Pickerel Lake Water Quality
Study Area Report

Prepared by
South Dakota Department of Water and Natural Resources
Water Quality Management Section

July 1985

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Pickerel Lake WQSA Summary

The Pickerel Lake Water Quality Study Area encompasses about 15,015 acres in Day, Marshall, and Roberts Counties with the majority of the drainage area situated in Day County. Pickerel Lake is the deepest natural lake in South Dakota and encompasses 935 acres in northeastern Day County. The lake is classified under the South Dakota State Water Quality Standards for the beneficial uses of warm water permanent fish life propagation, limited contact recreation, immersion recreation, wildlife propagation, and stock watering. The lake has a maximum depth of 43 feet and a mean depth of 22 feet. Symptoms of eutrophication such as blue-green algal blooms and aquatic weeds are present annually. The South Dakota Department of Game, Fish and Parks manages Pickerel Lake for walleye, perch, crappie, northern pike, largemouth and smallmouth bass. No winter or summer fish kills have been documented.

Approximately 62% of the Pickerel Lake watershed is grassland, 30% cropland and 7% water and wetland area. The U.S. Soil Conservation Service (SCS) has estimated that 68% of the drainage area was adequately treated in 1980.

Over 330 homes, cabins and trailer houses are presently located on Pickerel Lake. Other lakeshore developments include three resorts, two restaurants, a YMCA camp, a Bible camp, two State recreational areas, and a State fish hatchery. Pickerel Lake has extensive public use as a recreational area and there is considerable local interest in the lake as evidenced by strong local support of the Pickerel Lake Preservation Project.

A water quality monitoring program was in operation from 1979 to 1984 to determine water quality characteristics and identify water quality problems within Pickerel Lake and its watershed. Samples were collected at nine sites: Sites 1 to 5 were on intermittent streams entering the lake; Site 6

sampled the lake outflow; and Sites 7 to 9 were in-lake sampling sites. Samples were collected on the intermittent streams after rainfall events and during snowmelt runoff. In-lake samples were collected twice a month during the spring, summer, and autumn and once a month during the winter season.

In-lake sampling indicated Pickerel Lake to be eutrophic as evidenced by high concentrations of total phosphorus and organic nitrogen. The main problem at Pickerel Lake appears to be dangerous nutrient loading from the watershed. Estimates based on tributary sampling at Sites 4 and 5 indicated that areal loads to the lake exceeded .15 g/m^2/year P in 1979 and 2.22 g/m^2/year N in 1979 and 1982. These loads exceeded the permissible loading levels designated by Vollenweider (1968). If left unchecked, these nutrient loads will accelerate eutrophication processes in Pickerel Lake.

Water quality analysis has also indicated:

1. Based on the ratio of total nitrogen to total phosphorus, Pickerel Lake may be shifting from a lake that would tend toward phosphorus limitation to one that tends toward nitrogen limitation.

2. The trophic state indices calculated from total phosphorus concentrations indicate that total phosphorus is increasing in the lake over time.

3. The lake is very productive for a warm water fishery. The dominant fraction of nitrogen is organic and is probably derived from agricultural loading. Because Pickerel Lake is a popular recreation lake and because it is the deepest natural lake in South Dakota, emphasis should be placed on the lake to reduce non-point sources of nutrients in order to prevent lake degradation.

Shoreline erosion contributed nearly 98% of the sediment to Pickerel Lake or about 9,310 tons (7 acre-feet) per year. Sediment contribution from the watershed (208 tons/year) was relatively minor largely due to the settling action of numerous sloughs and potholes in the drainage area.

Excessive fecal coliform levels were observed in-lake three times at Site 7 and once at Site 8. Also, excessive fecal coliform levels were observed at tributary Sites 1 and 2. Non-point sources of pollution from the watershed as indicated by high nutrient loading and excessive fecal coliform levels are poor crop and grassland management, feedlots lacking pollution controls, streambank erosion, and failing individual septic tank systems.

A total of 8% of the watershed was treated with BMPs during the Pickerel Lake Preservation Project which brought the total percentage of treated watershed land to an estimated 76%. Permanent grass cover was established on 461 acres in Day County and 107 acres in Roberts County. One hundred acres in Day County were placed under the no-till system.

One animal waste management system and stock dugouts on five farms serving over 360 acres, were completed in 1982 and 1983. Several new septic tank systems were installed by lakeshore cabin owners and a new septic tank drainage field system was constructed for the Pickerel Lake Lodge. Total treated acreage during the Pickerel Lake Preservation Project amounted to about 1,027 acres.

Nutrient loading to the lake from the watershed may be reduced by using Best Management Practices (BMP's) such as proper fertilizer management practices, minimum tillage, proper rangeland management and feedlot wastewater control systems. Land owners need to maintain existing BMPs or else any gains in nutrient and sediment reduction will be lost. A septic tank survey should be

conducted around the lake to identify problem areas and technical assistance should be provided to control existing problems. Shoreline stabilization is recommended in rapidly eroding areas. After the above measures are implementated, selective dredging and chemical phosphorus flocculation may improve water quality and the overall recreational potential of the lake.

I. Pickerel Lake Watershed Description

A. General Description

Pickerel Lake is a popular recreational lake located in northeastern Day County. It is the deepest natural lake in South Dakota, having a maximum depth of 43 feet and a mean depth of 22 feet. The elongated lake has a surface area of 955 acres and 9.4 miles of shoreline (Marrone, 1978). The bottom is predominantly rubble with scattered areas of sand and gravel. Silt and organic clay are found in the bays and deeper areas of the lake.

Pickerel Lake is one of the recharge areas for the Basal System, Pierre Aquifer, and shallow aquifers in the vicinity of a chain of lakes known as the Waubay Lakes Basin. Water is supplied to the lake by direct precipitation, watershed runoff and groundwater. The quantity of groundwater entering the lake is unknown. It has been reported (Leap 1972) that all lakes in this area of Day County are surrounded by relatively thick, well developed surface aquifers. The aquifers range in thickness from about 10 to 20 feet and are in direct hydraulic connecton with the lakes.

The Pickerel Lake watershed is situated in the Coteau des Prairie, a hilly plateau of glacial moraine encompassing portions of Day, Marshall, and Roberts counties. The majority of the watershed is within Day County (Figure 1). The drainage area consists of about 17,496 acres according to Landsat-Remote Sensing estimates and 15,015 acres according to an on-site survey by the U.S. Soil

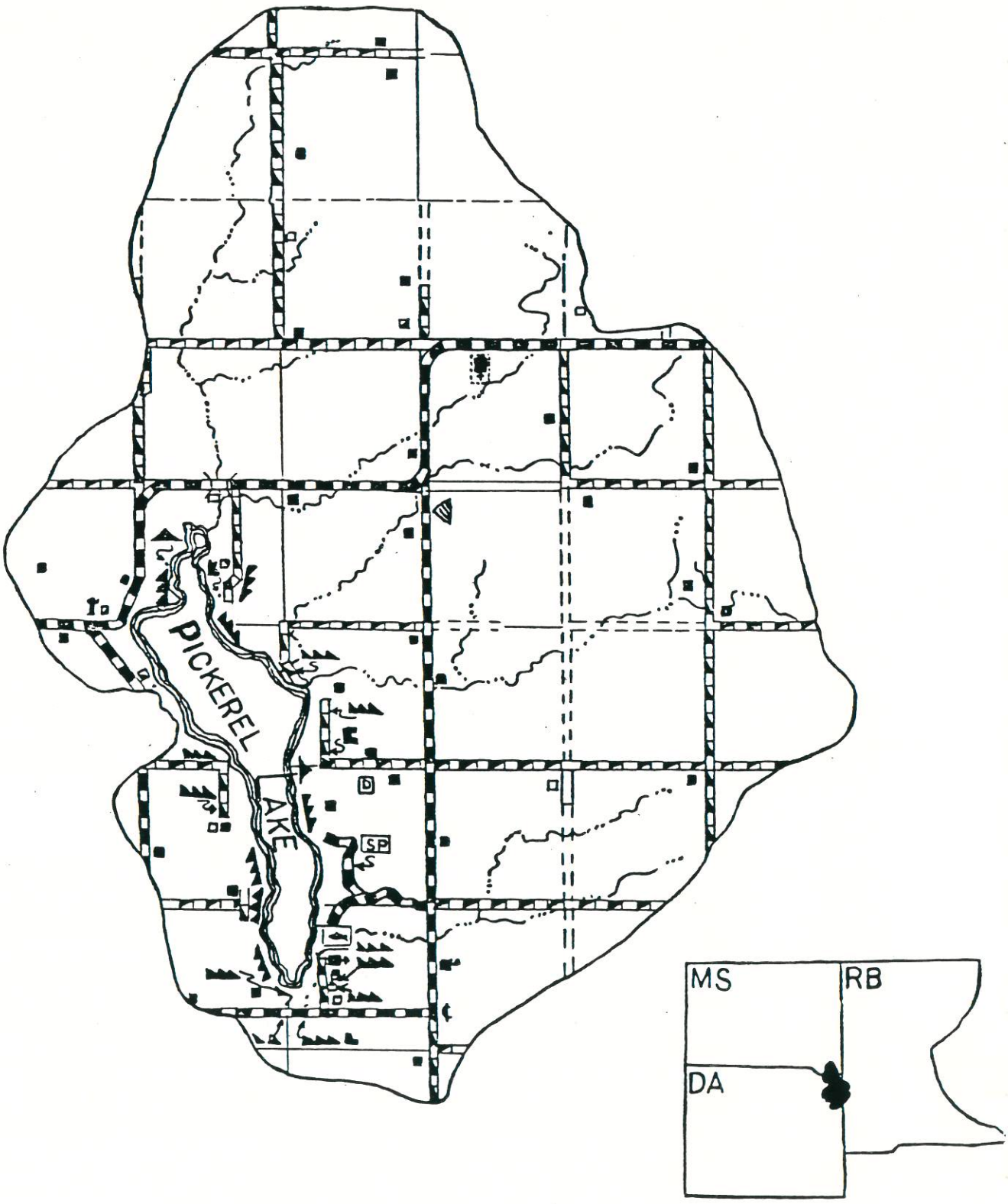

Figure 1. Pickerel Lake Watershed

Conservation Service (SCS). The on-site survey is considered to be more reliable.

The watershed consists of two major drainages and three minor drainages. Chekepa Creek enters the lake from the east and drains the largest area in the watershed. Dry Creek drains the next largest area and enters Pickerel Lake from the north. The remaining watershed area includes direct runoff areas along the shoreline and three minor drainages.

B. Beneficial Uses and Impairments

Pickerel Lake is a heavily used recreational lake providing fishing, boating, waterskiing, picnicking, camping and swimming. The lakeshore camping areas were used by 53,000 people in 1981, 55,000 people in 1982, and 60,000 people in 1983 (Day County Conservation District Final Report, 1984, Appendix A). These yearly increases indicate that public use in Pickerel Lake is growing at a rapid pace and will continue to increase in the future (ibid.). The lake supports a permanent warmwater fishery of perch, bass, crappie, bullhead, walleye, northern pike, and bluegill (Marrone, 1978). To date no fish kills have been documented. The South Dakota Department of Game, Fish, and Parks (GF&P) continues to manage the lake as a walleye-panfish-bass lake with limited stocking of northern pike and smallmouth bass. Appendix B contains the 1978 Pickerel Lake Fisheries Survey. At present the lake serves as a control in an ongoing study to determine the effectiveness of walleye stocking in other South Dakota lakes.

According to the South Dakota Board of Water and Natural Resources regulation, Chapter 74:03:02, "Surface Water Quality Standards", Pickerel Lake is classified as having the beneficial use designations of: warmwater permanent fish life propagation, limited contact recreation, immersion recreation, wildlife propagation and stockwatering (Table 1).

Dense weed beds in nearshore areas and blue-green algal blooms in open water impair immersion recreation in Pickerel Lake during the summer. Other problem areas include: faulty septic tanks, three feedlots with high pollution potential and soil erosion from cropland, pastures, and the lake shoreline (Day County Conservation District Final Report, 1984, Appendix B). These are sources of nutrients, fecal coliform bacteria, and sediment that enter Pickerel Lake and contribute to the degradation of water quality.

All of the contributing intermittent tributaries are classified for: wildlife propagation, stockwatering, and irrigation. Although the tributaries have less stringent water quality criteria, they must not cause the more stringent Pickerel Lake criteria to be exceeded (Table 1). Water quality data suggest that Pickerel Lake may be receiving excessive nutrient loads as well as high levels of fecal coliform from these drainages. The tributaries, mainly Chekapa and Dry Creek, are also sources of appreciable input of sediments into Pickerel Lake. The U.S. Soil Conservation Service (SCS) estimated an average of 208 tons of sediment is transported into the lake each year from cropland and grassland (SCS Soil Erosion and Yield Study 1981). However, the report also notes that nearly 98% of the sediment

TABLE 1. Surface Water Quality Standards for Pickerel Lake, Outlet, and Tributaries

Parameters:	Pickerel Lake				Outlet (Pickerel Creek)				Tributaries	
	Warm water permanent fish life propagation	Immersion recreation	Limited contact recreation	Wildlife propagation and stock-watering	Warm water marginal fish life propagation	Limited contact recreation	Wildlife propagation and stock-watering	Irrigation water (May 15 - Sept. 30)	Wildlife propagation and stock-watering	Irrigation water (May 15 - Sept. 30)
Beneficial Use Rating Number	4	7	8	9	6	8	9	10	9	10
Alkalinity, Total $CaCO_3$ - mg/l				750			750		750	
Chlorine, Total Residual - mg/l	<0.02				<0.02					
Coliform Fecal - organisms/100 ml		200	1000			1000				
Conductivity - micromhos/cm at 25°C				4000			4000	2500	4000	2500
Cyanide, Free - mg/l	0.005				0.005					
Cyanide, Total - mg/l	0.02				0.02					
Hydrogen Sulfide, Undisassociated - mg/l	0.002				0.002					
Nitrogen, Ammonia Unionized (as N) - mg/l	0.04				0.05					
Nitrogen, Nitrates (as N) - mg/l				50			50		50	
Oxygen, Dissolved - mg/l	>5.0	>5.0	>5.0		>4.0	>5.0				
pH - Units	6.5<pH<9.0	6.5<pH<8.3	6.0<pH<9.0	6.0<pH<9.5	6.0<pH<9.0	6.0<pH<9.0	6.0<pH<9.5		6.0<pH<9.5	
Polychlorinated Biphenyls - mg/l	0.000001				0.000001					
Sodium Absorption Ratio (SAR)								10		10
Solids, Suspended - mg/l	90				150					
Solids, Total Dissolved - mg/l				2500			2500		2500	
Temperature - °F	80				90					

delivered to the lake (9,310 tons/year) is derived from shoreline erosion.

Pickerel Creek, the outflow, is classified for: warmwater marginal fish life propagation, limited contact recreation, wildlife propagation and stockwatering, and irrigation. Levels of all water quality parameters at Pickerel Creek meet with applicable standards. Table 1 lists the water quality criteria by parameter for each beneficial use classification.

C. Land Use.

Land use in the watershed is predominantly agricultural. Estimates based on Landsat Remote Sensing (Figure 2) indicate a total watershed drainage of 17,496 acres. Approximately 10,869 acres (62%) of the area is grassland, 5,276 acres (30%) cropland, 1,174 acres (7%) water and wetland area, and 150 acres (1%) forestland, farmstead and/or lake cottages. Small grains are the main crops grown in the watershed. The major portion of the Pickerel Lake Watershed is privately owned although several areas adjacent to the lake are administered by the U.S. Bureau of Indian Affairs (BIA) and the Sisseton-Wapehton Sioux Tribe.

Extensive residential development has occurred along the shoreline of the lake. In 1971 approximately 55% of the shoreline had been developed (Hansen, 1976). At present, shoreline developments include over 330 homes, cabins, and trailer houses. Most of the latter are used only during the summer months. Other developments include three resorts, two restaurants, a YMCA camp, a Bible camp, two state

Land Cover - July 1979

CATEGORY	ACRES	HECTARES	%	ACCURACY
WATER	748	303	4.3%	90 %
WETLAND / SHALLOW WATER	426	172	2.4%	84 %
GRASSLAND	10,896	4,410	62.3%	91 %
CROPLAND	5,276	2,135	30.1%	81 %
FORESTLAND	150	61	.9%	N.O.*
TOTALS	17,496	7,081	100%	86 %

* No Observations

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PICKEREL LAKE WATER QUALITY STUDY AREA

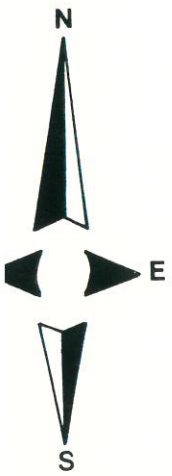
PRODUCED BY
SOUTH DAKOTA STATE PLANNING BUREAU

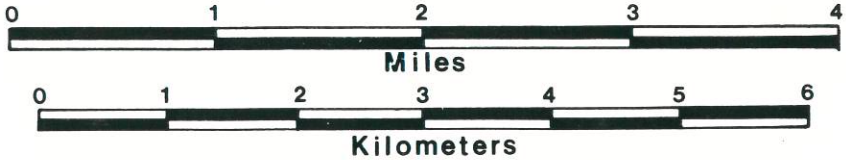
IN 1975, THE SOUTH DAKOTA STATE PLANNING BUREAU INITIATED A COMPREHENSIVE REMOTE SENSING MAPPING PROGRAM THOUGHOUT THE STATE. THIS PICKEREL LAKE WATER QUALITY STUDY AREA MAP WAS PART OF THAT PROGRAM, AND WAS PRODUCED THROUGH A COMPUTER ASSISTED CLASSIFICATION OF LANDSAT SATELLITE DATA FOR THE STUDY AREA. THE MAP HAS UNDERGONE A VERIFICATION PROCESS USING A 5% RANDOM SAMPLE, IN ORDER TO ASSESS THE ACCURACY OF THE REPRESENTED LAND COVER CATEGORIES.

SOIL EROSION CAN BE A MAJOR PROBLEM ON CULTIVATED LANDS, PARTICULARLY ON STEEP SLOPES AND DRAINAGE NETWORKS. CROP ROTATION, TILLAGE SYSTEMS, MANAGEMENT OF RESIDUES, AND OTHER CONSERVATION PRACTICES HAVE A SIGNIFICANT EFFECT IN REDUCING THE AMOUNT OF EROSION IN AREAS USED AS CROPLAND.

THE PREPARATION OF THIS MAP WAS FINANCED THROUGH A SECTION 208 WASTE TREATMENT MANAGEMENT GRANT FROM THE U.S. ENVIRONMENTAL PROTECTION AGENCY. FOR MORE INFORMATION CONTACT:

PLANNING INFORMATION SECTION
SOUTH DAKOTA STATE PLANNING BUREAU
CAPITOL BUILDING
PIERRE, SD 57501
605-773-3661





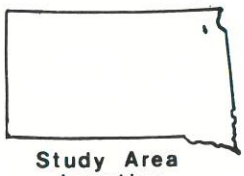


Figure 2

Pickerel Lake Water Quality Study Area

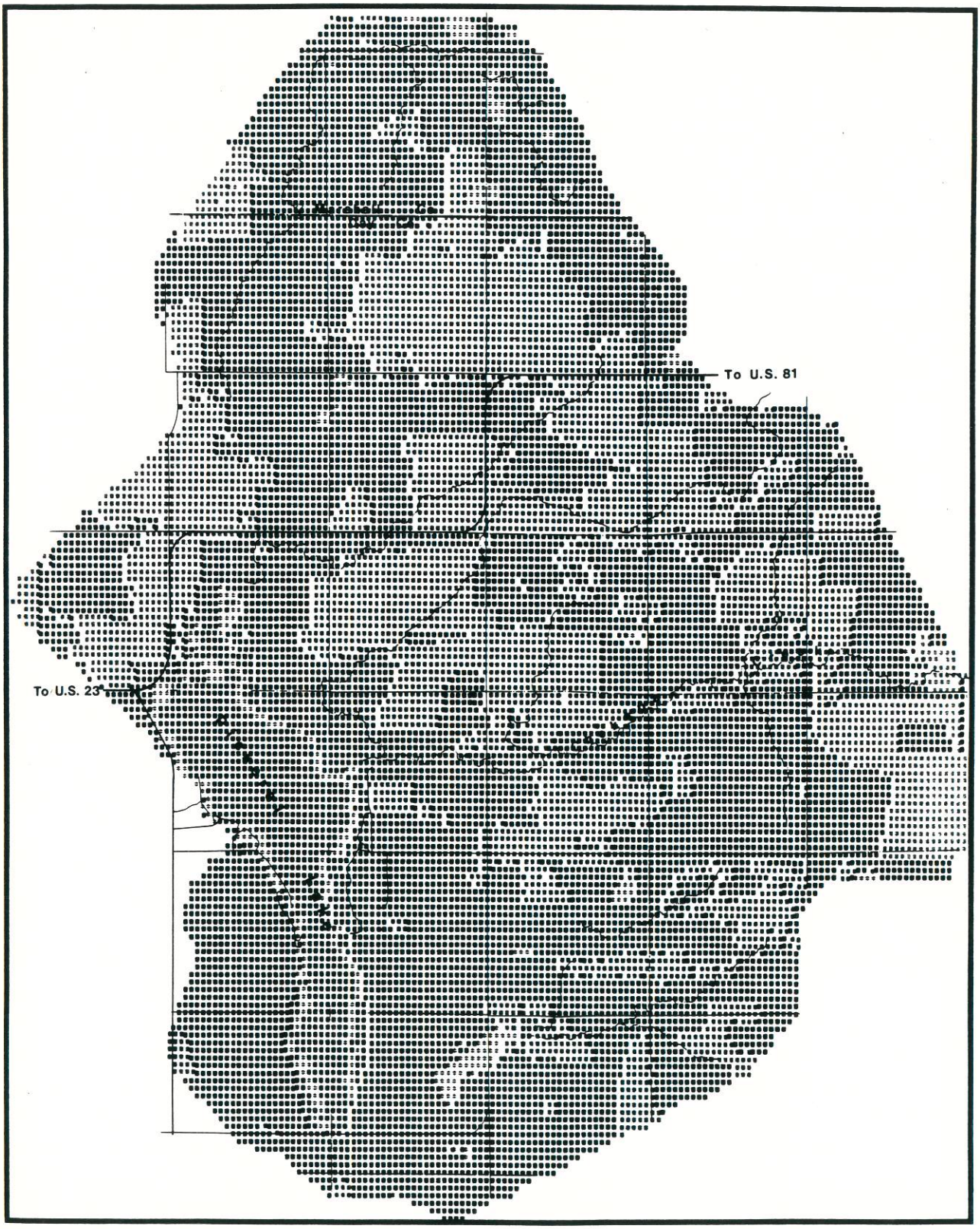


Figure 2 (continued)

recreational areas and a state fish hatchery. Much of the remaining shoreline area is too steeply sloped for residential development.

D. Climate, Major Soils and Geology

Climate

The climate of northeastern South Dakota is continental with cold, dry winters and short springs marked by rapid weather changes. Forty-two percent (42%) of total annual precipitation is normally recorded in the 3-month period from April through June. The highest monthly precipitation falls in June, averaging 3.93 inches over one 6-year period. Summer and autumn are characterized by warm to mild days with a maximum of sunshine. Mean minimum and maximum temperatures in the Waubay area are 60°F and 84°F during July; 0°F and 20°F during January (Hodge, 1960). Mean annual temperature is about 44°F. Average annual precipitation and lake evaporation amount to 22 and 32 inches, respectively (South Dakota State Planning Bureau, 1975).

Major Soils and Geology

Glacial drift is the parent material of the soils in the watershed and is also responsible for the topography of the area. Some of the watershed soils were formed in loess that overlies the drift while others were formed in alluvium.

The U. S. Soil Conservation Service (SCS) has assigned the following general soils classifications for the watershed (Soils of Day County, 1952):

a. Forman-Aastad-Buse Association

These soils are well drained and moderately well drained, gently undulating to steep, loamy soils formed in loamy glacial till. This association is a glacial moraine that consists of hills, swales, and numerous depressions or potholes. Slopes are short and irregular. The drainage pattern is well defined in parts of this association, but in other areas swales and small drainage ways terminate in sloughs, small lakes, and depressions.

About 40% of the area is comprised of Forman soils, 20% Aastad soils, and 15% Buse soils. The rest are minor soils.

Forman soils are on the sides of rounded hills. Aastad soils are in the swales. Buse soils are in the higher parts of the landscape. In many areas of this association, soils are too steep or too stony to be cultivated.

Most cultivated soils are subject to erosion. Control of erosion is the main concern of conservation management. A major portion of these soils are under cultivation. The soils are well suited to corn, small grains, flax, alfalfa, and tame grasses. Other areas remain in native grass and are used for grazing or for growing hay.

b. Renshaw-Fordville Association

These soils are somewhat excessively drained and well drained, nearly level to steep, loamy soils that are shallow and moderately deep over outwash sand and gravel. A few sloughs, small lakes, and potholes are scattered throughout the area.

About 45% of the area is comprised of Renshaw soils and 30% Fordville soils. The rest are minor soils. Fordville soils generally have sand and gravel at a depth of about 22 inches.

The soils are droughty. Available water capacity is low or moderate. Runoff is medium. These soils are subject to water erosion and soil blowing. Conservation of moisture and control of water erosion and soil blowing are the main concern of conservation management.

Many areas of this soil association are cultivated and used for growing small grains, flax, alfalfa, and other early maturing crops.

c. Other Soils

There are a number of minor soils including Sioux and Parnell. One of the more common ones is Parnell. It is very poorly drained and occurs in many depressions or potholes throughout the area. They generally have no natural outlets and are flooded during the greater part of the year. Nearly all of them are in grass or wetland vegetation. These soils cover nearly 7% of the watershed area.

II. Pickerel Lake Water Quality Study Area Selection

Nominations for designation as a Water Quality Study Area (WQSA) within the Fourth Planning and Development District were solicited from the Fourth Planning and Development District Commission. In February 1979 nominations were requested from all commissioners and the following lakes were suggested: Pickerel Lake (Day County), Lake Byron (Beadle County), Lake Eureka (McPherson County), and Cottonwood Lake (Spink County).

The criteria established for selection purposes were: the State Lakes Preservation Committee criteria, the South Dakota Lake Significance Ranking criteria, the availability of soils data, and background water quality data. The most important criteria after technical consideration was evidence of strong public support and the possibility of eventually establishing an implementation project. Pickerel Lake met these criteria and was selected by the Fourth Planning and Development District Commission as that District's WQSA. Appendix C contains the Fourth Planning and Development District's Pickerel Lake WQSA Report.

III. Soil Erosion and Sediment Yield Summary

SCS conducted a soil erosion and sediment yield study of Pickerel Lake. Results of the study are summarized in this Section while Appendix D contains the entire report. The SCS study detailed the type, extent, and location of erosion and sedimentation problems including the significance of the contribution from each tributary.

SCS estimated total watershed soil erosion to be 31,181 tons per year with total sediment deposited in Pickerel lake at 9,518 tons per year or 7.3 acre feet per year. Cropland and grassland erosion (21,871 tons per year)

contributes 208 tons of sediment per year to Pickerel Lake. All of the lake shore erosion ends up as sediment in Pickerel Lake and is estimated to be 9,310 tons per year.

SCS selected best management practices (BMP's) to reduce sediment yield and estimated required coverage and probable costs to adequately treat this watershed. The total cost for application of BMP's (conservation practices) was estimated at $124,660 or $8.30 per acre. Examples of needed conservation practices are: conservation tillage systems, grassed waterways, field windbreaks, pasture and hayland planting, sediment control measures, etc. A detailed breakdown of conservation practices and costs is presented in Table 2.

