 composite aerial photograph were used to describe the areas of concern. Each problem and proposed solution was described.

The proposed temporary solution of pumping water from the low area by county road #8 nearest Audubon Lake was generally considered to be too costly and unacceptable as a permanent solution.

Raising the county road and township road by McLean Slough was considered acceptable and will be recommended by the Corps of Engineers. In one of the two locations the county road #8 was raised last fall above water surface by the Corps with assistance from the USBR O&M forces.

Raising about 2,000 feet of the county road along the west side of Lake Nettie was agreed to be the best solution and will be accomplished by the Corps and/or USBR. The county will arrange for a source of fill material and a culvert.

It was mentioned that the cost of studies to clearly define the relationship of the high water in the Lake Nettie area to the raising of Audubon Lake would cost more than raising the road. The Commissioners agreed and feel the Federal Government should accept the primary responsibility in this situation and avoid any further disagreements. The Fish and Wildlife Service indicated approval to raising the road along the Lake Nettie Refuge.

The meeting adjourned at 9:15 a.m.

After the meeting, Roger Branning, Jack Knoll, Ron Shupe and Arden Mathison

discussed additional details on how to accomplish the work. The possibility of raising the Lake Nettie road by USBR purchase order was discussed with the Corps reimbursing the USBR for a portion of the work.

Subsequent to the meeting, Roger Branning indicated the Corps plans to contract for the township and county road #8 near Audubon Lake. Because of the high water on the Lake Nettie road a faster method than contracting may be required. The USBR will either prepare a contract or purchase order to complete the work. Mr. Branning indicated that the Corps of Engineers will reimburse the Bureau for one-half the cost. Because the water is on the road, the fastest procedure possible should be utilized.

On March 7, 1983 Mr. Ron Wagner of the McLean County Highway Department informed our office that a suitable source of fill material for the Lake Nettie road was located near the south quarter corner of Section 17, T. 148 N., R. 81 W.

Arden E. Mathison