IV. Pickerel Lake Water Quality Status Report

Introduction

Pickerel Lake is located in northeastern Day County (Latitude: 45° 30 min. 24 sec. N; Longitude: 97° 16 min. 24 sec. W; T124N-R53W, Sections 14, 22, 23, 26, 27, 34 and 35). It is the deepest natural lake in South Dakota, having a maximum depth of 13.2 meters and a mean depth of 6.1 meters. The lake has a surface area of 386.5 hectares (955 acres) and 9.4 miles of shoreline. Lake volume is $2.356 \times 10^7 m^3$ or 19,100-acre feet. The bottom is predominantly rubble with scattered areas of sand and gravel. Silt and organic rich clay are found in the bays and deeper areas of the lake.

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TABLE 2

BEST MANAGEMENT PRACTICES (Conservation Practices and Measures) 1/ 2/ 3/
PICKEREL LAKE WATERSHED AREA

Conservation Practices	Unit	Unit 4/ Cost	Subwatershed "A"		Subwatershed "B"		Subwatershed "C"		Subwatershed "D"		Total Watershed	
			Amount Needed	Cost	Amount Needed	Cost	Amount Needed	Cost	Amount Needed	Cost	Amount Needed	Cost
		(Dollars)		(Dollars		(Dollars)		(Dollars)		(Dollars)		(Dollars)
Cropland - 6,666 Acres												
Conservation Cropping system	acre	-	2,066	-	1,595	-	1,898	-	1,107	-	6,666	-
Conservation Tillage System	acre	5	2,066	10,330	1,595	7,975	1,898	9,490	1,107	5,535	6,666	33,330
Grasses & Legumes in Rotation	acre	18	155	2,790	120	2,160	142	2,556	83	1,494	500	9,000
Grassed Waterways	acre	500	2.5	1,250	2.0	1,000	2.2	1,100	1.3	650	8.0	4,000
Waste Utilization	acre	3	-	-	-	-	380	1,140	220	660	600	1,800
Minimize Fall Tillage	acre	-	330	-	638	-	759	-	443	-	2,170	-
Minimize Pesticide Use	acre	-	330	-	638	-	759	-	443	-	2,170	-
Contour Stripcropping	acre	6	62	372	48	288	57	342	33	198	200	1,200
Timing Nitrogen Application	acre	-	330	-	638	-	759	-	443	-	2,170	-
Field Windbreaks	mile	250	1.5	375	1.0	250	1.5	375	1.0	250	5.0	1,250
Grassland - 6,870 Acres												
Proper Grazing Use	acre	-	6,918	-	448	-	744	-	325	-	3,435	-
Pasture & Hayland Planting	acre	20	280	5,600	65	1,300	108	2,160	47	940	500	10,000
Deferred Grazing	acre	-	575	-	134	-	223	-	98	-	1,030	-
Planned Grazing Systems	acre	-	112	-	26	-	43	-	19	-	200	-
Livestock Water Stations	No.	1,000	1	1,000	1	1,000	1	1,000	1	1,000	4	4,000
Pasture & Hayland Management	acre	-	1,918	-	448	-	744	-	325	-	3,435	-
Waste Management Systems	No.	-	-	-	1	20,000	-	-	-	-	1	20,000
Wildlife Upland Habitat Mgmt.	acre	4	11	44	3	12	4	16	2	8	20	80
Farmsteads, Urban & Other, 556 acres												
Sediment Control Measures 5/	acre	2,000	18	36,000	-	-	2	4,000	-	-	20	40,000
TOTALS - Total acres - 15,015 6/	acres			57,761		33,985		22,179		10,735		124,660 or $8.30 per acre

1/ Needed to get "Land Adequately Treated."
2/ Refer to Soil Conservation Service Technical Guide for South Dakota 1981
3/ On site investigation and planning are necessary to determine kinds, locations, sizes, extent & costs of practices (BMP's)
4/ Refer to Soil Conservation Service Cost-Return Handbook for South Dakota 1981
5/ Examples of measures are: cover and green manure crop, filter strips, lined and grassed waterways, diversions, mulching, sediment basins, streambank protection, and critical area planting
6/ Includes 933 acres of non-sediment producing land

Pickerel lake has been assigned the following beneficial uses according to the South Dakota Board of Water and Natural Resources Regulation, Chapter 74:03:02:

° Warmwater permanent fish life propagation;

° Immersion recreation;

° Limited contact recreation;

° Wildlife propagation and stock watering.

Water quality samples were collected from in-lake and tributary sites between 1979 and 1984. Table IV-1 and Figures 3 and 4 describe the sampling site locations. Tables IV-2 through IV-14 summarize the water quality data collected at each site on an annual basis and Tables IV-15 through IV-27 summarize the violations of South Dakota's water quality standards observed at the various sampling sites. Tables and figures (IV-1 through IV-31) discussed in this chapter are contained in Appendix E.

The following discussion will center around the water quality data. Violations of the State's water quality standards will be described and the location of the violations identified. Any potentially limiting nutrient will be identified, trophic state indices will be discussed and nutrient loads presented.

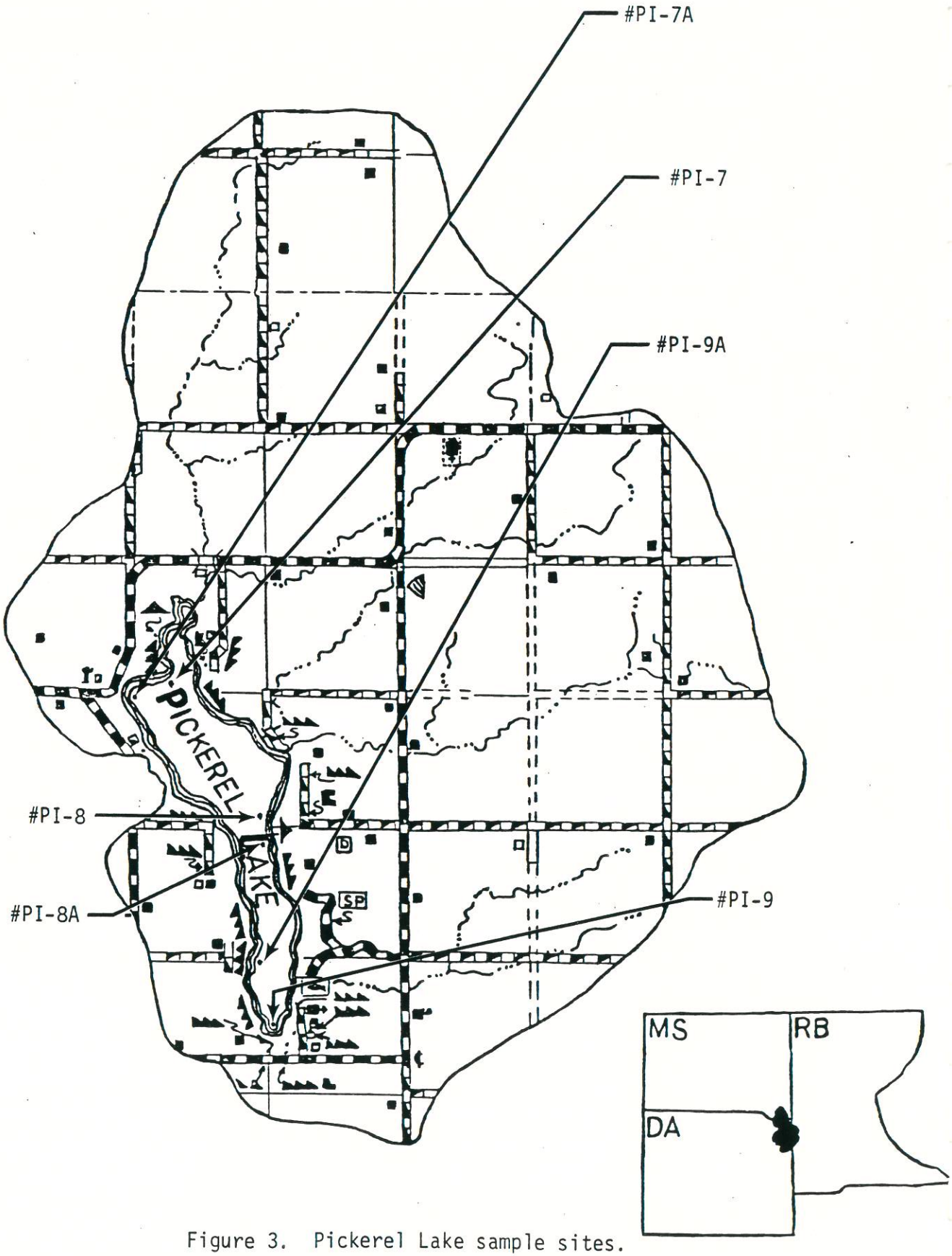

Figure 3. Pickerel Lake sample sites.

46PI07 (PI-7)	Latitude 45 deg., 31 min., 01 sec.; longitude 97 deg., 17 min., 01 sec.; Township 124N, Range 53W; Section 15. NE1/4, SE1/4, SW1/4, SW1/4. Pickerel in-lake site by northeast shore.
46PI08 (PI-8)	Latitude 45 deg., 30 min., 03 sec.; longitude 97 deg., 16 min., 03 sec.; Township 124N, Range 53W; Section 23. SW1/4, SW1/4, SW1/4, SW1/4. Pickerel in-lake site by east shore.
46PI09 (PI-9)	Latitude 45 deg., 28 min., 38 sec.; longitude 97 deg., 16 min., 04 sec.; Township 124N, Range 53W; Section 34. SE1/4, NE1/4, NE1/4, SE1/4. Pickerel in-lake site by south shore.
46PI7A (PI-7A)	Latitude 45 deg., 30 min., 55 sec.; longitude 97 deg., 17 min., 22 sec.; Township 124N, Range 53W; Section 16. SE1/4, SE1/4, SE1/4, SE1/4. Pickerel in-lake site by northwest shore.
46PI8A (PI-8A)	Latitude 45 deg., 29 min., 55 sec.; longitude 97 deg., 16 min., 00 sec.; Township 124N, Range 53W; Section 26. SE1/4, NW1/4, NW1/4, NW1/4. Pickerel in-lake site by east shore.
46PI9A (PI-9A)	Latitude 45 deg., 29 min., 08 sec.; longitude 97 deg., 16 min., 17 sec.; Township 124N, Range 53W; Section 34. NE1/4, NW1/4, NE1/4, NE1/4. Pickerel in-lake site by southwest shore.

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Figure 3 (cont.). Pickerel Lake sample sites.

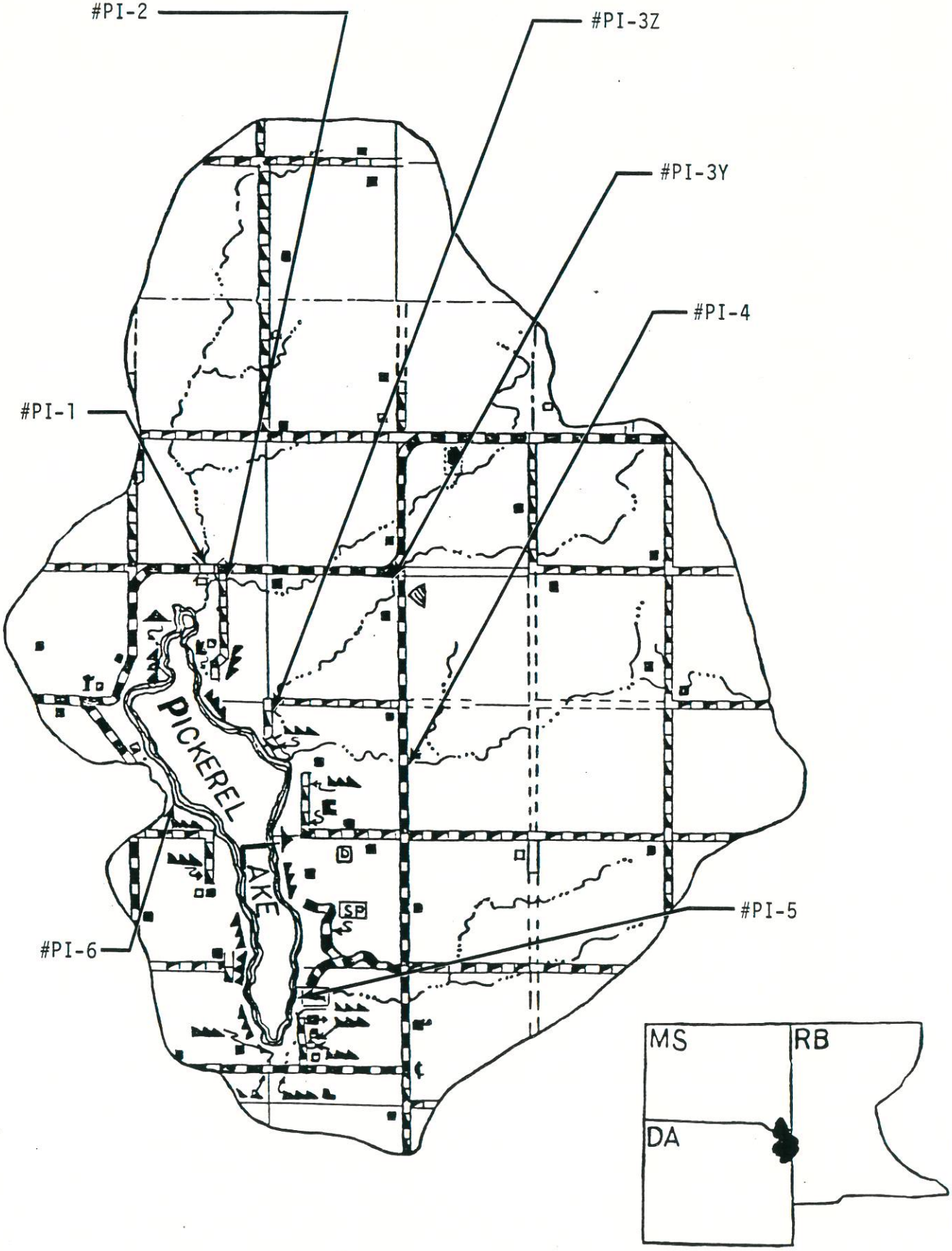

Figure 4. Pickerel Lake watershed sample sites.

46PI01 (PI-1)	Latitude 45 deg., 31 min., 47 sec.; longitude 97 deg., 16 min., 36 sec.; Township 124N, Range 53W; Section 15. NW1/4, NW1/4, NW1/4, NE1/4. North tributary to Pickerel Lake.
46PI02 (PI-2)	Latitude 45 deg., 31 min., 42 sec.; longitude 97 deg., 16 min., 29 sec.; Township 124N, Range 53W; Section 15. SW1/4, NE1/4, NW1/4, NE1/4. North-northeast tributary to Pickerel Lake.
46PI04 (PI-4)	Latitude 45 deg., 30 min., 34 sec.; longitude 97 deg., 15 min., 00 sec.; Township 124N, Range 53W; Section 23. NE1/4, SW1/4, SE1/4, NE1/4. Tributary northeast inlet to Pickerel Lake.
46PI05 (PI-5)	Latitude 45 deg., 28 min., 55 sec.; longitude 97 deg., 15 min., 46 sec.; Township 124N, Range 53W; Section 35. NE1/4, NE1/4, SW1/4, NW1/4. Pickerel Lake inlet at State Fish Hatchery.
46PI06 (PI-6)	Latitude 45 deg., 30 min., 15 sec.; longitude 97 deg., 16 min., 58 sec.; Township 124N, Range 53W; Section 22. NW1/4, NW1/4, SE1/4, SW1/4. Pickerel Lake outlet at State Park.
46PI3Y (PI-3Y)	Latitude 45 deg., 31 min., 46 sec.; longitude 97 deg., 14 min., 52 sec.; Township 124N, Range 53W; Section 14. NE1/4, NE1/4, NE1/4, NE1/4. Northeast tributary to Pickerel Lake.
46PI3Z (PI-3Z)	Latitude 45 deg., 30 min., 48 sec.; longitude 97 deg., 16 min., 04 sec.; Township 124N, Range 53W; Section 23. SW1/4, NW1/4, NW1/4, NW1/4. Northeast tributary to Pickerel Lake.

Figure 4 (cont.). Pickerel Lake watershed sample sites.

Water Quality Parameters

Dissolved Oxygen

Pickerel Lake has been classified by the State of South Dakota as a warm water permanent fish life propagation body of water. Therefore, dissolved oxygen (DO) concentrations are not to be less than 5.0 ppm. In-lake DO concentrations ranged from 5.5 to 13.8 ppm and therefore were never at dangerous levels in the upper surfaces of the water. DO concentrations at depth are not known. Figures IV-1 through IV-3 demonstrate the general trends of DO observed in 1979 at Sites 46P107, 46P108 and 46P109. In general, the DO appears to decrease through the summer until about September and then to increase. The decrease observed is probably related to increasing water temperatures.

At the tributary sampling sites, low DO concentrations were observed at Sites 46P101, 46P104 and 46P13Y. At Site 46P101, DO concentrations were low in 57% of the samples; at Site 46P104, DO concentrations were low in 35% of the samples; and at Site 46P13Y, DO concentrations were low in 50% of the samples. DO concentrations ranged from <1.0 to 10.3 ppm at Site 46P101, from 1.9 to 12.3 ppm at Site 46P104, and from 1.3 to 15.7 ppm at Site 46P13Y. The reason(s) for the low dissolved oxygen values are not known at this time. All other inflows or outflow sites had adequate DO levels.

Fecal Coliforms

As previously stated, Pickerel Lake has been assigned the beneficial use of immersion recreation. Therefore, fecal coliform levels are limited to 200 per 100 ml as a geometric mean based on a minimum of not less than five

samples obtained during separate 24-hour periods for any 30-day period, nor shall they exceed this value in more than 20% of the samples examined in the above described 30-day period; nor shall they exceed 400 per 100 ml in any one sample from May 1 to September 30. In-lake, the 400 per 100 ml limit was exceeded three times at Site 46P107 (mean violation 19,527 per 100 ml) and once at Site 46P108 (2,000 per 100 ml) in 1979 (see Figures IV-4 through IV-6).

High levels of fecal coliforms were observed at Site 46P101 twice in July, 1979 (i.e., 430 per 100 ml and 510 per 100 ml). Site 46P102 was observed to have high fecal coliforms in June and July, 1979. The geometric mean was 903 per 100 ml in June and 933 per 100 ml in July. The in-lake violations observed at Site P107 were probably a result of septic tank seepage (see Watershed Problems and Recommendations). Sites 46P104 and 46P105 also had high levels of fecal coliforms. Sources of fecal contamination should be identified in order to protect immersion recreation in the lake.

pH

The most stringent criteria for pH occurs under the beneficial use category of immersion recreation. The pH shall be greater than 6.5 units and less than 8.3 units. In-lake, the pH exceeded the 8.3 limit or was less than the 6.5 limit in 34% of the samples (Tables IV-20 through IV-22). Average in-lake pH values ranged from 7.3 to 8.1.

Based on the above criteria, the waters flowing into the lake from Site 46P101, Site 46P102 and Site 46P13Y were observed to have pH values

less than 6.5 units. Sites 46P102 and 46P13Z were observed to have pH values greater than 8.3.

Total Solids, Total Dissolved Solids and Suspended Solids (Total Residue, Dissolved Residue and Total Nonfilterable Residue)

Dissolved solids is a term associated with fresh water systems and consists of inorganic salts, small amounts of organic matter, and dissolved material (EPA, 1976). The principal inorganic anions dissolved in water include carbonates, chlorides, sulfates and nitrates and the principal cations are sodium, potassium, calcium and magnesium. Based upon the beneficial uses assigned to Pickerel Lake, total dissolved solids should not exceed 2,500 mg/l. In-lake concentrations of total dissolved solids ranged from 106 ppm at Site 46P18A to 660 at Site 46P19A. The observed levels are not considered to be excessive.

The limits for suspended solids established for a warm water permanent fishery is 90 ppm. Excessive suspended solids in a body of water can have a detrimental effect on a lake's fishery. In 1965, the European Inland Fisheries Advisory Committee identified four (4) means by which suspended solids can adversely affect fish and fish food populations (EPA, 1976). Fish swimming in waters with high suspended solids can be killed directly, their growth rate reduced, or their resistance to disease reduced. In addition, suspended solids can prevent the successful development of fish eggs and larvae, modify natural movements and migrations of fish and reduce the abundance of food available to fish. Only two excessive levels of suspended solids were observed (Site 46P105, 425 ppm; Site 46P109, 118 ppm). Although Site 46P109 is in the same vicinity as Site 46P105, the

sampling dates were different. Therefore, the source of the suspended solids cannot be attributed to Site 46P105.

Ammonia as Nitrogen

The limit of 0.04 ppm, established by the State for ammonia as nitrogen is based on un-ionized ammonia. Concentrations exceeding this limit were not observed in Pickerel Lake. Figures IV-7 through IV-9 illustrate the total ammonia concentrations for 1979. At Site 46P107, an increase in ammonia was observed over June and July and a large increase in November and December. Ammonia concentrations at Site 46P108 increased between July and August. Site 46P109 demonstrated ammonia concentrations similar to those observed at Site 46P107 except that the first increase was observed in August rather than over June and July.

In-lake mean concentrations of ammonia ranged from .006 ppm at Site 46P108 to .54 ppm at Site 46P18A. The mean concentrations of ammonia ranged from .01 ppm at Site 46P104 to .30 ppm at Site 46P105 (Note in Table IV-6 a value of 20 ppm for ammonia is reported. This value is not recorded on the raw data sheets and is assumed to be a typographical error).

Kjeldahl Nitrogen

In-lake Kjeldahl nitrogen ranged from .10 ppm at Site 46P19A to 3.6 ppm at Site 46P18A. The mean concentrations were .88 ppm at Site 46P107, .64 ppm at Site 46P108, .71 ppm at Site 46P109, .86 ppm at Site 46P17A, .88 ppm at Site 46P18A, and .68 ppm at Site 46P19A. Figures IV-10 through IV-12 show the total Kjeldahl nitrogen data observed at Sites 46P107, 46P108 and 46P109. There were no clearly discernable trends.

The inflows and output sites had total Kjeldahl nitrogen concentrations that ranged from .05 ppm at Site 46P104 to 5.05 ppm at Site 46P101. In general, total Kjeldahl nitrogen mean values tended to be higher in the tributary sites than the in-lake sites.

Nitrate as Nitrogen

Nitrate nitrogen concentrations range from 0 to 10 ppm in unpolluted fresh waters (Wetzel, 1975) and it is the nutrient source readily assimulated by the phytoplankton. In-lake concentrations ranged from .10 to .60 ppm and tributary concentrations ranged from .10 to 6.0 ppm. The 6.0 ppm concentration was observed at Site 46P102 in 1979 and the mean concentration at the site was 2.69 ppm.

Nitrite-Nitrogen

Nitrite-nitrogen levels are generally low in natural waters (0 to .01 ppm; Wetzel, 1975). The greatest concentration of nitrite-nitrogen observed in Pickerel Lake was .02 ppm. In general, the levels of nitrite were <.01 ppm. The highest nitrite-nitrogen concentration observed in the tributaries occurred at Site 46P102 and was .05 ppm.

Inorganic Nitrogen and Organic Nitrogen

Inorganic nitrogen is the sum of ammonia, nitrate and nitrite-nitrogen concentrations and organic nitrogen is total Kjeldahl nitrogen less ammonia. Table IV-28 gives the mean organic nitrogen (ORGN) and mean inorganic nitrogen (INON) concentrations observed in Pickerel Lake. In addition, the Table gives the standard deviations, number of observations and minimum and maximum values observed in the lake.

Organic nitrogen ranged from 0.0 ppm to 3.10 ppm and mean in-lake values ranged from .596 ppm to .848 ppm. These mean values suggest that the trophic status of the lake ranges from meso-eutrophic to eutrophic (Wetzel, 1975; Table 11-4). Based on those mean values, organic nitrogen is the dominant form of nitrogen in Pickerel Lake. Figures IV-13 through IV-18 show the observed data points. A common trend between sites was not discernable.

Inorganic nitrogen concentrations ranged from .116 ppm to 1.50 ppm and mean in-lake concentrations ranged from .142 to .225 ppm (Table IV-28). Based on these values, Pickerel Lake would be classified as ulta-oligotrophic to oligo-mesotrophic. Figures IV-19 through IV-24 demonstrate the observed data.

Total Phosphorus

Total phosphorus is a common water quality parameter often used as an index of a lake's trophic state. Reckhow, et al. (1980) proposed that a lake with phosphorus concentrations ranging between .020 and .050 ppm would be classified as a eutrophic lake and a lake with phosphorus concentrations greater than .050 ppm would be classified as hypereutrophic. General characteristics assigned to a eutrophic lake are: 1) reduction in aesthetic properties; 2) diminished enjoyment from body contact recreation; and 3) generally very productive for warm water fisheries. A hypereutrophic lake is considered to be a typical "old aged" lake in advanced succession. There would probably be some fisheries but there are also probably high levels of sedimentation and algae or macrophyte growth diminishing the open water surface area.

Total phosphorus concentrations in-lake ranged from .007 to .230 ppm and mean in-lake concentrations ranged from .036 ppm to .073 ppm. Therefore, Pickerel Lake's trophic status would be considered to range between eutrophic and hypereutrophic over the period of study. There is reason for concern about increasing phosphorus loads in Pickerel Lake because the mean concentrations in 1983 are higher than in 1979. The difference in means may or may not be real because the sites were changed between 1979 and 1983. This lake should be monitored in detail in order to determine if the lake is undergoing degradation.

Figures IV-25 through IV-27 illustrate the total phosphorus concentrations observed in Pickerel Lake. At Sites 46P107 and 46P109, increases in total phosphorus were observed in August and December in 1979. However, Site 46P108 only showed a large increase in total phosphorus in June of 1979.

Total Orthophosphorus

Total orthophosphate (or total reactive phosphorus) is a measure of dissolved orthophosphate, organic soluble phosphorus and colloidal phosphorus (Wetzel, 1975). In addition, in this case, it measures part of the hydrolyzable phosphorus because the total orthophosphate analyses were conducted on waters preserved with concentrated sulfuric acid (2 mls per liter).

The mean in-lake concentrations ranged from .005 to .023 ppm. As with the total phosphorus values, the total orthophosphate values were higher in 1982 and 1983 than in 1979. (NOTE: The total orthophosphate samples were not labelled as filtered.) The 1979 data is illustrated in Figures IV-28

and IV-30. Sites 46P107, 46P108 and 46P109 were observed to increase in orthophosphate concentrations in the fall. In addition, Site 46P108 showed an increase in orthophosphate concentrations in June.

Limiting Nutrient

If an organism is to survive in a given environment, it must have the necessary materials to maintain itself and be able to reproduce. If an essential material approaches a critical minimum, this material will be the limiting one (Odum, 1971). Phosphorus is often the nutrient that is limiting in an aquatic ecosystem.

In order to determine that nutrient which will tend to be limiting, EPA (1980) has suggested the ratio of total nitrogen to total phosphorus of 15:1. If the ratio calculated from observed data is greater than 15:1, the lake is assumed to tend toward phosphorus limitation. If the ratio is less than 15:1, the lake is assumed to tend toward nitrogen limitation. The further the calculated ratios are from the 15:1 ratio the more confident the analysist is in the conclusion.

Table IV-30 shows the 95% confidence intervals for the in-lake ratios of total nitrogen to total phosphorus. There are indications that the ratios are shifting from what would be considered a phosphorus limiting trend to a nitrogen limiting trend. Monitoring should be continued to determine if the observed values in Table IV-30 are real or an artifact of analytical procedures.

Trophic State Index (TSI)

In 1977, Carlson presented a numerical trophic state index from 0 to 100. Each major division (10, 20, 30, etc.) represents a doubling in algal biomass. The numerical index can be calculated from Secchi disc readings, chlorophyll *a* and total phosphorus concentrations. The results in Table IV-30 are the mean annual TSI's calculated from the total phosphorus concentrations. The trend observed suggests that the mean TSI's for total phosphorus are increasing over time. This means that the algal biomass is increasing indicating an increase in eutrophication. In future analyses it would be useful to obtain data for chlorophyll *a* and Secchi disc in addition to phosphorus in order to compare TSI values between parameters.

Nutrient Loads

The nutrient load data is not available for Sites 46P101, 46P102, 46P13Y, 46P13Z and 46P104 (at the 36-inch culvert). Data was available for the 60-inch culvert at Site 46P104 and at Site 46P105. Therefore, the estimated nutrient loads are underestimates.

Table IV-31 presents the nutrient loads for Sites 46P104 (60-inch culvert) and Site 46P105. Also present are the areal loads. Even though the areal loads are underestimates the values suggest that Pickerel Lake is receiving dangerous loads of the nutrients, total phosphorus and total nitrogen (Vollenweider, 1968; cited in Wetzel, 1975, Table 12-10). Because Pickerel Lake has a mean depth of 6.1 meters and Table 12-10 has estimates of dangerous loads for lakes with mean depths of 5 meters and 10 meters. dangerous load estimates were obtained by extrapolation. For a lake with a mean depth of 6.1 meters, the dangerous load for total phosphorus is

.15 g/m^2/yr. and for total nitrogen is 2.2 g/m^2/yr. Total phosphorus areal loads exceeded .15 g/m^2/yr. in 1979 and total nitrogen areal loads exceeded 2.2 g/m^2/yr. in both 1979 and in 1982 (Table IV-31). Therefore, based on these limited data, there is concern that Pickerel Lake is approaching a state of greater eutrophy.

Summary

Pickerel Lake is the deepest natural lake in South Dakota and has been assigned the following beneficial uses: 1) warm water permanent fish life propagation; 2) immersion recreation; 3) limited contact recreation; and 4) wildlife propagation and stock watering. The following information will summarize the water quality observations.

1. Dissolved oxygen concentrations in-lake were adequate to support a warm water permanent fishery. However, low dissolved oxygen concentrations were observed at tributary Sites 46P101, 46P104 and 46P13Y.

2. Excessive fecal coliform levels were observed in-lake three times at Site 46P107 and one at Site 46P108. Also, excessive fecal coliform levels were observed at tributary Sites 46P101 and 46P102.

3. In-lake pH values either exceeded the limit of 8.3 or were less than 6.5 in 34% of the samples. Tributary Sites 46P101, 46P102 and 46P13Y had pH values less than 6.5 and tributary Sites 46P102 and 46P13Z were observed to have pH values greater than 8.3.

4. Excessive suspended solids were observed at Site 46P104 (42.5 ppm) and 46P109 (118 ppm). Total dissolved solids were not considered to be excessive for maintaining fish life.

5. Excessive levels of un-ionized ammonia were not observed.

6. Nitrate nitrogen concentrations were within the range considered typical of unpolluted freshwaters.

7. Nitrite-nitrogen concentration higher than those considered to be typical of natural water were observed.

8. Based on the organic nitrogen concentrations, Pickerel Lake had a trophic state that ranged from meso-eutrophic to eutrophic. In addition, organic nitrogen appears to be the dominant form of nitrogen in the lake.

9. Based on the inorganic nitrogen concentrations, the trophic state of the lake ranged from oligotrophic to oligo-mesotrophic.

10. Total phosphorus concentrations predict the trophic state of Pickerel Lake to range from oligotrophic to hypereutrophic.

11. Based on the ratio of total nitrogen to total phosphorus, Pickerel Lake may be shifting from a lake that would tend toward phosphorus limited to one that tends toward nitrogen limitation.

12. The trophic state indices calculated from total phosphorus concentrations indicate that total phosphorus is increasing in the lake over time.

13. Nutrient load calculations for total phosphorus and total nitrogen indicate that Pickerel Lake is receiving dangerous loads.

In general, Pickerel Lake is best classified as a eutrophic lake. The lake is very productive for a warm water fishery. The dominant fraction of nitrogen is organic and is probably derived from agricultural loading. Because Pickerel Lake is a popular recreation lake and because it is the deepest natural lake in

South Dakota, emphasis should be placed on the lake to reduce non-point sources of nutrients in order to prevent lake degradation. The indications from the loading data suggest the lake is already receiving a dangerous load.

V. Pickerel Lake Watershed Problems And Recommendations

Problems adversely affecting water quality in Pickerel Lake are identified in the following discussion along with recommendations to alleviate these problems.

In-lake and watershed problems and recommendations are discussed separately. However, it must be remembered that in-lake problems are symptoms of the problems occurring in the watershed. Therefore, actions to mitigate the in-lake problems cannot proceed without concurrent and coordinated work on the watershed problems. In-lake restoration efforts alone would be futile. It should also be noted that the Pickerel Lake project is a preservation project; therefore, the major efforts should go into watershed treatment.

A. Watershed Problems and Recommendations

1. Individual Septic Tank/Drainfield Systems

Problem:

Pickerel Lake waters occasionally exceed the immersion recreation standards for fecal coliforms. Particularly high coliform levels were reported on several sampling dates at tributary Site 46P105 and in-lake Sites 46P107 and 46P108. High levels of fecal coliforms were also observed at tributary Sites 46P101 and 46P102 (Figure 4). These fecal coliform violations suggest that nearby

on-site wastewater disposal systems may be contaminating the lake and some of its tributaries. On May 9, 1980, EPA infrared photo imagery identified nine (9) homes on the perimeter of Pickerel Lake as having septic tank surface failures. Two are in close proximity to site 46PI07 and four are within 0.6 mile of site 46PI08 (Figure 3).

Since shoreline development on Pickerel Lake totals well over 300 dwellings it is probable that a number of septic tank surface failures still remain undetected. Dense tree cover obstructed aerial photography of numerous residential lots including those in the heavily developed southern portion of Pickerel Lake. It is possible that more sewage disposal systems are failing around southern Pickerel Lake based on the high concentration of older, well-established homes situated on soils that are poorly suited for sub-surface sewage disposal.

Buse-Barnes Loam, the major soil in the developed area of south Pickerel Lake, is poorly rated due to the absence of adequate permeability. Soil with low permeability can force excessive effluent toward the surface, causing ponding and surface seepage in the vicinity of the disposal system.

Studies at other South Dakota lakes suggest that septic tanks may be contributing more to high in-lake fecal coliform levels and nutrient concentrations than aerial scans have indicated. The aerial scan technique is limited by its ability to detect failure at the soil surface or near surface (increased vegetation growth or retardation of growth). Septic tank surveys at other South

Dakota lakes have revealed that large numbers of septic tanks are deficient with respect to established regulations (e.g. capacity, construction or location); therefore, septic tank contributions to in-lake nutrient and fecal coliform loading may be in excess of that indicated by aerial scans as a result of transmission of the septic tank leachate by the groundwater.

Recommendations:

a. It is recommended that the lake shore property owners form a sanitary district. In addition, a septic tank survey should be conducted to establish the location of the systems, their age, construction, maintenance practices and to identify problems or potential problem areas. If access to a particular septic tank site is not feasible or if information gained by way of a mail or door to door survey is inadequate, septic tank effluent to the lake may be located in-lake by means of a Septic Tank Leachate Detector.

   If severe problems are found, the sanitary district should initiate procedures necessary for correcting these systems. It should serve as the sponsoring agency in efforts to secure funds for planning and construction of any necessary facilities.

b. Homeowners should be educated in the proper operation and maintenance of septic tanks through public meetings, the media and public information material.

c. Current local and State regulations concerning installation and maintenance of individual wastewater systems should be enforced. Applicable zoning regulations need to be reviewed to determine if they adequately protect the lake.

d. Voluntary compliance to renovate malfunctioning systems needs to be promoted. Compliance and renovation progress need to be monitored, possibly with a Septic Tank Leachate Detector.

2. Watershed Runoff

Problem:

Nutrient loading from the watershed has helped create eutrophic conditions in Pickerel Lake. Conservative estimates based on two tributary sampling sites, 46P104 and 46P105, indicate that Pickerel Lake is still receiving dangerous loads of total phosphorus and total nitrogen. Total phosphorus areal loads were .19 $g/m^2/yr$ in 1979 and .08 $g/m^2/yr$ in 1982. Corresponding total nitrogen areal loads were 2.65 $g/m^2/yr$ and 2.86 $g/m^2/yr$, respectively (Table IV-31, Appendix E). These nutrients originate mainly in runoff from feedlots, livestock feeding stations, cropland and poorly functioning or failing septic tanks. If nutrient loads are not substantially reduced in the foreseeable future, the eutrophication process in Pickerel Lake may be accelerated with resultant dense algal blooms, increased water turbidity, fish kills and water odor problems.

Sediment loading from the watershed (208 tons/year) has not been a major lake-wide problem, although sediments deposited at the north end and at the mouth of Chekapa Creek have created shallow areas favorable for the growth of aquatic vegetation.

Recommendations:

Critical erosion areas identified in the watershed should be prioritized. The Best Management Practices (BMPs) outlined in the SCS report (Table 2) should be implemented as needed in the watershed. Current fertilizer application rates and timing should be determined. An evaluation of this data should be assessed to determine whether fertilizer management practices need to be implemented.

The drainage patterns and nutrient contribution of three feedlots and/or livestock feeding areas in the vicinity of Pickerel Lake (NW26-124-53; NW 23-124-53; SE 27-124-53) should be determined. Other potential problem areas such as probable faulty septic tanks in the vicintiy of tributary Sites 46P101 and 46P102 should be located and monitored. Additional monitoring should continue at major tributary sites to more accurately determine the extent and magnitude of watershed nutrient loading into Pickerel Lake.

B. In-Lake Problems and Recommendations

1. Shoreline Erosion

Problem:

Shoreline erosion contributes about 9,310 tons of sediment to Pickerel Lake each year. Although this is nearly 98% of the estimated annual sediment load, it represents only about .04% of the lake volume in acre-feet and therefore does not presently constitute a serious threat to Pickerel Lake. About 55% of the shoreline sediment is derived from two opposite stretches of eroding high banks (segments [12, 13, and 22]=3,000 ft.) north and northwest of the Chekapa Creek inlet (SCS Soil Erosion and Sediment Yield Study, pp. 12-13), Appendix D).

Recommendation:

Sediment input from the eroding high banks may be greatly reduced by grading to a 3:1 slope and placement of rock fill revetments three feet above the high water line to three feet below normal water levels.

2. Eutrophication

Problem:

The major problem with Pickerel Lake is eutrophication as evidenced by high concentrations of phosphates and organic nitrogen and increasing algal growth. The accumulation of sediment, particularly at the north end of the lake and at the

mouth of Chekepa Creek, results in shallow conditions promoting the accelerated growth of rooted macrophytes which interfere with the recreational uses of the lake.

Recommendations:

Watershed treatment will help alleviate the in-lake problems; however, results may not be appreciably noticeable for a number of years. The following are suggestions for in-lake treatment which should be considered:

a. Nitrogen reduction. It has been hypothesized that the high concentration of organic nitrogen results from the die-off of nitrogen fixing algae. A complete nitrogen budget for the lake must be developed to verify this. Available data are inadequate for the construction of a valid budget. If this is indeed found to be the major source, a program of algal harvesting should be initiated.

b. Chemical phosphorous precipitation. This method involves the application of a chemical such as aluminum sulfate (alum) to the lake surface to tie up the soluble phosphorus which forms a precipitate, settles out, and creates a partial bottom seal. This treatment may have to be repeated every 1 to 3 years, depending on conditions. Cost estimates are $333,000 to $350,000 per treatment.

Shoreline property owners should be encouraged to use detergents with no phosphates. Although this may seem like an insignificant measure, phosphate input from cleaning

products has been shown to be a major contributing source of the nutrients at other lakes.

c. A feasibility study should be conducted to determine if selective dredging should be undertaken in the north end of the lake. If dredging is identified as a cost effective alternative, efforts should be made to secure funding.

VI. Implementation Activities

Best Management Practices (BMPs) have been implmented on a total of 8% of the land in the Pickerel Lake watershed during the Preservation Project. This brings the total percentage of treated land in the watershed to an estimated 76% from an estimated 68% reported by SCS as adequately treated in 1980.

Establishment of permanent cover through grass seeding was completed on 461 acres in Day County and 107 acres in Roberts County (Day County Conservation District Final Report, 1984, Appendix A). Total ACP cost share funds expended for grass seeding projects was $4,888.00. In addition, 100 acres were placed under the no-till system with $619.00 of ACP cost shares funds. Total treated acreage in Day and Roberts Counties amounted to about 668 acres at a total ACP cost share expenditure of $5,507.00.

Five stock dugouts and one animal waste management system for a dairy cattle feedlot were completed in 1982 and 1983. Total ACP cost share of these projects amounted to $6,846.00. In the lakeshore area, several new septic tank systems were installed by cabin owners and a new field drainage system was constructed for Pickerel Lake Lodge.

These measures will help reduce the large phosphorus and nitrogen loads which have been a perennial problem in Pickerel Lake during the study period. Establishment of permanent land cover, particularly on land adjacent to Dry Creek should reduce sediment and nutrient loading to the lake.

Problem areas which still exist in the watershed and lake shoreline include faulty septic tanks on individual cabins, three feedlots with high pollution potential, and soil erosion from inadequately managed farm lands and pastures. There is a need for a comprehensive septic tank survey to determine the extent to which this sector contributes to water quality degredation in Pickerel Lake.

The Pickerel Lake Preservation Project has educated the public on water quality problems associated with Pickerel Lake and solutions to those problems. Local citizens plan to watch for potential pollution situations and work through the local Soil Conservation District, DWNR and other agencies for cooperative corrections or enforcement if needed.

Area farmers were exposed to conservation work and have become more aware of needed BMPs. ASCS has indicated that it will maintain the Pickerel Lake watershed as a high priority for cost-share expenditures. Landowners need to maintain existing BMPs or else any gains in nutrient and sediment reduction will be lost.

Interest is high in establishing a lake management water project district for continued pollution control work. For more information on implementation activities, please see the Day County Conservation District's Final Report on the Pickerel Lake Project (Appendix A).

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VIII. Appendices

Appendix A

Day County Conservation District Final Report

PICKEREL LAKE

PRESERVATION PROJECT

FINAL REPORT

FEBRUARY 14, 1984

PREPARED BY

EDMUND FROMELT

PROJECT COORDINATOR

TABLE OF CONTENTS

I. INTRODUCTION

In the fall of 1980, the Conservsation Districts of Day, Marshall and Roberts Counties decided to hire a temporary person to make field contacts and determine if local support warranted the feasibility of a project to preserve the water quality of Pickerel Lake. Mr. Magnus Gilbertson conducted a survey of the area in December 1980.

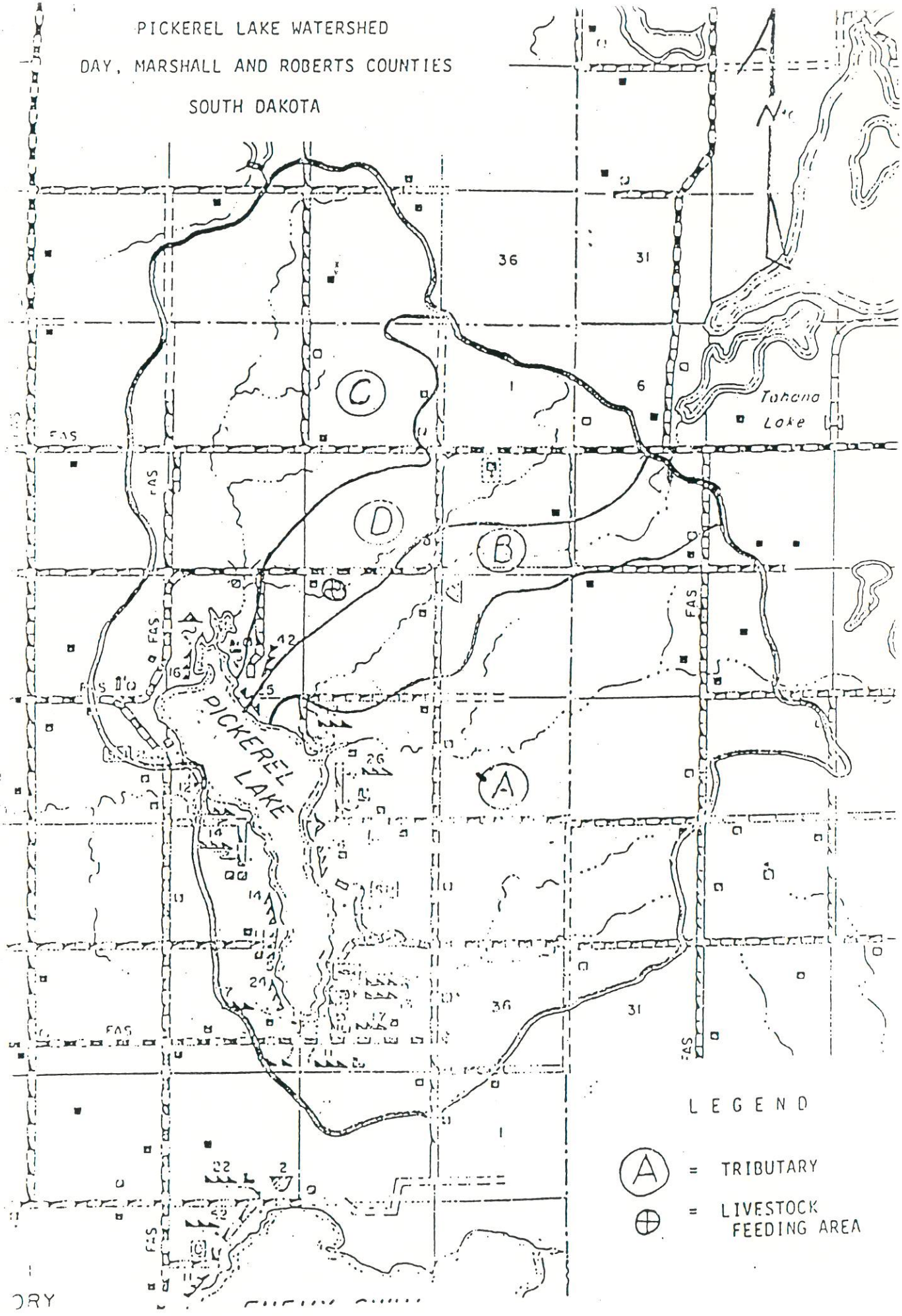
Several meetings were also held in early 1981 and many local groups, in the area, expessed an interest in the proposed project. On April 1, 1981, the three Districts agreed to sponsor the project and executed a contract with DWNR to develop a plan for improving and maintaining the water quality of Pickerel Lake and the tributary watershed. The contract provided for a completion date of one year, however, an addendum was signed to extend the contract to terminate February 14, 1984.

II. AREA DESCRIPTION & WATERSHED MAP

Pickerel Lake is the uppermost lake in a chain of lakes known as the Waubay Lakes Basin. It is a popular recreational lake located in northeastern Day County in the Coteau des Prairie, a hilly plateau of glacial moraine. Pickerel Lake is the deepest natural lake in South Dakota, with maximum depth of 43 feet and mean depth of 22 feet. The elongated lake has a surface area of 955 acres and 9.4 miles of shoreline. Predominant bottom type is rubble with scattered areas of sand and gravel, however, bays and deeper areas are covered with silt and organic-rich clay.

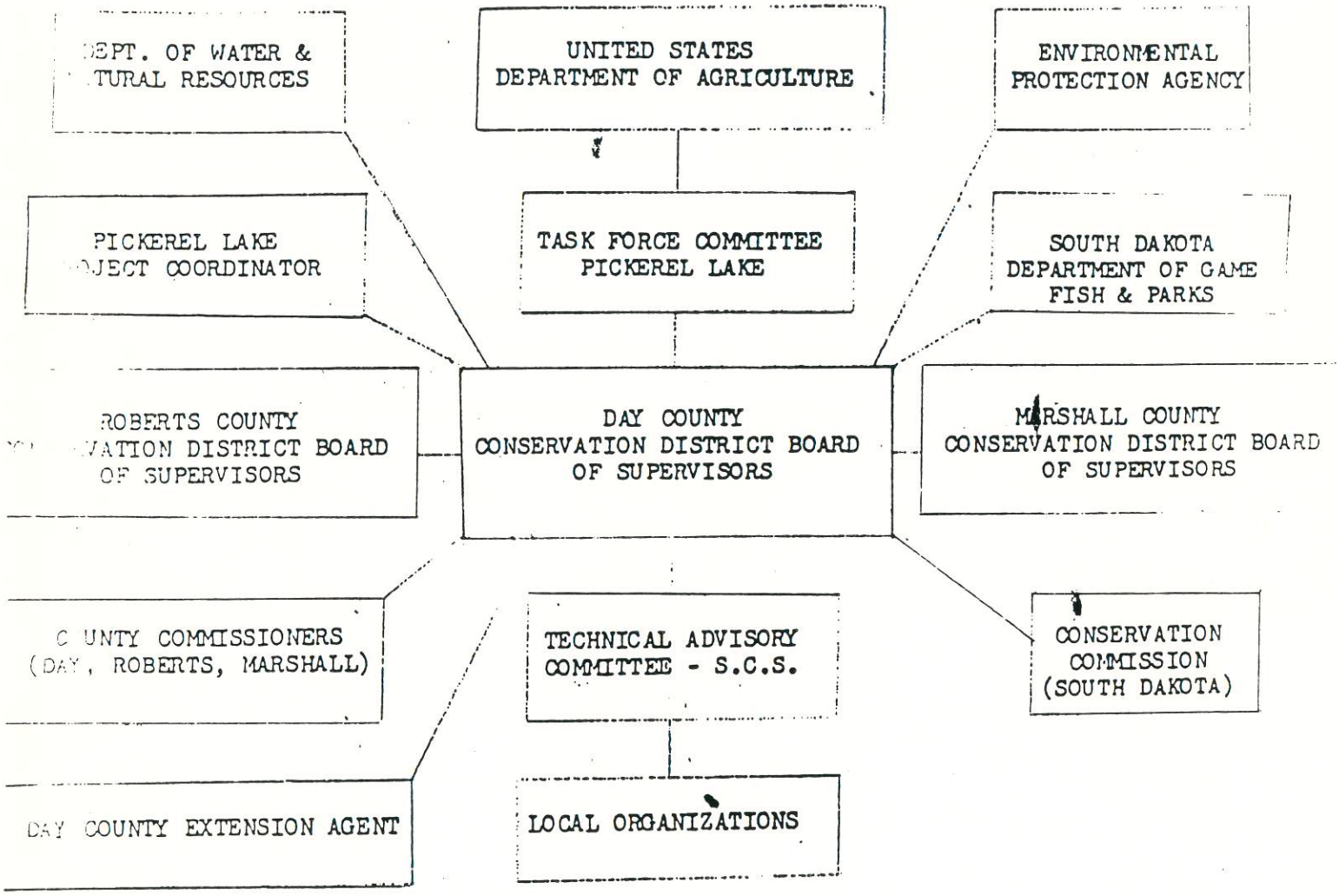
Total area of the Pickerel Lake Watershed is about 15,000 acres, consisting of two major drainages, three minor drainages, and shoreline that are contributing direct runoff to the lake. The major portion of the area is privately owned. However, several areas adjacent to the lake is Indian administered by the BIA and Sioux-Wapehton Tribe. Land use is almost entirely related to agriculture. On the shoreline of Pickerel Lake, there are over 330 homes and cabins. It has two State Parks with camping facilities that were utilized by 53,000 people in 1981, 55,000 people in 1982 and 60,000 people in 1983. These yearly increases indicated that public use on Pickerel Lake is growing at a rapid pace and will continue to increase as the travelling public becomes aware of the excellent facilities available on one of the finest lakes in the State.

Attached is a map of the watershed.


PICKEREL LAKE WATERSHED
DAY, MARSHALL AND ROBERTS COUNTIES
SOUTH DAKOTA
N
36
31
C
1
6
Tetonka Lake
FAS
D
B
A
PICKEREL LAKE
26
22
2
LEGEND
A = TRIBUTARY
⊕ = LIVESTOCK FEEDING AREA

III. PICKEREL LAKE PRESERVATION PROJECT

ORGANIZATIONAL STRUCTURE



IV. WORK PLAN

In May 1981, a work plan was prepared listing the objectives and goals for Pickerel Lake. The Plan has been our "Bible" and is a valuable tool that provides guidance in the procedures to be used towards our goal of preserving and improving the water quality of the lake.

The major activities of the Plan have been combined into specific categories and are listed in this report. A copy of the Plan is appended with notations on the progress of our goals and objectives.

WORK PLAN - PICKEREL LAKE PROJECT

OBJECTIVE 1 Assist and encourage land users in the Pickerel Lake watershed [illegible] practices to improve water quality.

GOALS A. Identify land areas that need additional land treatment.
B. Provide planning and technical assistance to the owners and users of that land.

ACTIVITY	WHO	HOW	WHEN FY-81	WHEN FY-82	WHEN FY-83	PROGRESS
1. Identify land areas contributing sediment to the watershed	Task Force, Fromelt	a. use soil and topography maps b. field observation of land areas needing treatment	Sept.			Completed
2. Identify feedlots contributing to poor water quality	Fromelt	a. field observation b. contact feedlot users c. determine capacity and usage		Oct.		Completed
3. Determine Crop Rotation Patterns-SCS	SCS, Fromelt	a. interview selected land users b. field observations	July			Continuous
4. Determine severity and location of shoreline and bankside erosion	SCS	a. field observation	June			Completed
5. Develop priority list of land users needing planning and technical assistance	Fromelt	a. develop list of prospects	Aug.			Completed
		b. identify land users who are District cooperators and non cooperators	Aug.			Completed
		c. determine conservation practices needed in project area	June			Completed
		d. prepare cost-benefit data for practices	Sept.			Completed
6. Promote use of special ACP funds for conservation practices	Fromelt	a. contact land users needing conservation practices	June-Sept.			Continuous
		b. prepare news releases emphasizing availability of additional cost-share funds	June			Continuous
		c. develop visual display for use in SCS and ASCS offices promoting special ACP funds for project area	Oct.			Maps on display

completed by the various agencies.

GOALS

A. Prepare and update a comprehensive plan for improving water quality in the Pickerel Lake watersheds.
B. Establish base line data for land use, water quality and runoff into Pickerel Lake so effectiveness of practices can be evaluated.
C. Establish a plan to handle any funds received from Federal, state or local sources.

ACTIVITY	WHO	HOW	WHEN FY-81	WHEN FY-82	WHEN FY-83	PROGRESS
1. Establish land use and treatment status	Fromelt	a. determine conservation planning and practice needs by use of followup contacts and field observation		April		Continuous
2. Determine cost of practices	SCS, Fromelt	a. estimate total cost and amount of ACP cost-sharing by determining extent of needed practices	Aug.			Completed
		b. estimate man days of technical time needed	Aug.			
3. Establish ACP cost-share rates	ASCS Co. Comm.	a. develop list of conservation practices that can be used in project area	July			Completed
4. Assess possible septic tank seepage around the lake	Fromelt	a. conduct septic tank survey	June			Survey Made
		b. assist in developing sewer system if needed	July			more surveys needed
5. Determine if other measures are necessary to control problems of sewage pollution around the lake.	Fromelt	a. contact DWNR to assist in developing plan to control sewage pollution of cabin owners around the lake	July			When need arises
6. Act as project officer for any grants on the project & administer accounts involving Federal, State & local funds.	Fromelt	a. with DWNR, seek and obtain implementation funds from local, industrial, state and federal sources	Continuous			
		b. set-up adequate fiscal accounting system				
		c. Handle the distribution of funds from said accounts				
		d. assist sponsors in developing their financial plans - assist sponsors in contacting local agencies that will be making financial contributions				

OBJECTIVE III Develop and maintain working relationships with all agencies who will be assisting in the Pickerel Lake Project.

GOALS
A. Participation by all agencies for the improvement of water quality in the project area.
B. Develop lines of communication among staff personnel of involved agencies.

ACTIVITY	WHO	HOW	WHEN			PROGRESS
			FY-81	FY-82	FY-83	
1. Develop and maintain lines of communication with agency personnel	Fromelt	a. prepare and update a directory of agency personnel assigned to the project	July			Completed
2. Develop lines of communication with sponsors	Fromelt	a. prepare directory of project advisory group members	July			Completed

OBJECTIVE IV Assist sponsors and other cooperating agencies in monitoring operations to determin the effectiveness of various land treatment measures.

GOALS
A. Establish a system of monitoring runoff and lake water that will provide data for evaluation of practices in the project area.

ACTIVITY	WHO	HOW	WHEN			PROGRESS
			FY-81	FY-82	FY-83	
1. Assist in establishing water quality monitoring stations	Bjork, Fromelt	a. locate sites in drainage area that will effectively monitor water quality	May			Completed
		b. establish procedure for collecting water samples and submitting them to the lab for testing	June			Completed
		c. take water samples twice a month during summer and once a month during the winter	Continuous			

OBJECTIVE V. Inform land users and the public of the project and its [illegible] to improve water quality.

GOALS

A. Inform general public of project activities and the impact [illegible] on water quality in the project area.

B. Inform land owners and users of the assistance available for conservation practices.

ACTIVITY	WHO	WHO	WHEN FY-81	WHEN FY-82	WHEN FY-83	PROGRESS
1. Develop information dissemanation plan for project period	Fromelt	a. form information advisory committee composed of representatives from agencies involved in the project	Aug.			
		b. set up schedule of news releases	June	June		Continuous
		c. develop brochure explaining project		Oct.		Completed
		d. secure documentary pictures of recreation use & BMP in watershed		Oct.		Still in progress
		e. prepare slide show for group presentations	Aug.			Completed
		f. prepare news releases keying on special project ACP cost-sharing advantages	Sept.			Continuous
2. Develop plan for agency reports	Fromelt	a. prepare & submit monthly progress report	Continuous			
		b. prepare & submit annual progress report	Continuous			
		c. prepare & submit final report at end of project			X	

A. Water Quality Objectives

The water quality objectives are dictated by the necessity to protect the natural water courses and lakes from further pollution and contamination by human activities. The primary goal of the South Dakota Statewide "208" Water Quality Management Plan is to improve and maintain water quality for the maximum beneficial uses by present and future generations of South Dakotans. The objectives to achieve this goal are as follows:

1. To eliminate or reduce underground seepage from septic tank systems into the lakes and watersources within the watershed.
2. To prevent contamination of underground water supplies by infiltration of wastewater effluents.
3. To eliminate or reduce above ground accumulations of unabsorbed effluents, plant nutrients or other pollutants which ultimately are washed into the streams and lakes.
4. To eliminate or reduce erosion caused by human activities which are contributing sediments to the streams and lakes.
5. To restore and improve the water quality of Pickerel Lake by the elimination or reduction of pollutants entering the lake.

B. Water Sampling

Water sampling plays an important part in determining the amount of nutrients in the lake. Monitoring the water quality from in-lake sampling and runoff should provide information on the amount of nutrients and sediment entering the lake. In-lake sampling was taken twice a month during the summer months and once a month during the winter season (weather permitting).

There was no spring run-off in 1981 as we received only traces of snow through the winter. In 1982 runoff was quite heavy. On March 15th Checkpa Creek started running and flow measurements were 34" deep thru a 60" culvert and 10" deep thru a 36" culvert. The north creek started running thru the bridge on March 31st. Flow measurements were 30" deep. Runoff continued on these two tributaries until May 19th on the north creek and flow on Checkpa Creek was last checked on June 7th. Water samples were taken 4 days a week during the period.

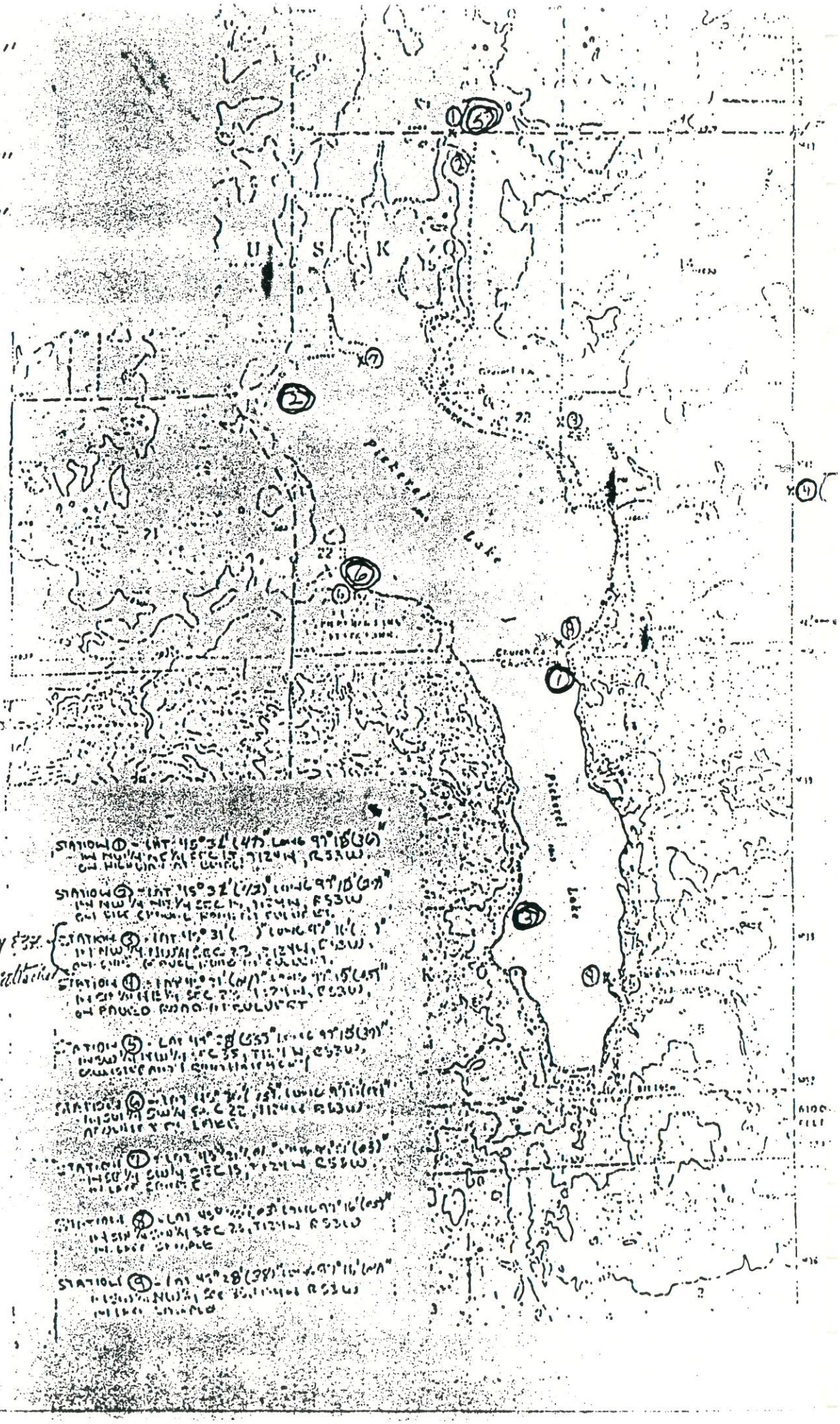
Runoff in 1983 was practically nill. On April 18, Checkpa Creek started running and flow measurements were 32" deep thru a 60" culvert. This lasted for a couple days and then the flow dropped to around 9" which is the normal flow from the springs located along Checkpa Creek. The tributary to the north amounted to a trickle for a couple of days.

Attached is a map showing the various sample sites.

Observations up to the present time indicate the water quality to be good with respect to the following tests:

1. Dissolved oxygen has ranged from 7.0 to 13.0 mg/l. (Quality Standard to be above 5.0 mg/l.)
2. PH has consistently been between the allowable variation of 6.5 and 8.3.
3. Temperature has not exceeded 80° F.

We have no information on nutrients, suspended solids, etc. The results of a laboratory analysis on water samples submitted to DWNR has not been received as yet.



IN-LAKE
STA. 1, 2, 3
Attached
STA. 4, 5
Exhibit
STA. 6

C. ACP FUNDING

An application for special ACP funds was made and an allocation of $30,000 received for the Pickerel Lake Project. These funds were for use in the watershed covering the counties of Day, Marshall and Roberts.

The following table is a summarization of ACP funds expended on projects for the years 1981 through 1983.

1982

Day County

SL-1	Establishment of Permanent Cover (grass seeding)	
	7 farms (304.5 acres)	$2781.00
SL-6	Stock Dugouts	
	4 farms (359.0 acres served)	3,110.00

Roberts County

SL-1	Establishment of Permanent Cover (grass seeding)	
	1 farm (107.0 acres)	$ 979.00
SL-6	Stock Dugouts	
	1 farm	1,111.00
TOTAL		$7981.00

1983

Day County

SL-1	Establishment of Permanent Cover (grass seeding)	
	4 farms (156.3 acres)	$1,128.00
SL-15	No-Till Systems	
	1 farm (100.0 acres)	619.00
TOTAL		$1,747.00

1984

Day County

WP-4 Animal Waste Disposal	
1 farm	$2,657.00
TOTAL	$2,657.00
TOTAL EXPENDITURES	$12,385.00

After consulting with SCS personnel on the use of ACP monies, we decided to set forth a practical goal of land treatment on lands in the Pickerel Lake Watershed.

The special ACP fund set up for this purpose should be used only for cost-sharing the BPMs listed below:

1. Grass Seeding, SL-1; SL-2
2. Animal Waste Systems directly related to contributing pollution to a stream or tributary that flows into the lake, WP-4
3. Grassed Waterways, WP-3
4. Stock Dugouts, SL-6
5. Sediment Settling Wildlife Developments, WL-1; WL-2
6. Field Windbreaks, SL-7
7. Small Retention Sediment Dams, WP-1
8. Stripcropping - Terraces, SL-3; SL-4
9. No-Till seeding, SL-15

V. PROGRESS SUMMARY

A review of the accomplishments on the Pickerel Lake Project show that in addition to ACP practices on the watershed, many areas around the lake received our attention. These were as follows:

1. Construction of a new field drainage system for the Pickerel Lake Lodge.
2. Several new septic tank systems installed by cabin owners.
3. A septic tank survey of homes around the lake.
4. Distribution of brochures in the two State public parks & other public places.

Considerable time was spent in gathering information on a Septic Leachate Detector. It is felt this type of equipment would be a valuable tool in locating and determining the amount of pollution that may be entering the lake. According to the Swanson Environmental, Inc. of Wisconsin, the cost is around $14,000. We tried to arrange a demonstration last fall, but cold weather was upon us before anything could be done.

There has been considerable interest in the establishment of a Lake Association District similar to the type now in use in the state of Wisconsin. It is hoped the State Legislature will pass legislation to make this possible. Many people feel having a Lake District would provide more funds for any projects the people are interested in doing.

Above all, it is felt the most important part of this project was making the people aware of the dangers of pollution and finding the solutions to combat this problem. Also stressing how important it is to maintain a clean lake for our present generation and for all our people in the future.

In conclusion, I wish to mention that a lot of the credit for work done on this project is due to the untiring efforts of Jim McFadden, Chm. of our Task Force. He has spent many hours and personal expense in promoting ideas to maintain and improve the quality of water in Pickerel Lake. Also, Mr. Lowell Noeske, Day County S.C.S., supervisors and the Day County Conservation District Board assisted in every way possible on all projects undertaken. It was a pleasure to work with these people.

VI. PUBLIC INFORMATION/PARTICIPATION

Evaluation of public input and comments received indicate there is general support for implementation of a program to reduce pollution within Pickerel Lake and its tributary watershed.

The following is a summary of meetings held.

On Sept. 22, 1980, a public meeting was held at the County Courthouse to discuss the preservation of the water quality in Pickerel Lake. A letter was received from the Pickerel Lake Assoc. South End expressing their support. There was no opposition to the project. On Nov. 25, 1980, the Day SCD Board met with supervisors from Marshall and Roberts SCDs to discuss the Pickerel Lake Project. It was resolved that the three SCDs would sign a joint powers agreement and hire Magnus Gilbertson for 1 month to make contacts in the watershed.

A meeting was held in Eden, SD on March 23, 1981 with Tim Bjork, DWNR, Pierre, presiding. All three counties, Day, Roberts and Marshall agreed to sign a cooperative agreement with DWNR covering the work to be done on the Pickerel Lake Project. There were 15 people present at this meeting.

Prepared brochure and issued newsletters on Pickerel Lake.

VII. PROJECT PERSONNEL BY AGENCY

Ed Fromelt, Project Coordinator
Day Co. Conservation District
710 Main
Webster, S.D. 57274

Alvin Nygaard, Chm.
Day Co. Conservation District
R 1 Box 7
Pierpont, S.D. 57468

SOIL CONSERVATION SERVICE (SCS)

William J. Parker
SCS
PIP Sub-Committee
Box 2890
Washington, S.D. 20013

R.D. Swenson, St. Conservationist
SCS
Federal Building
Huron, S.D. 57350

Lowell P. Noeske
District Conservationist
Day County (SCS)
710 Main
Webster, S.D. 57274

Janet Marx
District Business Manager
Day Co. Conservation District
710 Main
Webster, S.D. 57274

AGRICULTURAL STABILIZATION & CONSERVATION SERVICE (ASCS)

Dale Andersen, St. Executive Director
ASCS
Federal Building
Huron, S.D. 57350

Dale Cundy, ACP Program Specialist
ASCS
Federal Building
Huron, S.D. 57350

Guy Gleason, Co. Executive Director
ASCS
Webster, S.D. 57274

SOUTH DAKOTA DEPT. OF WATER AND NATURAL RESOURCES (DWNR)

Warren R. Nuefeld, Secretary
DWNR
Foe Foss Building
Pierre, S.D. 57501

William Markley, 208 Coordinator
DWNR
Joe Foss Building
Pierre, S.D. 57501

Herb Davis, Soil ~~Scientist~~ Conservationist
DWNR
Joe Foss Building
Pierre, S.D. 57501

Tim Bjork, Environmental Specialist
Division of Water Quality
DWNR
Joe Foss Building
Pierre, S.D. 57501

FARMERS HOME ADMINISTRATION (FmHA)

Dexter Gunderson, State Director
FmHA
200 4th St. S.W.
Huron, S.D. 57350

James Madsen, County Supervisor
FmHA
Webster, S.D. 57274

SOUTH DAKOTA DEPT. OF GAME, FISH & PARKS (SDGF&P)

Jack Merwin, Secretary
Dept. Game Fish & Parks
Anderson Building
Pierre, S.D. 57501

Doug Hanson
S.D. Game, Fish & Parks
603 E 8th Ave.
Webster, S.D. 57274

VII. PROJECT PERSONNEL BY AGENCY

ROBERTS & MARSHALL COUNTY CONS. DIST. BOARD (SCD)

in Nygaard, Chm.
County SCD
, Box 7
ont, S.D. 57468

eth Tedin, Chm.
rts Co. SCD
eton, S.D. 57262

ald W. Peters, Chm.
hall Co. SCD
ton, S.D. 57430

DEPT. OF AGRICULTURE

h Harner, Disision of Conservation
rson Building
re, S.D. 57501

PICKEREL LAKE - FUTURE

The work accomplished in the watershed and lake shoreline does not represent the total needs. Several problem areas still exist. These include faulty septic systems on individual cabins, three feedlots with high pollution potential and soil erosion from farmlands, grazed pastures and shoreline.

The project has aroused the public view toward water quality. Local citizens plan to watch for potential pollution situations and work through the local Soil Conservation District for cooperative corrections or enforcement if needed. The area farmers were exposed to conservation work and are becoming aware of needed conservation land treatment. ASCS has indicated interest in maintaining high priority for cost-share expenditures in the area. Interest is high in establishing a lake management district for taxation and pollution control work.

All the tools are in place to continue lake preservation work. The pace will be slowed due to manpower shortage and reluctance in landowner cooperation.

A total of 8% of the land in the Pickerel Lake Watershed was treated during the Pickerel Lake Preservation Project which brings the total percent of the land in the watershed that is treated to around 80%.

In conclusion, I wish to mention that a lot of the credit for work done on this project is due to the untiring efforts of Jim McFadden, Chm. of our Task Force. He has spent many hours and personal expense in rpomoting ideas to maintain and improve the quality of water in Pickerel Lake. Also, Mr. Lowell Noeske, Day County S.C.S., supervisors and the Day Coutny District Board assisted in every way possible on all projects undertaken. It was a pleasure to work with these people.

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Day County

***	SL-1 Establishment of Permanent Cover (grass seeding)	
	4 farms (156.3 acres)	$1,128.00
	SL-15 No-Till Systems	
	1 farm (100.0 acres)	619.00
TOTAL		$1,747.00

*** 125.3 acres were on Indian owned land.
2 farms ($870.00)

Appendix B

South Dakota Department of Game, Fish and Parks
South Dakota Statewide Fisheries Surveys (GF&P)

Name	County(ies)	No.	Watershed	Ident.No.
Pickerel Lake	Day	22	James	22-2
At or Near 2 E., 11 N., of Waubay, SD				

Township(s)	Range(s)	Section(s)
124	53	15,22,23,26, 27,34,35

Population: 20 miles 7,300 40 miles 35,400 100 miles 175,000*

Mgt.Classification	Ecological Classification	Fishing Water:	20 miles	40 miles	100 miles
Warmwater Permanent	Walleye-Panfish-Bass	Perm.,Semi-perm.	11,600 ac	36,600 ac	63,600 ac
		Marginal	5,300 ac	11,700 ac	42,100 ac

SOURCE OF INFORMATION: 1. Fish Lake Survey Report(s) 9/78 2. Game Lake Surveys
3. Lake File X 4. Gazetteer 5. D-J Report 74 6. 71
Maps: 8. GF&P Map 9. List of meand. lakes 10. Conservation Officer

Item	Data	Source
Area-Acres	955	8
Meander Ar-Ac	1052.33	9
Max. Depth- Ft.	43.3	8
Median Depth- Ft.	20.0	
Littoral Area - %	No Data	
Shore Length - Mi.	9.4	8
Greatest Length - Mi.	3.0	8
Meandered - Yes or No	Yes	9
Annual Fluctuation - Ft.	No Data + , -	
Long-term Fluctuation - Ft.	No Data + , -	
No. Islands	None	8
No. Dwellings	170	3
No. Resorts, Units at Resorts	5 No Data	3
No. Boats - Resort, Private	No Data	
No. Boat Liveries	No Data	

Dams: Spillway in outlet

Major Drainage Basin: Missouri

Sequence of Waterways to Major Drainage Basin:

Inlets-Trib.No.	Name	Source of info
Location	Flow-C.F.S.	
23-124-53	Chickapaw Cr., Dry Cr.	
15-124-53		8,3
Outlet	Trib.No.	
27-124-53	-	8,3

Watershed Description: Approximately 40-50% cultivated land

Watershed Ownership: No Data

Benchmark: Water level
No Data _____ feet below
Full Water Stage

Additional comments:

	Ledge-rock	Boulder	Rubble	Gravel	Sand	Silt	Clay	Muck			Source
Shoal Water No Data											
Soil - %											
Lake Bottom - %	No Data										
Shore Cover	No Data										
Accessibility	Ex.										
Erosion & Pollution	Siltation at inlet of Chicapaw Creek.										

% Emergent Cover No Data Dist. North Bay
% Occur. Submerged Veg. No Data Dist.

Water Plants	Species	Abund.	Water Plants	Species	Abund.	Water Plants	Species	Abund.
Typha latifolia		No Data	Myriophyllum Spp.		No Data	Lemna minor		No Data
Typha angustifolia		No Data	Potamogeton pectinatus		No Data	L. polyrhiza		No Data
Sparganium eurycarpum		No Data	P. richardsonii		No Data	Chara spp.		No Data
Scirpus validus		No Data	Najas flexilis		No Data	Zannichellia palustris		No Data
			Ceratophyllum demersum			Ruppia maritima		No Data
No Data								

Algae

Plants grew to depth of No Data ft.

*Population and acreage figures from [illegible]

Fish Species	No.	Wt.	Gear	Growth Rate	Spawning Facilities	S.
Perch	883	132.45	T	NoData	Good	
Rock Bass	46	8.74	T	NoData	Good	
Bl.Crappie	33	9.57	T	NoData	Good	
LM Bass	9	0.97	T	No Data	Good	
Bullhead	43	16.77	T	NoData	Good	
Walleye	19	38.83	T	NoData	Good	
N.Pike	52	23.92	T	NoData	Good	
Bluegill	1	0.32	T	NoData	Good	
W.Sucker	11	35.81	T	NoData	Good	

Item	Surface	S.	Below Therm.	S.
Temp.-°F.	77°	1	10'-76°	1
D.O. - p.p.m.	9.0	1	10'-9.0	1
T.Alk.-p.p.m.	230	1	No Data	
SO_4 -p.p.m.	57	1	No Data	
Cl. -p.p.m.	2.8	1	No Data	
T.P. -p.p.m.	0.32	1	No Data	
T.N. -p.p.m.	No Data		No Data	
Color	No Data			
Secchi Disc Reading 6 Ft.				1
Cause of Turbidity No Data				
Loc.of Therm. None Ft.from surf.				3
Winter D.O.				

Winterkill Dates No known dates G. T20

Special Problems Abundant carp population.

ABBREVIATIONS: A - abundant, C - common, O - occasional, R - rare, P - present, S - source of data, G - 250' gillnet set for 24 hours, T - trapnet set for 24 hours, E - Electrofishing

WATERFOWL HABITAT	No Data	S.
Nesting Cover		
Brood Cover		
Loafing Areas		

Utilization - Species	No.Adults	No.Broods	Species	No.Adults	No.Broods

Aquatic Furbearer Habitat No Data

Other Wildlife No Data

Recreational Use		Amount and/or Success	S.
Summer Angling	X	Heavy pressure - good for walleye and perch	10
Winter Angling	X	Heavy pressure - Good for walleye and perch	
Spearing			
Hunting			
Trapping			
Snowmobiling			
Boating	X	Heavy pressure	10
Canoeing			
Waterskiing	X	Heavey pressure	10
Picnicking	X	Heavy pressure	10
Camping	X	Heavy pressure.	10
Swimming	X	Heavy pressure.	10

(GF-Form 71-1)
Page 2

Additional information: (Netting tables, shoreline seining, other surveys, rough removal, stocking records, etc.)

Stocking record since 1970

1970	N. Pike	Fry	250,000
	Walleye	Fry	250,000
1971	N.Pike	Fry	500,000
	Walleye	Fry	300,000
	Walleye	Fgl.	25,000
1972	N.Pike	Fry	500,000
	Walleye	Fry	500,000
1973	BGill	Fgl.	11,500
	LM Bass	Fgl.	4,950
1974	BGill	Fgl.	1,031,460
	Walleye	Fgl.	44,000
	Walleye	Fry	700,000
1975	Walleye	Fry	200,000
	N.Pike	Fgl.	850
1976	LM Bass	Fgl.	48,000

Management Recommendations:

Continue management as a walleye-panfish lake with walleye stocking as scheduled under the walleye study F-1514. Rough fish should be removed by contract fishermen in the bay areas during the carp spawning period. The structure to control fish movement has been constructed in the culverts under the county highway on the outlet to Waubay Lake will continue to be maintained to prevent fish movement into the lake from the Waubay lakes.

By Gary Marrone

Date Feb. 1979

(GF-Form 71-1)
Page 3

NETTING SUMMARY SHEET

Observer Marrone

LAKE Pickerel COUNTY Day Date Sept., 21,22, 1978 Cavanaugh, Barber

a. Total Gillnet Sets _____ 250 ft. Experiment nylon nets.

SPECIES	TOTAL CATCH No.(%)	TOTAL CATCH Wt.(%)	Ave. Size Ins.	Ave. Size Lbs.	Average Catch/Net No.	Average Catch/Net Wt.	Statewide Median/net No.	Statewide Median/net Wt.

b. Trapnet sets 20 (Total), mesh size 3/4. Pocketnet sets _____ (Total), mesh size _____.

SPECIES	TOTAL CATCH No.(%)	TOTAL CATCH Wt.(%)	Ave. Size Ins.	Ave. Size Lbs.	Average Catch/Net No.	Average Catch/Net Wt.	Statewide Median/net No.	Statewide Median/net Wt.
Perch	883 (80.5)	132.45(49.3)	6.2	0.15	44.2	6.62	13.0	1.6
Rock Bass	46 (4.2)	8.74(3.3)	5.8	0.19	2.3	0.44	1.6	0.7
Bl.Crappie	33 (3.0)	9.57(3.6)	5.5	0.29	1.7	0.48	27.6	10.1
LM Bass	9 (0.8)	0.97(0.4)	5.6	0.11	0.5	0.05	1.7	1.1
Bullhead	43 (3.9)	16.77(6.3)	8.0	0.39	2.2	0.84	21.66	70.2
Walleye	19 (1.7)	38.83(14.5)	15.2	2.04	1.0	1.94	3.5	4.0
N.Pike	52(4.7)	23.92 (8.9)	12.0	0.46	2.6	1.20	2.8	6.5
Bluegill	1(0.1)	0.32(0.1)	7.0	0.32	0.1	0.02	23.8	5.1
W.Sucker	11(1.0)	35.81(13.4)	19.6	3.26	0.6	1.79	7.6	8.2

(GF-Form 71-6)
Page 8

37. Fish Sizes

Lake Pickerel

Sept. 21, 22, 1978

LENGTH - FREQUENCY DISTRIBUTIONS Marrone, Cavanaugh, Barber

SPECIES AND NUMBERS OF FISH IN LENGTH GROUPS

Total length in inches	Perch	Rock Bass	BlCrappie	LM Bass	Walleye	N.Pike	Bluegill	W.Sucker		
3.0 - 3.4			1							
3.5 - 3.9		1	20							
4.0 - 4.4		10								
4.5 - 4.9	1	2								
5.0 - 5.4	17	4		1	1					
5.5 - 5.9	31	6		4	3					
6.0 - 6.4	14	11								
6.5 - 6.9	8	3	1							
7.0 - 7.4	14	2					1			
7.5 - 7.9	5	5								
8.0 - 8.4	7	1								
8.5 - 8.9	2	1	1							
9.0 - 9.4	2		1		2					
9.5 - 9.9					5	3-				
10.0 - 10.4					1	6				
10.5 - 10.9					3	6				
11.0 - 11.4						1				
11.5 - 11.9										
12.0 - 12.9	1					4				
13.0 - 13.9			4							
14.0 - 14.9						1				
15.0 - 15.9						2		1		
16.0 - 16.9										
17.0 - 17.9								1		
18.0 - 18.9								2		
19.0 - 19.9					1			1		
20.0 - 20.9					2			2		
21.0 - 21.9					1			3		
22.0 - 22.9								1		
23.0 - 23.9					1	1				
24.0 - 24.9					1					
25.0 - 25.9					1					
26.0 - 26.9					1					
27.0 - 27.9										
28.0 - 28.9										
29.0 - 29.9										
30.0 - 30.9										
31.0 - 31.9										
32.0 - 32.9										
33.0 - 33.9										
34.0 - 34.9										
35.0 - 35.9										
36.0 - 36.9										
TOTALS	102	46	28	5	23	24	1	11		

(GF-Form 71-6)
Page 9

35. Natural Reproduction of Fish - Shoal Water Seining

Seine Measurements: Length 40 feet, Depth 6 feet,
Mesh size 1/4 inch square.

Lake Pickerel
County(ies) Day
Date Sept. 20, 1978
Collectors Marrone, Cavanaugh

	Station Number		Show number of seine hauls made at each station in ( )				Totals
	1 (1)	2 (1)	3 ( )	4 ( )	5 ( )	6 ( )	
Total linear distance covered-feet	300'	300'					600 Linear Feet
Greatest water depth - feet	4'	4'					18,000 Sq. Ft.
Bottom Soil Type Amount of Vegetation ++	Gravel-Sand Light	Gravel Light					0.4 Acre(s)
Water Temperature-°F.							
Wind Intensity & Direction +	Light N.W.	Light N.W.					C/A = Catch/Acre Seined.
Time of Day & Date	1:15 p.m.	1:30 p.m.					
Location on Lake	Beer Pier	W.State Park					

SIZE AND NUMBER

Species ***	Station #1		Station #2		Station #3		Station #4		Station #5		C/A Station #6		TOTALS		
	YY**	O*	YY	O	YY	O	YY	O	YY	O	YY	O	YY	O	All
LM Bass	5	1	3								20	2.5	8	1	9
Crappie	2			1							5	2.5	2	1	3
Perch	400	2	625	1							2563	7.5	1025	3	1028

++ Heavy, Moderate, Light, None, etc. + Strong, Moderate, Light, Calm.
*** Group separately minnows and darters without identifying them, unless readily identifiable in field. Preserve sample for later identification in laboratory.
** YY - Young-of-year or fingerlings.
* Others, includes yearlings and adults, minnows and darters. Take scale samples from sizes of fish, especially game fish, not taken in test nets.

Pickerel Lake, Day County Walleye Study 1514

Compiled here is a summary of the trawl study data for 1978. There was a total of 30 trawl pulls lasting 4 minutes each. And the Lake was visited on 6 separate days between July 20 and October 30. By Jim Riis

Species	Total Number	Size Range
Walleye fingerlings	26	3.14"-6.0"
Walleye $\geq$ 1 yr.	78	7.79"-10.2"
Yellow Perch	2,999	2.0"-6.0"
Northern Pike	44	6.99"-12.5"
Spottail Shiner	763	3.0"-4.7"
Johny Darter	94	
Rock Bass	224	YOY
Crappie	17	YOY
Bullhead	19	1.0"-7.0"
Brook Sticklebacks	10	

Appendix C

Fourth Planning and Development District

II. New Water Quality Study Area (WQSA)

A. WQSA Selection

2. Nominations and Selection of WQSA in District IV

April, 1979

The preparation of this report was financed through a Section 208 Waste Treatment Management Planning Grant from the U. S. Environmental Protection Agency

Prepared by: Fourth Planning and Development District
615 South Main Street
Aberdeen, South Dakota 57401

TABLE OF CONTENTS

MAP

APPENDICES

I. Introduction

On October 8, 1972, the United States Congress enacted the Federal Water Pollution Control Act Amendments. The purpose of these amendments is to attain an interim water quality goal of fishable and swimmable waters by July 1, 1983, and to eliminate the discharge of pollutants into out nation's water by 1985.

Section 208 of these amendments provide, "that an areawide water treatment management process be developed and implemented to assure adequate control of sources of pollutants in each state." To do this, Section 208 calls upon the Governor of the State to designate a state planning agency to be responsible for the conduct and coordination of the required water quality management planning. The designed state planning agency is empowered to delegate portions of its responsibilities to other State, Federal, local or interstate agencies.

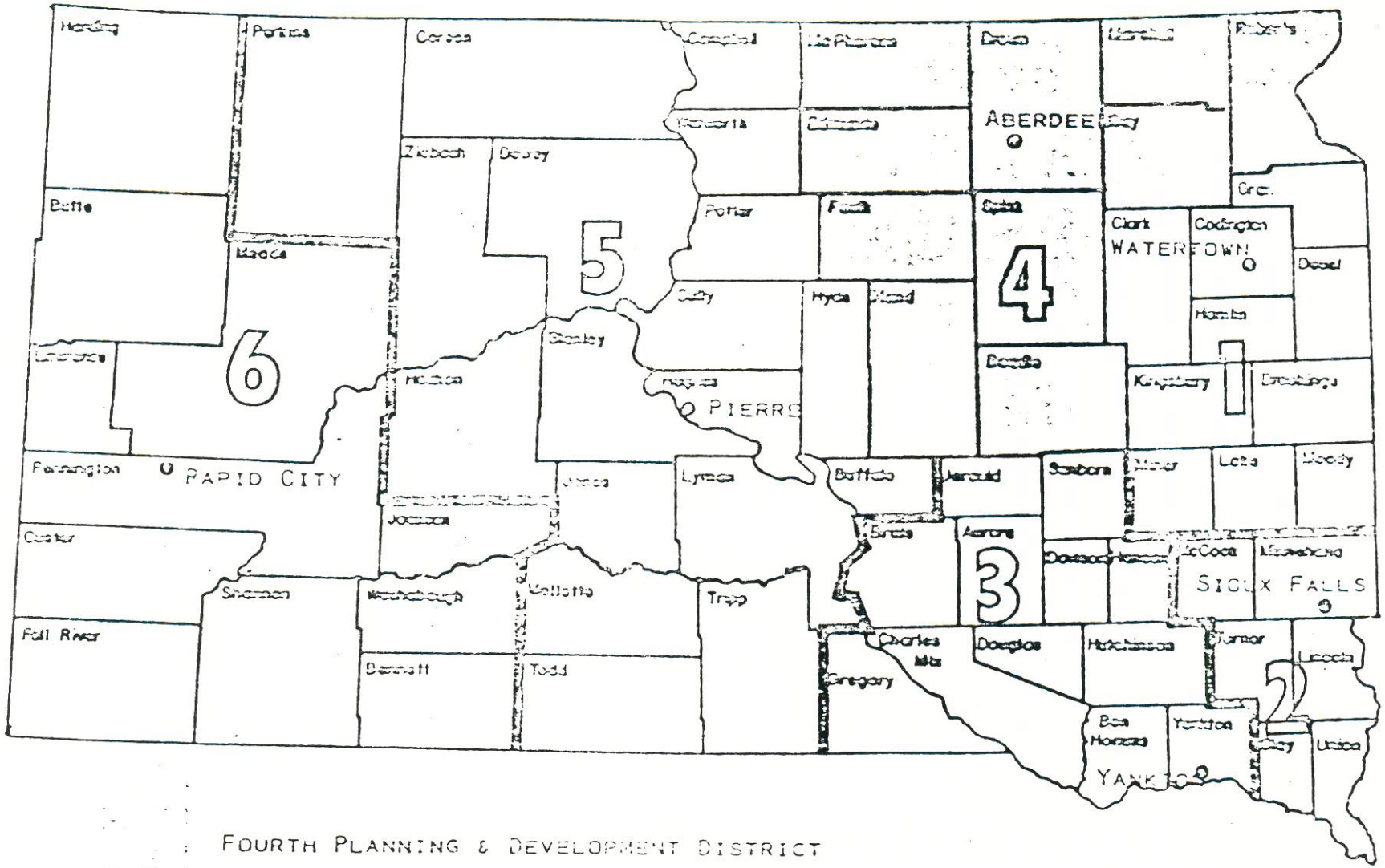
On March 23, 1976, Governor Richard F. Kneip designated the South Dakota Department of Environmental Protection as the agency responsible for the water quality management planning process in the State of South Dakota. Subsequently, the Department of Environmental Protection entered into agreements with various State, Federal, and local agencies. These agencies have agreed to participate in the South Dakota water quality management planning process by performing certain activities and providing various outputs to the Department of Environmental Protection. One of the agencies participating in this program is the Fourth Planning and Development District.

The Fourth Planning and Development District is a multicounty planning district whose boundaries were established by Executive Order

of the Governor of the State of South Dakota on December 4, 1970. The District functions under the Joint Exercise of Governmental Powers Act of 1966 (SDCL 1 - 24) and is a voluntary organization of local governments established to work on common problems, policies, and plans in a ten-county area in northeastern South Dakota (Map 1).

As part of its 208 planning responsibilities, the Fourth Planning and Development District agreed to report on the selection and designation process for the 1979 Water Qaulity Study Area in District IV.

PLANNING & DEVELOPMENT DISTRICTS



FOURTH PLANNING & DEVELOPMENT DISTRICT

LOCATION OF DISTRICT OFFICES

MAP 1

II. Nomination Procedure

Nominations of water bodies (lakes, rivers, streams, etc.) for designation as a Water Quality Study Area (WQSA) within the Fourth Planning District was solicited from the Fourth Planning and Development District Commission.

The Commission was informed of what a WQSA was, who was involved, what the results could lead to, and the criteria that would be used to rank the nominations.

Nominations were open to all commissioners and the following lakes were suggested. Pickerel Lake (Day County), Lake Byron (Beadle County), Lake Eureka (McPherson County), and Cottonwood Lake (Spink County).

The Commission was informed that these would be ranked prior to submitting the nomination to the South Dakota Department of Environmental Protection.

The nominations were ranked by staff, using the criteria noted in Chapter III, and aproved by the Commission at the March meeting. The order approved was Pickerel Lake, Lake Byron, Lake Eureka, and Cottonwood Lake.

III. Criteria

Each nominated lake was examined under the same criteria. The criteria established for ranking purposes were the States Lakes Preservation Committee criteria, the South Dakota Lake Significance Ranking criteria, and the availability of soils data for the watershed (see attachments).

The States Lakes Preservation Committee was established by the South Dakota Legislature in 1975 to assist in the identification and classification of lakes in the Northeast Lakes Region of the state. The committee followed the requirements set under Section 314 (a) of PL 92500 to examine the eutrophic condition, to develop recommendations for procedures, processes, and methods to control sources of pollutions. A priority system was developed to combine the general lake quality and cultural factors of the lakes. Various items such as lake depth, lake size, recharge quality, fisheries classification, population density, public access, present usage, and recreation facilities were examined. Lake depth and fisheries classification were weighed higher from the quality aspect, while public water per capita and public facilities investment were weighed higher from the cultural aspect.

The South Dakota Lake Significance Ranking List was also established by the South Dakota Legislature to fulfill Section 314 (a) requirements across the state while also setting the necessary criteria for state lake restoration grant programs. The Lake Significance Ranking List criteria examines the lake's mean depth, surface area, fisheries classification, public access, domestic water supply, public land around the lake, and public facilities available.

The nominated lakes with soils data available within their watershed received points because of the additional cost and manpower required to

complete such a study would be prohibitive within the allotted time frame and responsible recommendations regarding soils preservation could not be established and three recommendations based on soils data would be impaired.

Ranking sheets for the nominated lakes may be found in Appendix A.

IV. Literature Review

Generally, background information concerning the lakes nominated was somewhat limited. Information available, however, provided enough data to rank each lake according to the established criteria. The information gathered came from varied sources, including the South Dakota Department of Environmental Protection, the South Dakota Game, Fish and Parks, the libraries of South Dakota State University, Northern State College, and Huron College. The following depicts data available by lake.

Pickerel Lake

1. Statewide Fisheries Survey, completed 1978
2. Hanson, D. R., 1973 - Watershed Inventory of Waubay Lakes Basin (Pickerel Lake)

   1966 - Eutrophication of South Dakota Lakes - Generalized Model of Nutrient and Sediment Sources to Pickerel Lake
3. Haworth, E. J.,1972 - Dictum Succession in a Core from Pickerel Lake, Northeastern South Dakota
4. Leap, D, L., 1974 - The Glacial Geology and Hydrology of Day County, South Dakota
5. National Eutrophication Survey 1974 - Pickerel Lake
6. Watts, W. A. and Bright, R. C. 1968 - Pollen, Seed, and Mollersk Analysis of a Sediment Core from Pickerel Lake.
7. Weber, D. T., 1961 - Investigation of the Thermal Chemical Cycles of Pickerel Lake
8. Swanson, A. R. - Chemical Swing of Selected South Dakota Lake Sediments - (Pickerel)

Lake Byron

1. Statewide Fisheries Survey, completed 1978

Lake Byron, Cont.

2. National Eutrophication Survey - 1974 - Lake Byron
3. Schmidt, A. E., 1968 - Limnology of Selected Lakes

Lake Eureka

1. Statewide Fisheries Survey, completed 1978

Cottonwood Lake

1. Statewide Fisheries Survey, completed 1978
2. National Eutrophication Survey - 1974 - Cottonwood Lake

V. Public Interest

Pickerel Lake received the most points in the physical measure of the nominated lakes. However, the most important factor to examine before designation was final, was the public support for the water quality study.

The lake associations were notified of the possible designation as a WQSA, and that public support played a major role in getting the study. If they are to have the study done, support must be shown.

Letters of support received by the Fourth Planning and Development District and also the guest list of those who attended the meeting held April 29, 1979, at the Pickerel Lake Lodge may be found in Appendix B and C respectively.

VI. Summary

The ranking of lakes nominated by the Fourth Planning and Development District Commission followed the guidelines set by the South Dakota Department of Environmental Protection.

Pickerel Lake, according to the criteria, received designation as a Water Quality Study Area for 1979. Public interest, as well as the criteria, strongly supported the designation of Pickerel Lake.

The other lakes nominated in rank order were: Lake Byron, Lake Eureka, and Cottonwood Lake.

Appendix A

Lake PICKERAL County(ies) DAY, ROBERTS, & MARSHALL

I. Lakes Preservation Committee Criteria

Lake Depth

___ 0	0-3 ft
___ 6	3-6 ft
___ 12	7-9 ft
✓ 17	> 9 ft

Lake Size

___ 0	< 100 acres
___ 2	100-200 acres
___ 4	200-500 acres
✓ 5	500-1000 acres
___ 6	> 1000 acres

(If 3' depth)

Water Quality

___ 0	Primarily Surficial Recharge
___ 3	Limited Groundwater Recharge evident
___ 7	Moderate Groundwater Recharge evident
✓ 12	Extensive Groundwater Recharge evident

Fisheries Classification

___ 0	Wildlife
___ 8	Warm Water Marginal
___ 12	Warm Water Semi-permanent
✓ 17	Warm Water Permanent

Public Accessibility

___ 0	none
___ 4	Section Line only
___ 6	Public Access area
✓ 9	Public Access (2 or more pts)

Public Water per Capita

acres/capita within 40-mile radius	
✓ 0	> 1.0
4	.5-1.0
7	.25-.5
10	.1-.25
13	< .1

Population within 15-mile radius

___ 0	0-3,500
✓ 2	3,500-10,000
___ 3	10,000-20,000
___ 5	> 20,000

Public Usage

___ 0	Rare
___ 3	Slight
___ 6	Moderate
✓ 9	Severe

Public Facility Investment

Acreage	
___ 0	none
___ 1	0-5
___ 2	5-40
___ 3	40-100
✓ 4	> 100

Facilities	
___ 0	none
___ 1	Access
___ 2	Boat Ramp
___ 4	Basic Facilities
___ 6	Amenities short of bathing facilities
✓ 9	Amenities including bathing facilities

# of Points 84 out of 100

II. Detailed Soil Data Available Yes ✓ No ____ (22 points)

III. Lake Significance Ranking (State)

Lake Mean Depth

0	0-3 ft.
6	3-6 ft.
12	6-9 ft.
17	9-12 ft.
✓ 21	>12 ft.

Surface Area

0	<100 acres
2	100-200 acres
4	200-500 acres
6	500-1,000 acres
✓ 8	>1,000 acres

Fisheries Classification

8	warm water marginal
12	warm water semipermanent
✓ 17	warm water permanent or cold water marginal
21	cold water permanent

# of Points 69 out of 78

Public Accessibility

0	no public access
3	section line
7	public access area (1)
✓ 10	public access areas (>2)

Domestic Water Supply

✓ 0	if not
5	if yes

Public land Adjoining Lake

0	none
1	<5
2	5-40
3	40-100
✓ 4	>100

Public Facilities

0	none
3	toilets, picnic tables & garbage
6	toilets, picnic tables, garbage & camping (no bath facilities)
✓ 9	all of the above including bath facilities

Total Points 175 out of 200

Lake BYRON County(ies) BEADLE & SPINK

I. Lakes Preservation Committee Criteria

Lake Depth

___ 0	0-3 ft
___ 6	3-6 ft
✓ 12	7-9 ft
___ 17	> 9 ft

Lake Size

___ 0	< 100 acres
___ 2	100-200 acres
___ 4	200-500 acres
___ 5	500-1000 acres
✓ 6	> 1000 acres

(if 3' depth)

Recharge Quality

___ 0	Primarily Surficial Recharge
___ 3	Limited Groundwater Recharge evident
___ 7	Moderate Groundwater Recharge evident
✓ 12	Extensive Groundwater Recharge evident

Fisheries Classification

___ 0	Wildlife
✓ 9	Warm Water Marginal
___ 12	Warm Water Semi-permanent
___ 17	Warm Water Permanent

Public Accessibility

___ 0	none
___ 4	Section Line only
___ 6	Public Access area
✓ 9	Public Access (2 or more pts)

Public Water per Capita

acres/capita within 40-mile radius	
✓ 0	> 1.0
___ 4	.5-1.0
___ 7	.25-.5
___ 10	.1-.25
___ 13	< .1

Population within 15-mile radius

___ 0	0-3,500
___ 2	3,500-10,000
✓ 3	10,000-20,000
___ 5	> 20,000

Public Usage

___ 0	Rare
___ 3	Slight
___ 6	Moderate
✓ 9	Severe

Public Facility Investment

Acreage		Facilities	
___ 0	none	___ 0	none
___ 1	0-5	___ 1	Access
___ 2	5-40	___ 2	Boat Ramp
___ 3	40-100	___ 4	Basic Facilities
✓ 4	> 100	___ 6	Amenities short of bathing facilities
		✓ 9	Amenities including bathing facilities

# of Points 72 out of 100

II. Detailed Soil Data Available Yes ✓ No ____ (22 points)

III. Lake Significance Ranking (State)

(Lake Byron continued)

Lake Mean Depth

0	0-3 ft.
6	3-6 ft.
✓ 12	6-9 ft.
17	9-12 ft.
21	>12 ft.

Surface Area

0	<100 acres
2	100-200 acres
4	200-500 acres
6	500-1,000 acres
✓ 8	>1,000 acres

Fisheries Classification

✓ 8	warm water marginal
12	warm water semipermanent
17	warm water permanent or cold water marginal
21	cold water permanent

# of Points 51 out of 78

Public Accessibility

0	no public access
3	section line
7	public access area (1)
✓ 10	public access areas (>2)

Domestic Water Supply

✓ 0	if not
5	if yes

Public land Adjoining Lake

0	none
1	<5
2	5-40
3	40-100
✓ 4	>100

Public Facilities

0	none
3	toilets, picnic tables & garbage
6	toilets, picnic tables, garbage & camping (no bath facilities)
✓ 9	all of the above including bath facilities

Total Points 145 out of 200

Lake EUREKA County(ies) McPHERSON

I. Lakes Preservation Committee Criteria

Lake Depth

___	0	0-3 ft
___	6	3-6 ft
✓	12	7-9 ft
___	17	> 9 ft

Lake Size

✓	0	< 100 acres
✓	2	100-300 acres
(if 3' depth)	4	300-500 acres
___	5	500-1000 acres
___	6	> 1000 acres

Recharge Quality

___	0	Primarily Surficial Recharge
✓	3	Limited Groundwater Recharge evident
___	7	Moderate Groundwater Recharge evident
___	12	Extensive Groundwater Recharge evident

Fisheries Classification

___	0	Wildlife
___	8	Warm Water Marginal
✓	12	Warm Water Semi-permanent
___	17	Warm Water Permanent

Public Accessibility

___	0	none
___	4	Section Line only
✓	6	Public Access area
___	9	Public Access (2 or more pts)

Public Water per Capita

acres/capita within 40-mile radius		
✓	0	> 1.0
___	4	.5-1.0
___	7	.25-.5
___	10	.1-.25
___	13	< .1

Population within 15-mile radius

___	0	0-3,500
✓	2	3,500-10,000
___	3	10,000-20,000
___	5	> 20,000

Public Usage

___	0	Rare
___	3	Slight
✓	6	Moderate
___	9	Severe

Public Facility Investment

Acreage		
___	0	none
___	1	0-5
✓	2	5-40
___	3	40-100
___	4	> 100

Facilities		
___	0	none
___	1	Access
___	2	Boat Ramp
✓	4	Basic Facilities
___	6	Amenities short of bathing facilities
___	9	Amenities including bathing facilities

# of Points 49 out of 100

II. Detailed Soil Data Available Yes ✓ No ____ (22 points)

III. Lake Significance Ranking (State)

(Lake Eureka continued)

Lake Mean Depth

0	0-3 ft.
6	3-6 ft.
✓ 12	6-9 ft.
17	9-12 ft.
21	>12 ft.

Surface Area

0	<100 acres
✓ 2	100-200 acres
4	200-500 acres
6	500-1,000 acres
8	>1,000 acres

Fisheries Classification

8	warm water marginal
✓ 12	warm water semipermanent
17	warm water permanent or cold water marginal
21	cold water permanent

# of Points 38 out of 78

Public Accessibility

0	no public access
3	section line
✓ 7	public access area (1)
10	public access areas (>2)

Domestic Water Supply

✓ 0	if not
5	if yes

Public and Adjoining Lake

0	none
1	<5
✓ 2	5-40
3	40-100
4	>100

Public Facilities

0	none
✓ 3	toilets, picnic tables & garbage
6	toilets, picnic tables, garbage & camping (no bath facilities)
9	all of the above including bath facilities

Total Points 109 out of 200

Lake COTTONWOOD County(ies) SPINK, HAND, & FAULK

I. Lakes Preservation Committee Criteria

Lake Depth

___	0	0-3 ft
___	6	3-6 ft
✓	12	7-9 ft
___	17	> 9 ft

Lake Size

	___	0	< 100 acres
	___	2	100-200 acres
(If 3' depth)	___	4	200-500 acres
	___	5	500-1000 acres
	✓	6	> 1000 acres

Recharge Quality

___	0	Primarily Surficial Recharge
___	3	Limited Groundwater Recharge evident
✓	7	Moderate Groundwater Recharge evident
___	12	Extensive Groundwater Recharge evident

Fisheries Classification

___	0	Wildlife
✓	8	Warm Water Marginal
___	12	Warm Water Semi-permanent
___	17	Warm Water Permanent

Public Accessibility

___	0	none
___	4	Section Line only
___	6	Public Access area
✓	9	Public Access (2 or more pts)

Public Water per Capita

acres/capita within 40-mile radius		
✓	0	> 1.0
___	4	.5-1.0
___	7	.25-.5
___	10	.1-.25
___	13	< .1

Population within 15-mile radius

___	0	0-3,500
✓	2	3,500-10,000
___	3	10,000-20,000
___	5	> 20,000

Public Usage

___	0	Fare
___	3	Slight
✓	6	Moderate
___	9	Severe

Public Facility Investment

Acreage		
___	0	none
___	1	0-5
___	2	5-40
___	3	40-100
✓	4	> 100

Facilities		
✓	0	none
___	1	Access
___	2	Boat Ramp
___	4	Basic Facilities
___	6	Amenities short of bathing facilities
___	9	Amenities including bathing facilities

# of Points 54 out of 100

II. Detailed Soil Data Available Yes ___ No ✓ (22 points)

III. Lake Significance Ranking (State)

(Cottonwood Lake continued)

Lake Mean Depth

0	0-3 ft.
6	3-6 ft.
✓ 12	6-9 ft.
17	9-12 ft.
21	>12 ft.

Surface Area

0	<100 acres
2	100-200 acres
4	200-500 acres
6	500-1,000 acres
✓ 8	>1,000 acres

Fisheries Classification

✓ 8	warm water marginal
12	warm water semipermanent
17	warm water permanent or cold water marginal
21	cold water permanent

# of Points 42 out of 78

Public Accessibility

0	no public access
3	section line
7	public access area (1)
✓ 10	public access areas (>2)

Domestic Water Supply

✓ 0	if not
5	if yes

Public and Adjoining Lake

0	none
1	<5
2	5-40
3	40-100
✓ 4	>100

Public Facilities

✓ 0	none
3	toilets, picnic tables & garbage
6	toilets, picnic tables, garbage & camping (no bath facilities)
9	all of the above including bath facilities

Total Points 96 out of 200

Appendix B

CHARLES H. RATHBUN

2300 E. 50th St.
12 8TH AVENUE WEST
WEBSTER, SOUTH DAKOTA 57274
Sioux Falls 57103

REAL ESTATE RENTALS
PHONE 345-4340

Mr. & Mrs. O'Hara
615 Belmont
Aberdeen, S. Dak.
57401

Dear Mr. O'Hara,

We have owned cottages on Pickerel Lake for
two years now and are most interested in
vacation land and are most interested in
Pickerel staying a safe & beautiful lake.
I will not be able to be at the meeting
on April 5th but I am in support of the water
study and would do anything I can to personally
to help keep the lake safe and beautiful.

Sincerely,
Charles Rathbun
2300 E. 50th St.
Sioux Falls, S. Dak.
57103

Webster, S. D.
April 1, 1979

Dear Mr O'Hara:

I highly support the study of the Proposed Tri-Area Water Study. I am greatly concerned about sedimentation in the Lake etc.

Sincerely,
Clyde Anderson

Webster, S.D.
April 13, 1979

Marvin O'Hara
Aberdeen, S.D.
Dear Sir;

I am glad to hear that Pickerel Lake has been chosen as a possible water study area.

I am sure something could be done to stop run off sediment from entering the Lake.

We hope to have a good turnout at the Pickerel Lake Lodge April 24th

Yours truly,
Board member South Pickerel Lake Assn
Herman Reed

April 13. 1979.

Dear Sir

So glad to hear our Lake Richard was been choosen for a study. We are writing to let you know We want our Lake included in Funding for water study.

Oak.

Sincerely

Ed [illegible]

Jeanne Grover Taylor
1403 North Lincoln
Aberdeen, S. D. 57401

April 12, 1979

Marvin O'Hara
615 South Main Street
Aberdeen, S. D. 57401

Dear Mr. O'Hara:

As a property owner at Pickerel Lake in Day County, South Dakota, I most certainly support a water study program at Pickerel Lake. I understand this study is federally funded and I hope that the good points of this spring-fed and water runoff lake will also be studied as well as any problems. The number of people using the lake and surrounding properties had multiplied in the 30 years that I have had the pleasure of residing at Pickerel during the summer months.

Other than the study, who and what agencies will be advised of the findings and results of the proposed study and what advantages will this study bring to me, as a property owner?

I hope to be able to attend the meeting at Pickerel on April 29, 1979.

Sincerely,

Jeanne Grover Taylor

April 4, 1979

USA 15¢ THE BRAVE

Harris Peters

We are unable to attend the meeting of cabin owners being held at the lodge on Pickerel Lake on April 29. However we are aware that there is money available to keep Pickerel Lake beautiful safe & clean. If there is a petition that we can sign or a letter we can write, as lake front land owners, we will be glad to do it.

Mrs. W. C. Ziebell
4449 Country Club Blvd
Sioux City, Ia. 51104

Peters -
West north & the East side state park
on the south side of High Park.

Representing
Iowa Mutual
Insurance Co.

Millers Mutual
Insurance Association

BARKLEY Agency, Inc.
227 South Prairie - P.O. Drawer 1003 - Sioux Falls, South Dakota 57101 - 605/336-100

March 26, 1979

Mr. Marvin O'Hare
615 S. Main
Aberdeen, South Dakota
57401

Dear Mr. O'Hare:

I received a call from Merle Goedken advising that some funds would be available for maintaining Pickerel Lake.

As a property owner on Pickerel Lake, I would be very interested in how these funds are to be used and would certainly be willing to cooperate in any way we can to put these funds to their best use.

I understand there will be a meeting on April 29th at the Lodge and I will plan on attending.

If there are any further details that you have available, prior to the meeting, I would be pleased to receive them.

Best regard,

BARKLEY AGENCY, INC.

Robert M. Barkley, C.P.C.U.

RMB:sf

I Thru ex to advise you we are in favor of the proposed water study area at Pickerel Lake.

We will be returning to So. Dak the week end of the 29th (from Virginia) therefore will be unable to attend the meeting —

Mr + Mrs John Pagones

MR. J. PAGONES
205 1/2 S. MAIN
ABERDEEN, S.D.
57401

INTERNATIONAL BANK OF CALIFORNIA
2323 BEVERLY BOULEVARD
LOS ANGELES, CALIFORNIA 90057

April 17, 1979

Mr. Marvin O'Hara,
615 So. Main Street
Aberdeen, S. Dak. 57401

Dear Mr. O'Hara:

We are glad to hear that Pickerel Lake has been chosen as a possible water study by your commission, and we urge you to give it your full support.

Although we reside in California, Pickerel Lake is still our vacation spot for part of nearly every summer, there we own a cottage and a nice vacant lot on South End for a future home for some of our family.

Distance prevents our presence on April 29th, but you have our support in favor of the project.

Sincerely,

Lorraine B. and Fred Kocsch

14838 Cantara
Panorama City, Calif 91402

Le Mars Daily Sentinel
Iowa's Only Completely Local Daily Newspaper

Carter A. Pitts, Publisher
Phone 712, 546-7031
41 First Ave. N.E.
Le Mars, Iowa 51031

April 18, 1979

Mr. Marvin O'Hara
615 So. Main St.
Aberdeen, SD 57401

Dear Mr. O'Hara:

Although I'm not a resident of South Dakota, my wife is (Webster) and we have enjoyed portions of each summer for the past 12 years at our cottage on the south end of Pickerel Lake.

We believe Pickerel Lake is one of the nicest family lakes in South Dakota, a feeling that must also be shared with the South Dakota Parks and Recreation department which supports two separate state parks for camping on the lake, and the state fish and game commission which operates the state fish hatchery near our cottage.

My wife and I wholeheartedly support the planning commission's idea to make a water study of Pickerel Lake and its watershed to help identify problems and sources of problems. Preservation of the lake and it's surrounding beauty must be maintained, and improved, not only for our enjoyment, but for generations to come.

Now is the time to start the study. The threat of an endangered ecology may be too late. Pickerel Lake is a good, a natural place to start.

We appreciate your interest. Thank you, and good luck!

Best regards,

Carter A. Pitts

April 19, 1979

Mr. Marvin O'Hara
615 S. Main Street
Aberdeen, S.D. 57401

Dear Mr. O'Hara:

As a land owner and long time resident of Pickerel Lake I am very interested that this lake be chosen as a water study area by the Fourth Planning District. We have owned our cottage since 1954 and have seen many changes in the lake bed. Weeds which had been cleared some years ago have returned in full force in our bay and are a detriment to fishing, boating, swimming and water-skiers to the point it is almost impossible to enjoy life there as we once did. Real estate values have risen terrifically in the last 25 years and these will be lost unless the lake is improved so that living on the lake will be enjoyable again.

Please give Pickerel Lake an opportunity to return to the most beautiful lake in South Dakota.

Very truly yours,

Luverne Atkinson

Luverne Atkinson
P.O. Box 614
Webster, S.D. 57274

Sanford Lake
April 23, 1979

Dear Mr. O'Hara -

As a cabin owner at Pickerel Lake I am very much interested in it being selected as a water study area.

Yours truly
Rudolf Zalar

'81

4-23-79

Mr. Marvin O'Hara
Fourth Planning District
615 South Main Street
Aberdeen, So. Dakota

Dear Mr O'Hara,

Mrs. Johnson, Secretary of our Pickerel Lake South Park Association has advised us that your Planning District has Chosen Pickerel Lake as a possible Water Study Area.

We appreciate your thoughts of such a study, for each year there seems to be more pollution of one type or another in Pickerel Lake. We hope you will select our Lake for such a study, & better yet after the study is made, that something be done promptly to Reduce the pollutants which run into the Lake. Several Speakers from the Game + Fish Dept. have spoken to our Association suggesting that a Series of Small Dams be built

in the 2 creeks running into the north end of the lake. This makes sense to me and I would certainly like to see this or some other plan implemented to keep Pickerel from becoming more polluted or better yet reduce that which we already have.

We look foreward to seeing you at the Lodge this coming Sunday.

Sincerely,

Fred & Lois Wiswall
1405 East 33rd. Street
Sioux Falls So Dak 57105

(Summer Residents @ Pickerel)

Sioux Falls, S. D.
April 23, 1979

Mr. O'Hara —

I understand that there is a possibility of an allocation of funds for a potential water study at Pickerel Lake and as an interested tax payer, I would be most supportive of such a study.

Not being very informed about such a potential study nor much of an expert on what happens after such a study is made would also concern me as a tax payer, since each of us should be doing everything possible to keep taxes in line.

Since Pickerel Lake is one of our most beautiful fresh water lakes in South Dakota we should do every thing possible, including a study, to not only keep it that way but even improve it in the future.

Yours truly

Dennis D. Peterson
2605 S. Van Eps
Sioux Falls, S. D. 57105

Lutheran Brotherhood
FRATERNAL INSURANCE FOR LUTHERANS
701 Second Avenue So., Minneapolis, Minn. 55402

JAMES DEDRICKSON, FIC
509 South Minnesota Avenue
Sioux Falls, South Dakota 57102
Phone: Bus. . .339-9797
Res. . .339-2329

April 24, 1979

Mr. Marvin O'Hara
615 S. Main St.
Aberdeen, South Dakota 57401

Dear Mr. O'Hara:

It has been brought to my attention that you are the individual that is involved in the promotion of Federal funds to be used at Pickeral Lake in northeastern South Dakota.

I, as a property owner at Pickeral Lake, am very interested in the promotion of the lake. The lake itself is one of the finest that we have in the northeastern part of South Dakota. The people that use the lake during the summer for recreational purposes are of a great number. We at Pickeral Lake have also seen that through the years Pickeral has been one of the few lakes that hasn't gone dry and from that standpoint we know that the springs that feed Pickeral Lake and the run off from the surrounding area has kept the lake at a very good level through the years. Fishing is good. The scenery at the lake is beautiful. I, for one, would be very encouraged to have the lake promoted so that other people will see the facilities that we have and use the lake more. I also feel that by using the funds that you have available for the lake you could enhance this.

I appreciate your concern and hope that you can see you way clear to promote Pickeral Lake.

Thank you very much.

Sincerely,

James Dedrickson

James Dedrickson

JD/mo

38 Roberts Drive
Sioux Falls South Dakota
April 23, 1979

Mr. O'Hara
615 S. Main Street
Aberdeen, South Dakota 57401

Dear Mr O'Hara;

We are property owners at the south end of Pickerel Lake. We have informed of the meeting on April 29 to discuss a possible water study of Pickerel Lake.

We are doubtful that we will be able to attend the meeting. However we want to let you know that we are behind the study one hundred percent.

We want our lake included in funding for a water study.

Sincerely

Jim and Audrey Haug

April 23, 1979

Marvin O'Hara
615 S. Main Street
Aberdeen, S. D. 57401

Dear Mr. O'Hara,

I am taking this opportunity in writing to you regarding the possibility of choosing Pickeral Lake as a water study area by your commission. I am sorry that I will be unable to attend the meeting on Sunday, April 29 because of previous commitments. However, I wanted to let you know of my intense interest in this project and that I would like very much to see it done if at all possible. I am originally from Webster and practically grew up at Pickeral Lake. My family has had a cottage there for the past 50 years, and I am now also a proud cabin owner and love the lake and would like to see it stay the jewel that it is.

I feel strongly also, that this is the time that something has to be done and looked into to maintain water quality and proper watershed for the Lake, etc.

I hope that your commission sees it in a favorable light, and will go ahead with the water study they have proposed.

Thank you for your consideration.

Sincerely,

E. H. Peters, M.D.
Dept. of Family Practice
Central Plains Clinic
2727 S. Kiwanis
Sioux Falls, S. D. 57105

EHP/cc

337 N. Stacle Rd.
West Hartford Conn.
06117 April '73

Dear Mr. O'Hara

In a letter from a South Dakota friend I learned that my favorite vacation spot, Pickerel Lake, is being considered by Iowa Commission for a water study. We own cabins on the South End which was built by my husband's grandfather and we'd like to see the whole area kept beautiful for our children and theirs to come. We will do our part to help make this possible.

I'm eager to hear what will transpire and I count on friends to keep me informed until I am at home on Pickerel Lake during July and August. Sincerely

Mrs. John C. Peters

FARMERS STATE BANK

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

MELLETTE, SOUTH DAKOTA 57461

USA 15¢ HOME OF THE BRAVE

April 26, 1979

Fourth Planning District
615 South Main
Aberdeen, S. Dak. 57401

Re: Water Quality Study Area
Pickerel Lake Watershed

Gentlemen:

I have a place on Chekapa Bay area of Pickerel Lake.

I wont be able to attend your Meeting of 4/29/79 but would like to go on record as being in full support of a water quality study for the Pickerel Lake Watershed.

Very truly yours,

John T. Collins

John T. Collins
President.

Langford, South Dakota 57454

April 27, 1979

Forth District Planning Dist.
615 S. Main
Aberdeen, S. Dak. 57401

Gentlemen:

I read your artical in the Aberdeen American News, and will not be able to attend the meeting scheduled for Sunday April 29 at the Pickerel Lake Lodge.

I am very interested in a Pickeral Lake Watershed as a Water Quality Study Area and would assist in any way possible to have this done.

I am a cabin owner on the Lake and know that something will have to be done to presserve our fresh water lakes if they are going to be suitable for years to come for future generations.

Yours very truly,

LeRoy Erickson
Langford, S. Dak. 57454

MERLE L. GOEDKEN
SPECIAL AGENT

NATIONAL LEADER

410 N.W. Nat. Bk.
~~1320 SOUTH MINNESOTA AVENUE~~
SIOUX FALLS, SOUTH DAKOTA 57105
Office: 336-3317 Residence: 332-6258

4-11-79

Dear Mary,

As President of Pickerel Lake South assoc. I have heartily endorsed your work. Many from our association plan to attend a meeting we are having on Sunday April 29th at 1:00 P.M. at Pickerel Lake Lodge. We hope you can be there.

We have contacted others around the area to spread the word and to learn more of your plans.

Looking Forward to seeing you.

Merle Goedken

Appendix C

Pickerel Lake Public Meeting 4-29-79

	Name	Organization	Resident or Landowner
1.	Dave Pfahler	DEP	
2.	Vincent Saunders	So. P. Assoc	yes
3.	Ed Paul	So. P. Assoc	yes.
4.	Mrs Ed Paul	So. Pic Lake Assoc	yes
5.	Shirm Horton	Spirit Lake Assoc	yes
6.	Peg Morton	So Shore Pickerel Lake	yes
7.	Merle Goedken	So. Shore Pickerel Lake	yes
8.	J. Paul Peterson		no
9.	Dennis D. Peterson	South Lake Park Assoc.	yes
10.	Gust Gruba	Grenville L D	
11.	Ted Jastyska	Grenville L Dt	no
12.	Glenn Walberg	Wiggot addition	yes.
13.	Ron Hammett	none	yes
14.	Lois Hammett	none	yes
15.	Jayne Galbraith	Pickerel Lake Ass	yes
16.	L Carden Baker	Bass Beach Assn	yes
17.	J. L. McFadden	—	yes
18.	Dick Yeon	Bass Beach Assn.	yes
19.	Bud Larsen	" " "	yes
20.	Edward J Blank	Chapin	yes
21.	Bernard F. Reidl	YMCA road	yes
22.	Ruth Reidl	YMCA Road	yes
23.	Fred Weswall	So. Shore Pickerel Lake	yes
24.	Lois Weswall	"	yes
25.	Mr. & Mrs. Gust Gruba.	Pickerel L. Assn.	yes
26.	Lorayne Goedken	So. Shore Pickerel Lake	yes
27.	Dick & Eileen Jones	" " "	yes

	Name	organization	Resident or Land owner	Yes or No
28.	Mr. + Mrs. Robert M. Barkley	YMCA Road	yes	
29.	Mr & Mrs Richard E Handyside	Bass Beach Ass'n	yes	
30.	Harry Heupel	Bass Beach	Yes	
31.	Robert Penner	Bass Beach	yes	
32.	[illegible]	" "		No
33.	Cheryl McKuen	" "		No
34.	Mr. + Mrs. Dale McKuen	" "	yes-	
35.	LINTON B. HINOS	RAMONA BEACH		YES
36.	ROBERT F. GORDER -	RAMONA BEACH -	YES	
37.	[illegible]	[illegible]	[illegible]	[illegible]
38.	L.C. LARSEN	CHEKAPA BAY	YES	YES
39.	Ron R. Bondyan	Chekapa Bay	yes	yes
40.	H.E. Keel	S.W. side	yes	yes
41.	Neal Jensen	South West Side	yes	yes
42.	Arden Grorud	West side	yes	yes
43.	Mr & Mrs Robt Johnson	So Park Pickerel Lake	yes	yes
44.	Walter B. Herold	Bass Beach	yes	[illegible]
45.	E.F. Sallstrom	Bass Beach	yes	No
46.	Sally Hatling	South ~~Beach~~ Pickerel Lake	yes	yes
47.	Gerald Hatling	South Beach	yes	yes
48.	Robert Lund		yes	
49.	Dolores Rosand	East Shore	Yes	Yes
50.	[illegible]	" "	yes	yes
51.	Mr + Mrs. Norman Hals-Aberdeen		yes	
52.	Mr + Mrs Dean Trevor -	Aberdeen	yes	yes
53.	Marvin W. Mackner	Sisseton	yes	yes
54.	William Eaton	"	yes	No
55.	Cornelia Kenny	Pickerel Lake	yes	No
56.	Jane A. Klein	Granville	yes	yes

	Name	Organization	Resident or Land Owner	
57.	Charles Robinson			Yes
58.	Georgianna Bell	self		yes
59.	Hobb Nelson	East Shore	yes	yes
60.	Rose Nelson	East Shore	yes	yes
61.	Stella Hauge	North 1st add.		yes
62.	Clarence Hauge	" " "		yes
63.	Gertrude Gulbickson	" " "	yes	
64.	Marion Gulbickson	" " "	yes	
65.	Verna Birkeland	~~more~~ Fakahatchee now		yes
66.	Art Birkeland	" "		yes
67.	Otho Rix	Duncans		yes
68.	Arden Rix	"		yes
69.	Yhvonne McMillan	Hyde Parks	(Trustee)	yes
70.	[illegible] Seeman	South West Shore	yes	—
71.	Lucile Bell	South West	yes	—
72.				
73.				
74.				
75.				

FOURTH PLANNING
& DEVELOPMENT
DISTRICT (605) 229-4740

615
s. main
aberdeen, s.d. 57401

Appendix D

Soil Conservation Service Soil Erosion and Sediment Yield Study

SECTION 208 - WATER QUALITY STUDY AREAS

SOIL EROSION AND SEDIMENT YIELD STUDY

IN

PICKEREL LAKE WATERSHED

DAY, MARSHALL AND ROBERTS COUNTIES, SOUTH DAKOTA

SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
HURON, SOUTH DAKOTA

ASSISTED BY
SOUTH DAKOTA DEPARTMENT OF WATER AND NATURAL RESOURCES
PIERRE, SOUTH DAKOTA

January 1981

SOIL EROSION AND SEDIMENT YIELD

IN

PICKEREL LAKE WATER QUALITY STUDY AREA

IN

DAY COUNTY, SOUTH DAKOTA

Introduction

Intense use of our natural resources over the years has caused a general deterioration of our environment. Some of our air, soil, and water resources have become polluted. Increased public awareness of this situation helped to bring about the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). Section 208 of P.L. 92-500 addresses water pollution problems as it calls for management practices "...(to) be developed and implemented to assure adequate control of sources of pollutants in each state."

The South Dakota Department of water and Natural Resources has responsibility for formulating a section 208 water quality management plan for South Dakota. The watershed was one of six selected in 1980 for study to facilitate formulation of the plan. (See Figure 1.)

It is generally thought that sediment and nutrients are the principal pollutants in South Dakota lakes and streams. 1/, 2/, 3/

This report outlines more detailed information on soil erosion, sediment sources and quantities, management practices to control sediment, and costs for those practices. This information was developed by the Soil Conservation Service (SCS) for the South Dakota Department of Water and Natural Resources.

1/ Mathew, F.L., "Water Pollution in South Dakota, Part I: Natural Water Quality and Pollution Sources," 1970, South Dakota Water Resources Institute, South Dakota State University, Brookings, South Dakota, 34 pages.

2/ "Development Components of the South Dakota Water Plan, Volume II-B" 1977, Division of Resources Management, South Dakota Department of Water and Natural Resources, Pierre, South Dakota.

3/ "A plan for the Classification-Preservation-Restoration of Lakes in Northeastern South Dakota" 1977, State Lakes Preservation Committee, State of South Dakota and the Old West Regional Commission, Pierre, South Dakota.

Summary

This study has determined relative percentages of erosion and sediment yield from cropland, grassland, gullies, streambanks, and other sources. The Universal Soil Loss Equation and direct volume methods were used to estimate gross erosion which was multiplied by estimated sediment delivery ratios developed by watershed shape analysis 1/ to obtain estimated sediment yields.

Sediment was determined to be a pollutant in the Pickerel Lake Water Quality Study Area (WQSA). Best management practices (BMP's) for this state section 208 water quality management plan thus became those management practices that reduced sediment yield.

A review of the Technical Guide for South Dakota (available at offices of the Soil Conservation Service) indicated soil and water conservation practices (management practices) that are potential BMP's. The relationships between runoff, sediment yield, and management practices, were outlined and, coupled with views of SCS district conservationists, a number of BMP's were selected for the WQSA. Costs for BMP's were generally abstrated from the SCS Cost-Return Handbook.

No quantification of reductions in sediment yield due to application of BMP's was attempted. The reasons for this are twofold:
1. The technical data base was inadequate.
2. The potential combinations of BMP's were too great.

Definition and Outline of Study Methods

Erosion

Sheet erosion occurs as water flows overland and moves layers of soil particles loosened by raindrop impact. Rill erosion is movement of soil particles as overland flow concentrates into small channels, or rills, 2 to 12 inches deep. Soil particles are loosened in rills by shear force exerted on the bottom and banks of the rill by the channelized water. Bank sloughing, or miniature landslides, occur as the bottom and lower banks are eroded.

The Universal Soil Loss Equation (USLE), 2/, 3/ was used to estimate sheet and rill erosion in the WQSA's. SCS personnel familiar with each WQSA derived the data needed for the USLE from their field experience, Section III of the South Dakota Technical Guide and detailed soils maps.

1/ "Sediment yield was Gross Erosion in Minnesota" by O.M. Finkelson, Geologist, SCS, St. Paul, Minnesota 1978.

2/ Wischmeir, W.H., and Smith, D.D., "Prediction Rainfall Erosion Looses, A Guide to Conservation Planning", Agricultural Handbook, No. 537, December 1978, Science & Education Administration.

3/ "Estimating Soil Loss Resulting from Water and Wind Erosion in South Dakota," June 1977, South Dakota Technical Guide III-1, USDA, SCS, Huron, South Dakota.

Sheet and rill erosion from construction sites, roads and roadbanks was estimated using a direct volume method (multiplying the area of erosion by an estimated rate of erosion and the volume weight of the eroding soil. 1/ Sample areas were observed in each WQSA and county highway maps were used to expand the sample data.

Gully and streambank erosion is soil moved by water flowing in channels that are greater than 12 inches deep. The mechanisms of loosening and moving soil particles are the same as in rill erosion except for the larger scale. Lake shore erosion occurs as wave action loosens and moves soil particles. The direct volume method was used to estimate gully, streambank, and lake shore erosion. The effects of ice were also considered in the erosion rate. Sample areas were observed in each WQSA and aerial photographs were used to expand the sample data.

Sediment Yield

Sediment yield is the amount of soil removed from a drainage basin. 2/, 3/ It is measured (or estimated) at a point or a stream channel cross section and only represents a fraction of the total soil eroded in the basin above that point.

In this study, gross erosion was estimated and then multiplied by an estimated sediment delivery ratio to obtain sediment yield. This ratio is expressed as a percent and represents the amount of soil removed from a watershed (sediment) divided by the amount of soil moved in the watershed (erosion). It is thus inversely proportional to the amount of deposition occurring between points of erosion and the point where sediment yield is measured.

Many factors affect sediment yield - watershed size, shape, hydrology, channel density, land use, vegetative cover, geology and topography, soil structure, texture, and permeability. The interaction between all of these factors was subjectively analyzed after a delivery ratio was selected from a drainage area versus delivery ratio curve. This analysis resulted in raising or lowering the curve ratio and the adjusted ratio was used to estimate sediment yield from all sources of sheet and rill erosion. Much higher ratios were used to estimate sediment yield from gully, streambank, and lakeshore erosion.

1/ Method is outlined in the "Erosion and Sediment Inventory Handbook," USDA-SCS, Syracuse, New York (1972) and in "Guide to Sedimentation Investigations," Technical Guide 12, South Technical Service Center, USDA-SCS, Fort Worth, Texas (1976).

2/ "Sedimentation," 1975 National Engineering Handbook, Section 3, USDA, SCS, Washington, D.C.

3/ "Predicting Sediment Yields," in "Proceedings of the National Symposium on Soil Erosion and Sedimentation by Water," 1977, American Society of Agricultural Engineers, Publication 4-77, St. Joseph, Michigan.

Narrative Comments (cont.)

Table 2 - "Soil Erosion and Sediment Yield Estimates" lists erosion and sediment yield information. The figures are given by tributaries. They are further broken down by land use, sheet and rill erosion, and other erosion and sediment yields. A final total column shows estimated total tons of sediment per year for the watershed.

No figures were developed showing the extent of soil losses from erosion by wind. It was felt that an estimate of 1 to 1½ tons per acre per year could be used if this information is needed.

Table 3 - "Estimates of Best Management Practices (Conservation Practices and Measures) needed for Land Adequately Treated, Including Costs" shows the major land treatment needed in this watershed area. The table also shows estimated amounts and probable costs to get the land in this watershed "adequately treated". It must be kept in mind, that these are "Estimates" only, and that specific practices, and accurate amounts together with precise costs can only be obtained in a planning process with the owners and operators of each tract of land, based on their decisions on how each field is to be used and treated. This study does not show this sort of detailed information.

This study contains a "Shoreline Erosion and Sediment Contributing Area Map". Table 4 lists the amounts of sediment produced from each of the segments shown on the map. The total tons of sediment per year in Table 4 corresponds to the total tons of sediment yield from the lakeshore column in Table 2.

Best Management Practices

The Environmental Protection Agency (EPA) has defined best management practices, as published in the Federal Register, as follows:

> "The term, best management practices (BMP), means a practice, or combination of practices, that is determined by a State (or designated areawide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals (40 CFR Part 130)."

Thus best management practices in section 208 water quality management plans are primarily those management practices that are believed to have a beneficial impact on water quality. 1/ Since sediment yield affects water quality adversely in these study areas, management practices that reduce sediment yield will be BMP's. Best management practices were selected from Section III of the South Dakota Technical Guide and costs were taken from the SCS Cost-Return Handbook.

Narrative Comments

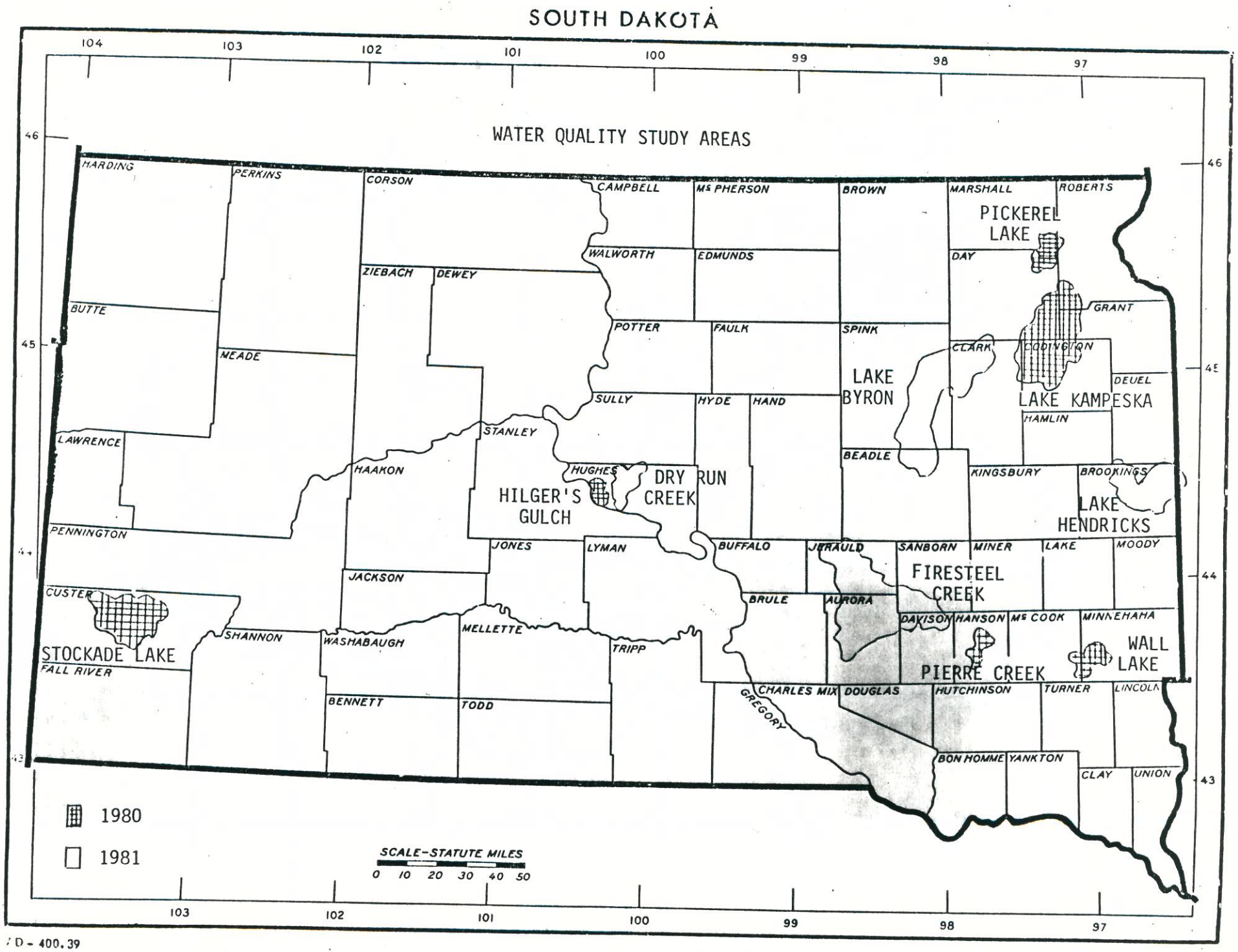
The Soil Conservation Service completed a study of the Pickerel Lake Watershed. The purpose of this study was to identify the water erosion and sedimentation problems relative to Pickerel Lake. The watershed was divided into four tributaries. (See Watershed Map)

This study brings out the kinds and amounts of erosion and sedimentation including the location, extent, and whether or not each tributary significantly contributes sediment into Pickerel Lake.

Table 1 shows the present "Land Uses and Estimated Acres Needing Treatment" of the Pickerel Lake Watershed Area. Figures are given for each tributary and a total for watershed. Pickerel Lake Watershed contains 15,025 acres. Figures are given for the following uses: cropland, grassland (both tame and native included), woodland, farmsteads, and urban, and non-sediment contributing areas. Estimated acres are listed for acres adequately treated, and acres needing treatment with recommended Best Management Practices (conservation practices) which will contribute to water quality improvement as well as erosion control on the land in the watershed area.

1/ "Environmental Impact of Land Use on Water Quality, Final Report on the Black Creek Project (Summary," 1977, U.S. Environmental Protection Agency 905/9-77-007-A, Great Lakes National Program Office, Chicago, Illinois.

FIGURE 1



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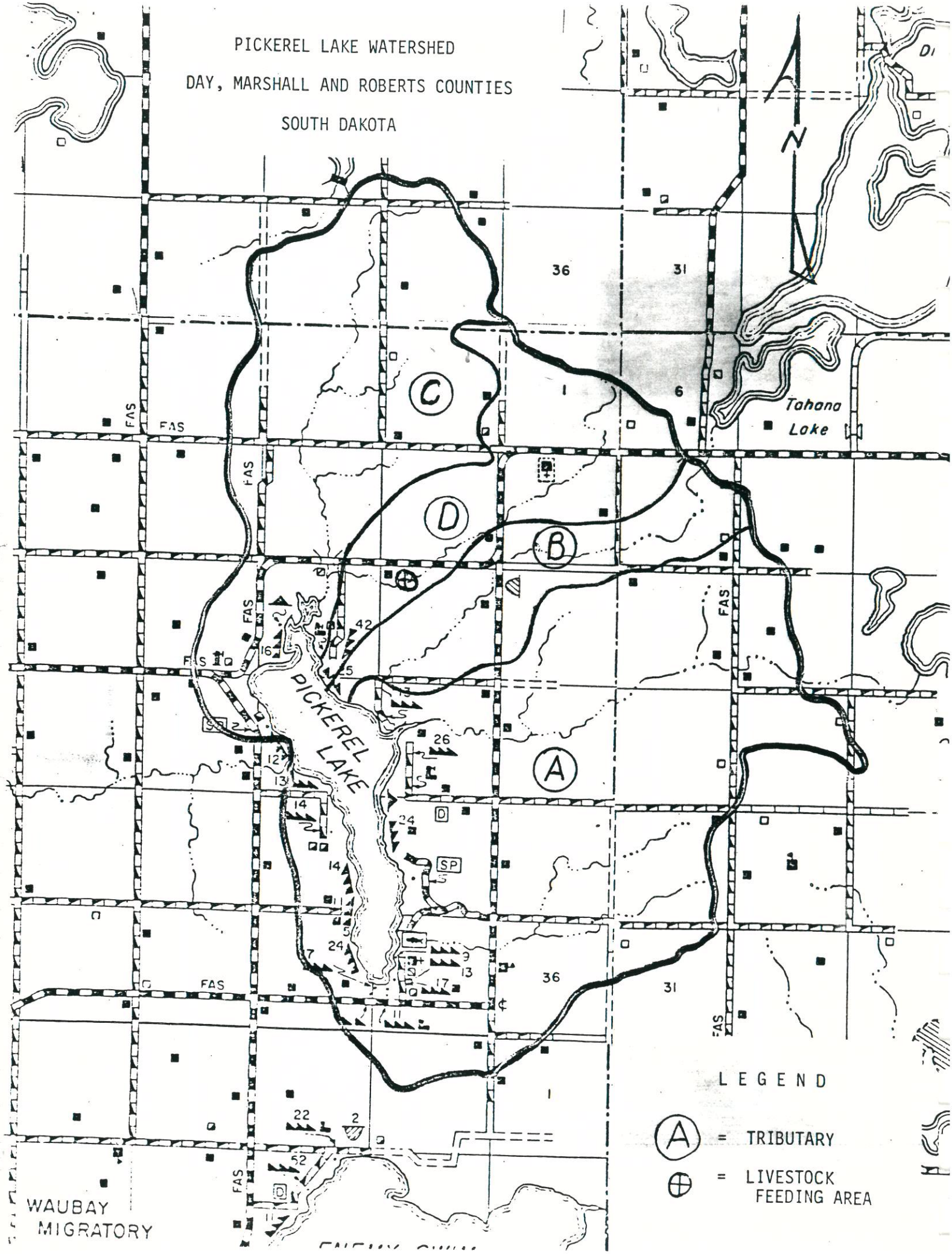

PICKEREL LAKE WATERSHED
DAY, MARSHALL AND ROBERTS COUNTIES
SOUTH DAKOTA
N
Tahoma Lake
PICKEREL LAKE
FAS
SP
WAUBAY MIGRATORY
LEGEND
A = TRIBUTARY
⊕ = LIVESTOCK FEEDING AREA

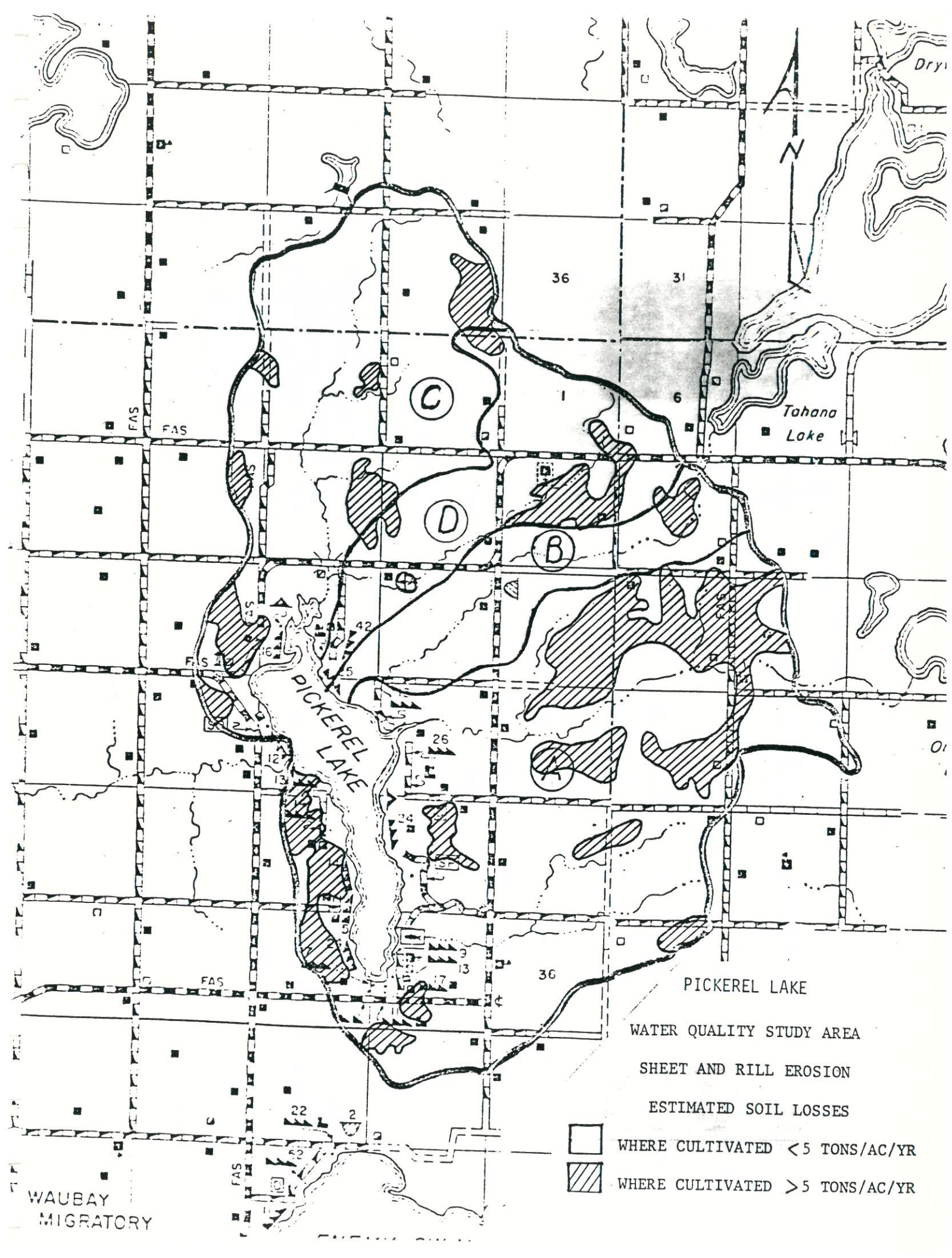

PICKEREL LAKE
WATER QUALITY STUDY AREA
SHEET AND RILL EROSION
ESTIMATED SOIL LOSSES
WHERE CULTIVATED < 5 TONS/AC/YR
WHERE CULTIVATED > 5 TONS/AC/YR
PICKEREL LAKE
Tahoma Lake
WAUBAY MIGRATORY
FAS
C
D
B
A
36
31
1
6
26
42
22
2

TABLE 1

LAND USE AND ESTIMATED ACRES NEEDING TREATMENT
PICKEREL LAKE WATERSHED AREA

WQSA or SUBWATERSHEDS	LAND USE (Acres) and TREATMENT (Acres and Percent)											
	CROPLAND		GRASSLAND		WOODLAND		FARMSTEAD AND URBAN		NON SEDIMENT CONTRIBUTING[1]		TOTAL	
	AC	%	AC	%	AC	%	AC	%	AC	%	AC	%
Subwatershed"A"												
Adequately Treated	2,066	100	3,836	100	-	-	363	100	340	100	6,605	100
Needs Treatment	1,240	60	2,685	70	-	-	305	84	340	100	4,570	69
	826	40	1,151	30	-	-	58	16	0	-	2,035	31
Subwatershed"B"												
Adequately Treated	1,595	100	897	100	-	-	21	100	122	100	2,635	-
Needs Treatment	957	60	628	70	-	-	21	100	122	100	1,728	66
	638	40	269	30	-	-	0	-	0	-	907	34
Subwatershed"C"												
Adequately Treated	1,898	100	1,487	100	-	-	137	100	313	100	3,835	-
Needs Treatment	1,139	60	1,041	70	-	-	108	79	313	100	2,601	68
	759	40	446	30	-	-	29	21	0	-	1,234	32
Subwatershed"D"												
Adequately Treated	1,107	100	650	100	-	-	35	100	158	100	1,950	-
Needs Treatment	664	60	455	70	-	-	35	100	158	100	1,312	67
	443	40	195	30	-	-	0	0	0	-	638	33
TOTAL FOR WATERSHED												
Adequately Treated	6,666	100	6,870	100	-	-	556	100	933	100	15,025	100
Needs Treatment	4,000	60	4,809	70	-	-	469	84	933	100	10,211	68
	2,666	40	2,061	30	-	-	87	16	0	-	4,814	32

1/ Generally, water, marsh and sloughs

TABLE 2

SOIL EROSION AND SEDIMENT YIELD
PICKEREL LAKE WATERSHED AREA

WQSA or Subwatershed		Cropland	Grassland	Sub Total	Channels	Lakeshore	Construction [1]	Sub Total	Total	Acre Feet Per Yr. [2]	Percent [3]
		Average Annual Tons of Soil Per Year									
Subwatershed "A"	Erosion Tons/Yr	5,347	2,532	7,879		6,970		6,970	15,849		
	Sed. Yield [4] Tons/Yr.			156		6,970		6,970	7,126	5.5	.029
Subwatershed "B"	Erosion Tons/Yr.	4,554	378	4,932		1,593		1,593	6,525		
	Sed. Yield [4] Tons/Yr.			-		1,593		1,593	1,593	1.2	.006
Subwatershed "C"	Erosion Tons/Yr.	5,722	547	6,269		747		747	7,016		
	Sed. Yield [4] Tons/Yr.			52		747		747	799	0.6	.003
Subwatershed "D"	Erosion Tons/Yr.	2,456	335	2,791					2,791		
	Sed. Yield [4] Tons/Yr.			-					-	-	
Total	Erosion Tons/Yr.	18,079	3,792	21,871		9,310		9,310	38,197		
	Sed. Yield [4] Tons/Yr.			208		9,310		9,310	9,518	7.3	.038

1/ Not estimated, but has high potential - Planned developments should include a sediment control plan for before, during, and after construction.

2/ Tons converted to acre feet. Sediment in lake volume computed at 60 pounds per cubic foot due to sediment being submerged.

3/ Annual sediment yield expressed as a percent of total lake volume. Lake volume of Pickeral Lake is 19,072 acrefeet.

4/ Sediment deposited in Pickeral Lake.

TABLE 3

BEST MANAGEMENT PRACTICES (Conservation Practices and Measures) 1/ 2/ 3/
PICKEREL LAKE WATERSHED AREA

Conservation Practices	Unit	Unit 4/ Cost	Subwatershed "A"		Subwatershed "B"		Subwatershed "C"		Subwatershed "D"		Total Watershed	
			Amount Needed	Cost	Amount Needed	Cost	Amount Needed	Cost	Amount Needed	Cost	Amount Needed	Cost
		(Dollars)		(Dollars		(Dollars)		(Dollars)		(Dollars)		(Dollars)
Cropland - 6,666 Acres												
Conservation Cropping system	acre	-	2,066	-	1,595	-	1,898	-	1,107	-	6,666	-
Conservation Tillage System	acre	5	2,066	10,330	1,595	7,975	1,898	9,490	1,107	5,535	6,666	33,330
Grasses & Legumes in Rotation	acre	18	155	2,790	120	2,160	142	2,556	83	1,494	500	9,000
Grassed Waterways	acre	500	2.5	1,250	2.0	1,000	2.2	1,100	1.3	650	8.0	4,000
Waste Utilization	acre	3	-	-	-	-	380	1,140	220	660	600	1,800
Minimize Fall Tillage	acre	-	330	-	638	-	759	-	443	-	2,170	-
Minimize Pesticide Use	acre	-	330	-	638	-	759	-	443	-	2,170	-
Contour Stripcropping	acre	6	62	372	48	288	57	342	33	198	200	1,200
Timing Nitrogen Application	acre	-	330	-	638	-	759	-	443	-	2,170	-
Field Windbreaks	mile	250	1.5	375	1.0	250	1.5	375	1.0	250	5.0	1,250
Grassland - 6,870 Acres												
Proper Grazing Use	acre	-	6,918	-	448	-	744	-	325	-	3,435	-
Pasture & Hayland Planting	acre	20	280	5,600	65	1,300	108	2,160	47	940	500	10,000
Deferred Grazing	acre	-	575	-	134	-	223	-	98	-	1,030	-
Planned Grazing Systems	acre	-	112	-	26	-	43	-	19	-	200	-
Livestock Water Stations	No.	1,000	1	1,000	1	1,000	1	1,000	1	1,000	4	4,000
Pasture & Hayland Management	acre	-	1,918	-	448	-	744	-	325	-	3,435	-
Waste Management Systems	No.	-	-	-	1	20,000	-	-	-	-	1	20,000
Wildlife Upland Habitat Mgmt.	acre	4	11	44	3	12	4	16	2	8	20	80
Farmsteads, Urban & Other. 556 acres												
Sediment Control Measures 5/	acre	2,000	18	36,000	-	-	2	4,000	-	-	20	40,000
TOTALS - Total acres - 15,015 6/	acres			57,761		33,985		22,179		10,735		124,660 or $8.30 per acre

1/ Needed to get "Land Adequately Treated."
2/ Refer to Soil Conservation Service Technical Guide for South Dakota 1981
3/ On site investigation and planning are necessary to determine kinds, locations, sizes, extent & costs of practices (BMP's)
4/ Refer to Soil Conservation Service Cost-Return Handbook for South Dakota 1981
5/ Examples of measures are: cover and green manure crop, filter strips, lined and grassed waterways, diversions, mulching, sediment basins, streambank protection, and critical area planting
6/ Includes 933 acres of non-sediment producing land

SHORELINE EROSION AND SEDIMENT CONTRIBUTING AREA MAP

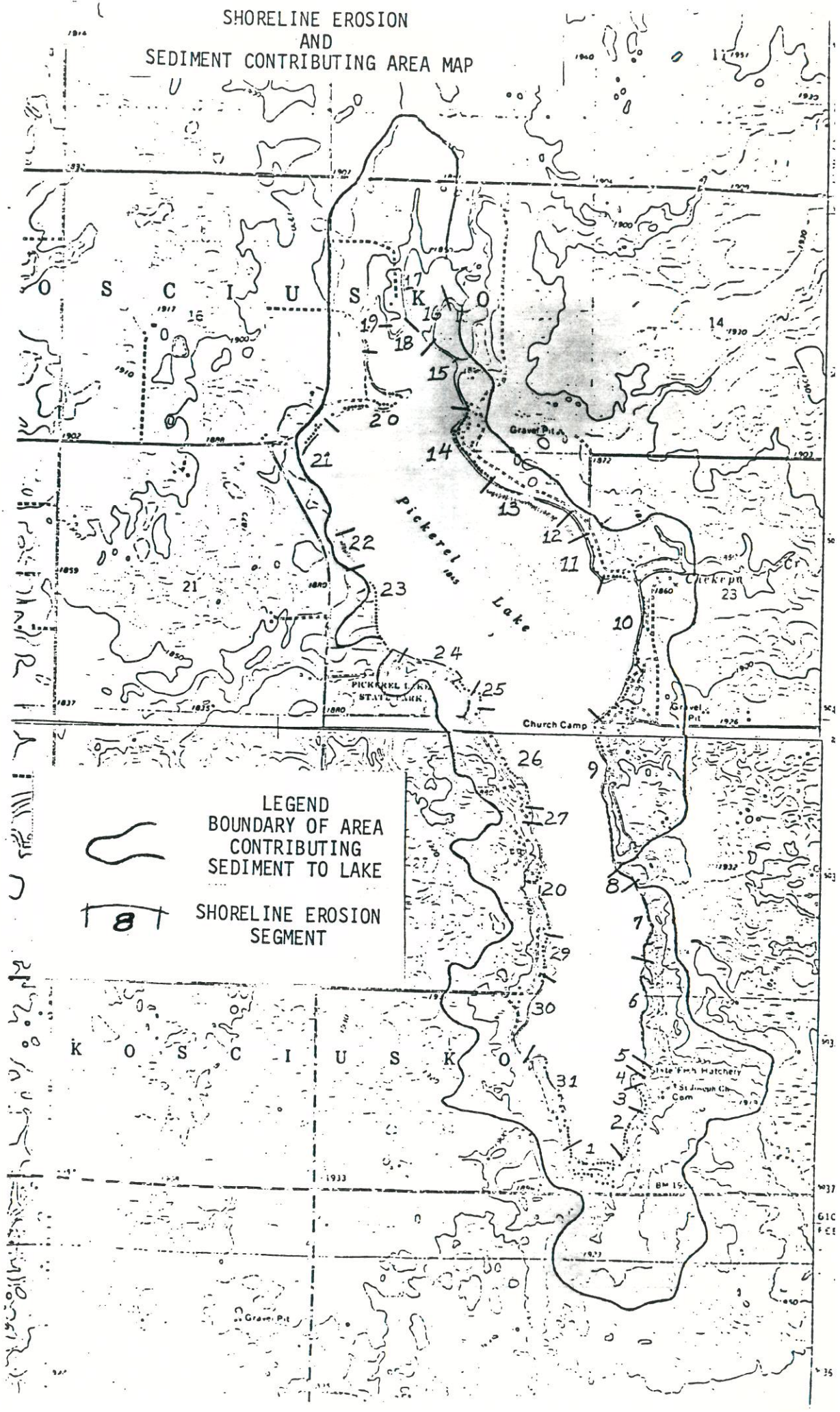


Table 4.

Pickerel Lake Shoreline Erosion[1/]

Segment No.	Sed/Yr (Tons)	Shoreline Length (Ft.)	Sediment produced/ft. of shoreline Tons/lineal foot)
1	35.40	1,180	0.03
2	171.00	950	0.18
3	10.13	450	0.02
4	28.35	420	0.07
5	5.00	200	0.03
6	54.00	2,000	0.03
7	157.50	1,750	0.09
8	-	450	-0-
9	742.50	3,300	0.23
10	97.20	3,600	0.03
11	47.25	1,050	0.05
12	750.00	600	1.25
13	3,140.00	1,570	2.00
14	45.00	1,800	0.03
15	171.00	1,520	0.11
16	-	1,250	-0-
17	-	4,150	-0-
18	28.69	850	0.03
19	-	1,750	-0-
20	465.75	3,450	0.14
21	117.50	2,350	0.05
22	1,245.00	830	1.50
23	192.50	2,750	0.07
24	72.90	1,350	0.05
25	36.00	400	0.09
26	405.00	2,250	0.18
27	52.5	350	0.15
28	735.00	2,450	0.30
29	60.00	1,000	0.06
30	232.88	2,070	0.11
31	211.50	2,350	0.09
Total	9,310.00		

[1/] Direct volume method used to compute sediment produced.

Appendix E

Water Quality Summary Tables and Figures

Site Number	Site Description
46PI01 (PI-1)	Latitude 45 deg., 31 min., 47 sec.; longitude 97 deg., 16 min., 36 sec.; Township 124N, Range 53W; Section 15; NW1/4, NW1/4, NW1/4, NE1/4. North tributary to Pickerel Lake.
46PI02 (PI-2)	Latitude 45 deg., 31 min., 42 sec.; longitude 97 deg., 16 min., 29 sec.; Township 124N, Range 53W; Section 15. SW1/4, NE1/4, NW1/4, NE1/4. North-northeast tributary to Pickerel Lake.
46PI04 (PI-4)	Latitude 45 deg., 30 min., 34 sec.; longitude 97 deg., 15 min., 00 sec.; Township 124N, Range 53W; Section 23. NE1/4, SW1/4, SE1/4, NE1/4. Tributary northeast inlet to Pickerel Lake.
46PI05 (PI-5)	Latitude 45 deg., 28 min., 55 sec.; longitude 97 deg., 15 min., 46 sec.; Township 124N, Range 53W; Section 35. NE1/4, NE1/4, SW1/4, NW1/4. Pickerel Lake inlet at State Fish Hatchery.
46PI06 (PI-6)	Latitude 45 deg., 30 min., 15 sec.; longitude 97 deg., 16 min., 58 sec.; Township 124N, Range 53W; Section 22. NW1/4, NW1/4, SE1/4, SW1/4. Pickerel Lake outlet at State Park.
46PI07 (PI-7)	Latitude 45 deg., 31 min., 01 sec.; longitude 97 deg., 17 min., 01 sec.; Township 124N, Range 53W; Section 15. NE1/4, SE1/4, SW1/4, SW1/4. Pickerel in-lake site by northeast shore.
46PI08 (PI-8)	Latitude 45 deg., 30 min., 03 sec.; longitude 97 deg., 16 min., 03 sec.; Township 124N, Range 53W, Section 23. SW1/4, SW1/4, SW1/4, SW1/4. Pickerel in-lake site by east shore.
46PI09 (PI-9)	Latitude 45 deg., 28 min., 38 sec.; longitude 97 deg., 16 min., 04 sec.; Township 124N, Range 53W; Section 34. SE1/4, NE1/4, NE1/4, SE1/4. Pickerel in-lake site by south shore.
46PI3Y (PI-3Y)	Latitude 45 deg., 31 min., 46 sec.; longitude 97 deg., 14 min., 52 sec.; Township 124N, Range 53W; Section 14. NE1/4, NE1/4, NE1/4, NE1/4. Northeast tributary to Pickerel Lake.
46PI3Z (PI-3Z)	Latitude 45 deg., 30 min., 48 sec.; longitude 97 deg., 16 min., 04 sec.; Township 124N, Range 53W; Section 23. SW1/4, NW1/4, NW1/4, NW1/4. Northeast tributary to Pickerel Lake.
46PI7A (PI-7A)	Latitude 45 deg., 30 min., 55 sec.; longitude 97 deg., 17 min., 22 sec.; Township 124N, Range 53W; Section 16. SE1/4, SE1/4, SE1/4, SE1/4. Pickerel in-lake site by northwest shore.
46PI8A (PI-8A)	Latitude 45 deg., 29 min., 55 sec.; longitude 97 deg., 16 min., 00 sec.; Township 124N, Range 53W; Section 26. SE1/4, NW1/4, NW1/4, NW1/4. Pickerel in-lake site by east shore.
46PI9A (PI-9A)	Latitude 45 deg., 29 min., 08 sec.; longitude 97 deg., 16 min., 17 sec.; Township 124N, Range 53W; Section 34. NE1/4, NW1/4, NE1/4, NE1/4. Pickerel in-lake site by southwest shore.

Table IV-1. Site numbers and descriptions on Pickerel Lake and its watershed.

STORET RETRIEVAL DATE 84/01/25

46PI01
45 31 47.0 097 16 36.0 2
NORTH TRIB T124N R53W SECTION 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596271-0624701

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			20	17	24		23	1	24	24	24
	MAXIMUM			9.50000	7.80000	510.000		7.89000	258.000	573.000	564.000	16.0000
	MINIMUM			.0799999	5.60000	3.00000		7.39000	258.000	232.000	226.000	1.00000
	MEAN			3.58399	7.14117	62.1667		7.61478	258.000	439.250	434.041	5.33333
80/01/00												
81/01/01												
YEAR	NUMBER			1	1	1				1	1	1
	MAXIMUM			10.3000	6.50000	3.00000				359.000	355.000	4.00000
	MINIMUM			10.3000	6.50000	3.00000				359.000	355.000	4.00000
	MEAN			10.3000	6.50000	3.00000				359.000	355.000	4.00000
82/01/00												
82/01/01												
YEAR	NUMBER			7	7	7				7		7
	MAXIMUM			9.50000	7.00000	210.000				397.000		19.0000
	MINIMUM			7.50000	6.30000	3.00000				332.000		1.00000
	MEAN			8.34285	6.67143	48.0000				354.857		7.85714
83/01/00												
83/01/01												
YEAR	NUMBER				1	1				1	1	1
	MAXIMUM				7.60000	10.0000				219.000	189.000	30.0000
	MINIMUM				7.60000	10.0000				219.000	189.000	30.0000
	MEAN				7.60000	10.0000				219.000	189.000	30.0000
84/01/00												
00/00/00												
STATION	NUMBER			28	26	33		23	1	33	26	33
	MAXIMUM			10.3000	7.80000	510.000		7.89000	258.000	573.000	564.000	30.0000
	MINIMUM			.0799999	5.60000	3.00000		7.39000	258.000	219.000	189.000	1.00000
	MEAN			5.01356	7.00769	55.7879		7.61478	258.000	412.242	421.577	6.57576
99/99/99												

Table IV-2.

STORET RETRIEVAL DATE 84/01/25

46PI01
45 31 47.0 097 16 36.0 2
NORTH TRIB T124N R53W SECTION 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596271-0624701

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		24	24	24	24	24		24
	MAXIMUM		.140000	.0100000	.200000	5.05000	.536000		.445000
	MINIMUM		.0200000	.0100000	.100000	.410000	.0240000		.0050000
	MEAN		.0300000	.0100000	.104166	1.00416	.121750		.0623331
80/01/00									
81/01/01									
YEAR	NUMBER		1	1	1	1		1	1
	MAXIMUM		.0200000	.0100000	.100000	2.62000		.0170000	.0050000
	MINIMUM		.0200000	.0100000	.100000	2.62000		.0170000	.0050000
	MEAN		.0200000	.0100000	.100000	2.62000		.0170000	.0050000
82/01/00									
82/01/01									
YEAR	NUMBER		7	7	7	7	6	1	7
	MAXIMUM		.130000	.0100000	.100000	1.35000	.0679999	.0639999	.0290000
	MINIMUM		.0300000	.0100000	.100000	.170000	.0310000	.0639999	.0100000
	MEAN		.0657142	.0100000	.100000	.750000	.0413333	.0639999	.0184286
83/01/00									
83/01/01									
YEAR	NUMBER		1	1	1	1	1		1
	MAXIMUM		.0400000	.0100000	.100000	.510000	.122000		.0090000
	MINIMUM		.0400000	.0100000	.100000	.510000	.122000		.0090000
	MEAN		.0400000	.0100000	.100000	.510000	.122000		.0090000
84/01/00									
00/00/00									
STATION	NUMBER		33	33	33	33	31	2	33
	MAXIMUM		.140000	.0100000	.200000	5.05000	.536000	.0639999	.445000
	MINIMUM		.0200000	.0100000	.100000	.170000	.0240000	.0170000	.0050000
	MEAN		.0375757	.0100000	.103030	.984240	.106193	.0405000	.0642119
99/99/99									

Table IV-2. Continued

STORET RETRIEVAL DATE 84/01 ?5

46PI02
45 31 42.0 097 16 29.0 2
NORTH NORTHEAST TRIB T124W R53W SECTION 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
/TYPA/AMBNT/STREAM/RUNOFF 21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596272-0624702

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		32	32	32	32	32		32
	MAXIMUM		.130000	.0500000	6.00000	2.47000	.410000		.201000
	MINIMUM		.0140000	.0100000	.100000	.250000	.0170000		.0050000
	MEAN		.0329374	.0128125	2.68749	.878434	.0813121		.0429999
80/01/00									
81/01/01									
YEAR	NUMBER		1	1	1	1		1	1
	MAXIMUM		.0200000	.0100000	.100000	1.21000		.0170000	.0050000
	MINIMUM		.0200000	.0100000	.100000	1.21000		.0170000	.0050000
	MEAN		.0200000	.0100000	.100000	1.21000		.0170000	.0050000
82/01/00									
82/01/01									
YEAR	NUMBER		7	7	7	7	5	2	7
	MAXIMUM		.120000	.0100000	.100000	.920000	.0510000	.0440000	.0240000
	MINIMUM		.0200000	.0100000	.100000	.320000	.0270000	.0310000	.0100000
	MEAN		.0657142	.0100000	.100000	.725714	.0386000	.0375000	.0160000
83/01/00									
00/00/00									
STATION	NUMBER		40	40	40	40	37	3	40
	MAXIMUM		.130000	.0500000	6.00000	2.47000	.410000	.0440000	.201000
	MINIMUM		.0140000	.0100000	.100000	.250000	.0170000	.0170000	.0050000
	MEAN		.0383499	.0122500	2.17000	.859996	.0755402	.0306666	.0373249
99/99/99									

Table IV-3. Continued

STORET RETRIEVAL DATE 84/01/25

46PI02
45 31 42.0 097 16 29.0 2
NORTH NORTHEAST TRIB T124W R53W SECTION 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596272-0624702

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			21	24	32		27	4	32	31	32
	MAXIMUM			12.9000	8.60000	4100.00		8.39000	298.000	591.000	537.000	68.0000
	MINIMUM			7.10000	5.80000	3.00000		7.80000	263.000	196.000	185.000	1.00000
	MEAN			9.95237	7.95833	452.812		8.15295	279.500	461.844	450.709	10.5156
80/01/00												
81/01/01												
YEAR	NUMBER			1	1	1				1	1	1
	MAXIMUM			13.8000	7.00000	3.00000				369.000	364.000	5.00000
	MINIMUM			13.8000	7.00000	3.00000				369.000	364.000	5.00000
	MEAN			13.8000	7.00000	3.00000				369.000	364.000	5.00000
82/01/00												
82/01/01												
YEAR	NUMBER			7	7	7				7		7
	MAXIMUM			9.10000	7.60000	50.0000				386.000		14.0000
	MINIMUM			8.20000	6.30000	3.00000				324.000		3.00000
	MEAN			8.69999	7.09999	15.5714				349.714		6.00000
83/01/00												
00/00/00												
STATION	NUMBER			29	32	40		27	4	40	32	40
	MAXIMUM			13.8000	8.60000	4100.00		8.39000	298.000	591.000	537.000	68.0000
	MINIMUM			7.10000	5.80000	3.00000		7.80000	263.000	196.000	185.000	1.00000
	MEAN			9.78275	7.74062	365.050		8.15295	279.500	439.900	448.000	9.58750
99/99/99												

Table IV-3.

STORET RETRIEVAL DATE 84/01/25

46PI04
45 31 04.0 097 15 05.0 2
TRIB NE INLET SE1/4,NE1/4 SEC 23 T124N R53W
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596273-0624703

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			20	27	34		26		34	33	34
	MAXIMUM			12.3000	8.20000	490.000		8.21000		527.000	509.000	24.0000
	MINIMUM			1.90000	6.80000	3.00000		7.43000		204.000	199.000	1.00000
	MEAN			7.38000	7.68147	73.3823		7.87615		357.559	347.424	7.23529
80/01/00												
82/01/01												
YEAR	NUMBER				2	2				2		2
	MAXIMUM				6.90000	790.000				428.000		11.0000
	MINIMUM				6.50000	220.000				397.000		7.00000
	MEAN				6.70000	505.000				412.500		9.00000
83/01/00												
83/01/01												
YEAR	NUMBER				2	2				2	2	2
	MAXIMUM				7.80000	10.0000				444.000	834.000	14.0000
	MINIMUM				7.80000	10.0000				348.000	443.000	1.00000
	MEAN				7.80000	10.0000				396.000	638.500	7.50000
84/01/00												
00/00/00												
STATION	NUMBER			20	31	38		26		38	35	38
	MAXIMUM			12.3000	8.20000	790.000		8.21000		527.000	834.000	24.0000
	MINIMUM			1.90000	6.50000	3.00000		7.43000		204.000	199.000	1.00000
	MEAN			7.38000	7.62580	92.7631		7.87615		362.474	364.057	7.34210
99/99/99												

Table IV-4.

STORET RETRIEVAL DATE 84/01/25

46PI04
45 31 04.0 097 15 05.0 2
TRIB NE INLET SE1/4,NE1/4 SEC 23 T124N R53W
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596273-0624703

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4-N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		34	34	34	34	34		34
	MAXIMUM		.100000	.0100000	2.10000	1.86000	.610000		.157000
	MINIMUM		.0100000	.0100000	.100000	.0500000	.0170000		.0050000
	MEAN		.0304705	.0100000	.391176	.754408	.0894114		.0396763
80/01/00									
82/01/01									
YEAR	NUMBER		2	2	2	2	2		2
	MAXIMUM		.0799999	.0100000	.400000	1.72000	.0709999		.0550000
	MINIMUM		.0699999	.0100000	.100000	1.34000	.0679999		.0450000
	MEAN		.0749999	.0100000	.250000	1.53000	.0694999		.0500000
83/01/00									
83/01/01									
YEAR	NUMBER		2	2	2	2	2		2
	MAXIMUM		.0600000	.0100000	.200000	.490000	.0639999		.0160000
	MINIMUM		.0600000	.0100000	.100000	.420000	.0580000		.0150000
	MEAN		.0600000	.0100000	.150000	.455000	.0610000		.0155000
84/01/00									
00/00/00									
STATION	NUMBER		38	38	38	38	38		38
	MAXIMUM		.100000	.0100000	2.10000	1.86000	.610000		.157000
	MINIMUM		.0100000	.0100000	.100000	.0500000	.0170000		.0050000
	MEAN		.0343684	.0100000	.371052	.779469	.0868681		.0389472
99/99/99									

Table IV-4. Continued

STORET RETRIEVAL DATE 84/01/25

46PI05
45 28 55.0 097 15 39.0 2
LK INLET AT ST FISH HATCHERY T124N R53W SEC 35
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596274-0624704

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			12	18	22		17	3	22	21	22
	MAXIMUM			9.20000	8.00000	2400.00		8.20000	291.000	545.000	519.000	425.000
	MINIMUM			5.10000	6.50000	10.0000		7.69000	268.000	342.000	120.000	1.00000
	MEAN			7.72499	7.45555	489.682		8.01176	281.000	420.000	394.809	27.0454
80/01/00												
00/00/00												
STATION	NUMBER			12	18	22		17	3	22	21	22
	MAXIMUM			9.20000	8.00000	2400.00		8.20000	291.000	545.000	519.000	425.000
	MINIMUM			5.10000	6.50000	10.0000		7.69000	268.000	342.000	120.000	1.00000
	MEAN			7.72499	7.45555	489.682		8.01176	281.000	420.000	394.809	27.0454
99/99/99												

Table IV-5.

STORET RETRIEVAL DATE 84/01/25

46PI05
45 28 55.0 097 15 39.0 2
LK INLET AT ST FISH HATCHERY T124N R53W SEC 35
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596274-0624704

/TYPA AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4-N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4-T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		22	22	22	22	22		22
	MAXIMUM		.302000	.0100000	4.40000	2.74000	.176000		.120000
	MINIMUM		.0200000	.0100000	.100000	.200000	.0410000		.0050000
	MEAN		.0384091	.0100000	.295454	.921362	.0714088		.0281818
80/01/00									
00/00/00									
STATION	NUMBER		22	22	22	22	22		22
	MAXIMUM		.302000	.0100000	4.40000	2.74000	.176000		.120000
	MINIMUM		.0200000	.0100000	.100000	.200000	.0410000		.0050000
	MEAN		.0384091	.0100000	.295454	.921362	.0714088		.0281818
99/99/99									

Table IV-5. Continued

STORET RETRIEVAL DATE 84/01/25

46PI06
45 30 15.0 097 17 00.0 2
OUTLET AT STATE PARK T123N R53W SEC 22
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596275-0624705

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			23	16	23		15	1	23	23	23
	MAXIMUM			13.0000	8.80000	10.0000		8.80000	186.000	432.000	432.000	36.0000
	MINIMUM			6.50000	6.70000	2.00000		7.99000	186.000	201.000	185.000	.500000
	MEAN			9.03478	8.09999	3.56522		8.39532	186.000	372.000	363.869	8.21739
80/01/00												
82/01/01												
YEAR	NUMBER				3	3				3		3
	MAXIMUM				7.50000	60.0000				351.000		80.0000
	MINIMUM				7.20000	17.0000				287.000		7.00000
	MEAN				7.36666	42.3333				316.000		32.6667
83/01/00												
00/00/00												
STATION	NUMBER			23	19	26		15	1	26	23	26
	MAXIMUM			13.0000	8.80000	60.0000		8.80000	186.000	432.000	432.000	80.0000
	MINIMUM			6.50000	6.70000	2.00000		7.99000	186.000	201.000	185.000	.500000
	MEAN			9.03478	7.98421	8.03846		8.39532	186.000	365.538	363.869	11.0385
99/99/99												

Table IV-6.

STORET RETRIEVAL DATE 84/01/25

46PI06
45 30 15.0 097 17 00.0 2
OUTLET AT STATE PARK T123N R53W SEC 22
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596275-0624705

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		23	23	23	23	23		23
	MAXIMUM		20.0000	.0100000	.300000	1.25000	.119000		.0240000
	MINIMUM		.0100000	.0100000	.100000	.460000	.0070000		.0050000
	MEAN		.901516	.0100000	.117391	.799129	.0436086		.0079130
80/01/00									
82/01/01									
YEAR	NUMBER		3	3	3	3	3		3
	MAXIMUM		.160000	.0100000	.100000	.650000	.0410000		.0130000
	MINIMUM		.0400000	.0100000	.100000	.110000	.0240000		.0110000
	MEAN		.0799999	.0100000	.100000	.460000	.0306666		.0116667
83/01/00									
00/00/00									
STATION	NUMBER		26	26	26	26	26		26
	MAXIMUM		20.0000	.0100000	.300000	1.25000	.119000		.0240000
	MINIMUM		.0100000	.0100000	.100000	.110000	.0070000		.0050000
	MEAN		.806726	.0100000	.115384	.759998	.0421153		.0083461
99/99/99									

Table IV-6. Continued

STORET RETRIEVAL DATE 84/01/25

46PI07
45 31 01.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596276-0624706

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			16	15	16		8		16	16	16
	MAXIMUM			13.1000	8.60000	55000.0		8.71000		455.000	451.000	27.0000
	MINIMUM			5.90000	6.50000	2.00000		8.40000		337.000	321.000	1.00000
	MEAN			8.95624	8.05333	3666.06		8.58624		387.750	378.375	9.43750
80/01/00												
00/00/00												
STATION	NUMBER			16	15	16		8		16	16	16
	MAXIMUM			13.1000	8.60000	55000.0		8.71000		455.000	451.000	27.0000
	MINIMUM			5.90000	6.50000	2.00000		8.40000		337.000	321.000	1.00000
	MEAN			8.95624	8.05333	3666.06		8.58624		387.750	378.375	9.43750
99/99/99												

Table IV-7.

STORET RETRIEVAL DATE 84/01/25

46PI07
45 31 01.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596276-0624706

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		16	16	16	16	16		16
	MAXIMUM		.120000	.0100000	.100000	2.07000	.0679999		.0100000
	MINIMUM		.0100000	.0100000	.100000	.100000	.0140000		.0030000
	MEAN		.0327500	.0100000	.0999997	.880625	.0356875		.0051875
80/01/00									
00/00/00									
STATION	NUMBER		16	16	16	16	16		16
	MAXIMUM		.120000	.0100000	.100000	2.07000	.0679999		.0100000
	MINIMUM		.0100000	.0100000	.100000	.100000	.0140000		.0030000
	MEAN		.0327500	.0100000	.0999997	.880625	.0356875		.0051875
99/99/99									

Table IV-7. Continued

STORET RETRIEVAL DATE 84/01/25

46PI08
45 30 03.0 097 16 05.0 2
PICKEREL/INLAKE E SHORE T124N R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596277-0624707

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			16	15	16		8		16	16	16
	MAXIMUM			13.1000	8.70000	2000.00		8.80000		439.000	438.000	25.0000
	MINIMUM			5.80000	6.80000	2.00000		8.38000		329.000	321.000	1.00000
	MEAN			8.88749	8.02666	133.687		8.56624		379.250	372.000	7.28125
80/01/00												
00/00/00												
STATION	NUMBER			16	15	16		8		16	16	16
	MAXIMUM			13.1000	8.70000	2000.00		8.80000		439.000	438.000	25.0000
	MINIMUM			5.80000	6.80000	2.00000		8.38000		329.000	321.000	1.00000
	MEAN			8.88749	8.02666	133.687		8.56624		379.250	372.000	7.28125
99/99/99												

Table IV-8.

STORET RETRIEVAL DATE 84/01/25

46PI08
45 30 03.0 097 16 05.0 2
PICKEREL/INLAKE E SHORE T124N R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596277-0624707

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		16	16	16	16	16		16
	MAXIMUM		.300000	.0100000	.100000	1.12000	.120000		.0550000
	MINIMUM		.0060000	.0100000	.100000	.200000	.0070000		.0020000
	MEAN		.0441250	.0100000	.0999997	.640000	.0358750		.0082500
80/01/00									
00/00/00									
STATION	NUMBER		16	16	16	16	16		16
	MAXIMUM		.300000	.0100000	.100000	1.12000	.120000		.0550000
	MINIMUM		.0060000	.0100000	.100000	.200000	.0070000		.0020000
	MEAN		.0441250	.0100000	.0999997	.640000	.0358750		.0082500
99/99/99									

Table IV-8. Continued

STORET RETRIEVAL DATE 84/01/25

46PI09
45 28 38.0 097 16 04.0 2
PICKEREL/INLAKE S SHORE T123N R53W SEC34
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596278-0624708

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			16	15	16		8	1	16	16	16
	MAXIMUM			13.8000	8.60000	140.000		8.73000	182.000	511.000	417.000	118.000
	MINIMUM			5.50000	3.20000	2.00000		8.34000	182.000	325.000	313.000	1.00000
	MEAN			8.81249	7.77999	16.3750		8.55124	182.000	387.812	373.312	14.3125
80/01/00												
00/00/00												
STATION	NUMBER			16	15	16		8	1	16	16	16
	MAXIMUM			13.8000	8.60000	140.000		8.73000	182.000	511.000	417.000	118.000
	MINIMUM			5.50000	3.20000	2.00000		8.34000	182.000	325.000	313.000	1.00000
	MEAN			8.81249	7.77999	16.3750		8.55124	182.000	387.812	373.312	14.3125
99/99/99												

Table IV-9.

STORET RETRIEVAL DATE 84/01/25

46PI09
45 28 38.0 097 16 04.0 2
PICKEREL/INLAKE S SHORE T123N R53W SEC34
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596278-0624708

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4-N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4-T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		16	16	15	16	16		16
	MAXIMUM		.180000	.0100000	.100000	1.50000	.0610000		.0120000
	MINIMUM		.0100000	.0100000	.100000	.0200000	.0100000		.0020000
	MEAN		.0363750	.0100000	.0999997	.711250	.0333125		.0056875
80/01/00									
00/00/00									
STATION	NUMBER		16	16	15	16	16		16
	MAXIMUM		.180000	.0100000	.100000	1.50000	.0610000		.0120000
	MINIMUM		.0100000	.0100000	.100000	.0200000	.0100000		.0020000
	MEAN		.0363750	.0100000	.0999997	.711250	.0333125		.0056875
99/99/99									

Table IV-9. Continued

STORET RETRIEVAL DATE 84/01/25

46PI3Y
45 31 44.0 097 15 00.0 2
NORTHEAST TRIB T124N R53W NE1/4 SEC 14
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596279-0624709

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			8	7	9		9		9	9	9
	MAXIMUM			15.7000	8.00000	350.000		8.20000		578.000	562.000	32.0000
	MINIMUM			1.30000	5.60000	3.00000		7.58000		299.000	299.000	1.00000
	MEAN			7.02499	7.34285	118.333		7.81999		516.333	508.666	8.00000
80/01/00												
00/00/00												
STATION	NUMBER			8	7	9		9		9	9	9
	MAXIMUM			15.7000	8.00000	350.000		8.20000		578.000	562.000	32.0000
	MINIMUM			1.30000	5.60000	3.00000		7.58000		299.000	299.000	1.00000
	MEAN			7.02499	7.34285	118.333		7.81999		516.333	508.666	8.00000
99/99/99												

Table IV-10.

STORET RETRIEVAL DATE 84/01/25

46PI3Y
45 31 44.0 097 15 00.0 2
NORTHEAST TRIB T124N R53W NE1/4 SEC 14
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596279-0624709

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		9	9	9	9	9		9
	MAXIMUM		.0300000	.0100000	.200000	1.32000	.312000		.263000
	MINIMUM		.0200000	.0100000	.100000	.230000	.0140000		.0050000
	MEAN		.0222222	.0100000	.111111	.623333	.152222		.119667
80/01/00									
00/00/00									
STATION	NUMBER		9	9	9	9	9		9
	MAXIMUM		.0300000	.0100000	.200000	1.32000	.312000		.263000
	MINIMUM		.0200000	.0100000	.100000	.230000	.0140000		.0050000
	MEAN		.0222222	.0100000	.111111	.623333	.152222		.119667
99/99/99									

Table IV-10. Continued

STORET RETRIEVAL DATE 84/01/25

46PI3Z
45 30 48.0 097 16 04.0 2
NW1/4,NW1/4 SECTION 23 T125N R53W, TRIB
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596280-0624710

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
79/01/01												
YEAR	NUMBER			6	7	7		7		7	7	7
	MAXIMUM			11.8000	8.40000	240.000		8.33000		547.000	541.000	7.00000
	MINIMUM			6.30000	7.70000	3.00000		7.80000		471.000	469.000	1.00000
	MEAN			9.64999	8.07142	49.4286		8.14856		513.714	510.143	3.64286
80/01/00												
00/00/00												
STATION	NUMBER			6	7	7		7		7	7	7
	MAXIMUM			11.8000	8.40000	240.000		8.33000		547.000	541.000	7.00000
	MINIMUM			6.30000	7.70000	3.00000		7.80000		471.000	469.000	1.00000
	MEAN			9.64999	8.07142	49.4286		8.14856		513.714	510.143	3.64286
99/99/99												

Table IV-11.

STORET RETRIEVAL DATE 84/01/25

46PI3Z
45 30 48.0 097 16 04.0 2
NW1/4,NW1/4 SECTION 23 T125N R53W, TRIB
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596280-0624710

/TYPA/AMBNT/STREAM/RUNOFF

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
79/01/01									
YEAR	NUMBER		7	7	7	7	7		7
	MAXIMUM		.0300000	.0100000	.100000	1.11000	.0510000		.0200000
	MINIMUM		.0200000	.0100000	.100000	.340000	.0200000		.0050000
	MEAN		.0214286	.0100000	.100000	.815714	.0347143		.0071429
80/01/00									
00/00/00									
STATION	NUMBER		7	7	7	7	7		7
	MAXIMUM		.0300000	.0100000	.100000	1.11000	.0510000		.0200000
	MINIMUM		.0200000	.0100000	.100000	.340000	.0200000		.0050000
	MEAN		.0214286	.0100000	.100000	.815714	.0347143		.0071429
99/99/99									

Table IV-11. Continued

STORET RETRIEVAL DATE 84/01/25

46PI7A
45 30 55.0 097 17 22.0 4
PICKEREL LAKE/INLAKE NW SHORE 124N-53W-16 DDD
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673718-0707576

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
82/01/01												
YEAR	NUMBER			4	4	4				4	4	4
	MAXIMUM			12.9000	7.20000	3.00000				386.000	384.000	5.00000
	MINIMUM			9.50000	7.00000	3.00000				346.000	345.000	1.00000
	MEAN			11.1000	7.10000	3.00000				364.000	360.750	3.25000
83/01/00												
83/01/01												
YEAR	NUMBER			11	11	12				12	12	12
	MAXIMUM			13.0000	8.50000	140.000				400.000	398.000	15.0000
	MINIMUM			8.20000	7.20000	3.00000				342.000	340.000	2.00000
	MEAN			10.0091	8.09090	23.0000				380.416	374.833	5.58333
84/01/00												
00/00/00												
STATION	NUMBER			15	15	16				16	16	16
	MAXIMUM			13.0000	8.50000	140.000				400.000	398.000	15.0000
	MINIMUM			8.20000	7.00000	3.00000				342.000	340.000	1.00000
	MEAN			10.3000	7.82666	18.0000				376.312	371.312	5.00000
99/99/99												

Table IV-12.

STORET RETRIEVAL DATE 84/01/25

46PI7A
45 30 55.0 097 17 22.0 4
PICKEREL LAKE/INLAKE NW SHORE 124N-53W-16 DDD
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673718-0707576

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
82/01/01									
YEAR	NUMBER		4	4	4	4		4	4
	MAXIMUM		.0200000	.0200000	.200000	1.25000		.0410000	.0190000
	MINIMUM		.0200000	.0100000	.100000	.300000		.0270000	.0070000
	MEAN		.0200000	.0125000	.125000	.767500		.0322500	.0155000
83/01/00									
83/01/01									
YEAR	NUMBER		12	12	12	12	11	1	12
	MAXIMUM		.0500000	.0100000	.100000	1.65000	.0779999	.0370000	.0140000
	MINIMUM		.0200000	.0100000	.100000	.460000	.0370000	.0370000	.0050000
	MEAN		.0275000	.0100000	.0999999	.887500	.0585454	.0370000	.0059167
84/01/00									
00/00/00									
STATION	NUMBER		16	16	16	16	11	5	16
	MAXIMUM		.0500000	.0200000	.200000	1.65000	.0779999	.0410000	.0190000
	MINIMUM		.0200000	.0100000	.100000	.300000	.0370000	.0270000	.0050000
	MEAN		.0256250	.0106250	.106250	.857500	.0585454	.0332000	.0083125
99/99/99									

Table IV-12. Continued

STORET RETRIEVAL DATE 84/01/25

46PI8A
45 29 55.0 097 16 00.0 4
PICKEREL LAKE/INLAKE E SHORE 124N-53W-S26 BBD
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673719-0707577

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
82/01/01												
YEAR	NUMBER			4	4	4				4	4	4
	MAXIMUM			12.9000	7.00000	7.00000				375.000	375.000	9.00000
	MINIMUM			9.20000	6.40000	3.00000				358.000	349.000	1.00000
	MEAN			10.9750	6.75000	4.00000				364.750	360.250	4.75000
83/01/00												
83/01/01												
YEAR	NUMBER			10	10	10				10	10	10
	MAXIMUM			13.4000	8.50000	80.0000				421.000	404.000	17.0000
	MINIMUM			8.50000	7.50000	3.00000				113.000	105.000	2.00000
	MEAN			10.3400	8.12000	16.3000				348.900	342.700	6.20000
84/01/00												
00/00/00												
STATION	NUMBER			14	14	14				14	14	14
	MAXIMUM			13.4000	8.50000	80.0000				421.000	404.000	17.0000
	MINIMUM			8.50000	6.40000	3.00000				113.000	105.000	1.00000
	MEAN			10.5214	7.77142	12.7857				353.428	347.714	5.78571
99/99/99												

Table IV-13.

STORET RETRIEVAL DATE 84/01/25

46PI8A
45 29 55.0 097 16 00.0 4
PICKEREL LAKE/INLAKE E SHORE 124N-53W-S26 BBD
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673719-0707577

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
82/01/01									
YEAR	NUMBER		4	4	4	4		4	4
	MAXIMUM		.0200000	.0200000	.200000	1.14000		.0470000	.0250000
	MINIMUM		.0200000	.0100000	.100000	.290000		.0310000	.0100000
	MEAN		.0200000	.0125000	.150000	.675000		.0365000	.0190000
83/01/00									
83/01/01									
YEAR	NUMBER		10	10	10	10	10		10
	MAXIMUM		.540000	.0100000	.600000	3.64000	.230000		.198000
	MINIMUM		.0200000	.0100000	.100000	.420000	.0340000		.0050000
	MEAN		.0819999	.0100000	.150000	.963999	.0728999		.0248000
84/01/00									
00/00/00									
STATION	NUMBER		14	14	14	14	10	4	14
	MAXIMUM		.540000	.0200000	.600000	3.64000	.230000	.0470000	.198000
	MINIMUM		.0200000	.0100000	.100000	.290000	.0340000	.0310000	.0050000
	MEAN		.0642856	.0107143	.150000	.881428	.0728999	.0365000	.0231428
99/99/99									

Table IV-13. Continued

STORET RETRIEVAL DATE 84/01/25

46PI9A
45 29 08.0 097 16 17.0 4
PICKEREL LAKE/INLAKE SW SHORE 123N-53-34 ABA
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673720-0707578

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00431 T ALK FIELD MG/L	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00095 CNDUCTVY AT 25C MICROMHO	00403 LAB PH SU	00410 T ALK CACO3 MG/L	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	00530 RESIDUE TOT NFLT MG/L
82/01/01												
YEAR	NUMBER			3	3	3				3	3	3
	MAXIMUM			11.0000	7.50000	40.0000				368.000	364.000	4.00000
	MINIMUM			9.10000	7.10000	3.00000				357.000	355.000	2.00000
	MEAN			10.2667	7.36666	15.3333				363.333	360.666	2.66667
83/01/00												
83/01/01												
YEAR	NUMBER			12	11	12				12	12	12
	MAXIMUM			13.0000	8.60000	80.0000				674.000	660.000	19.0000
	MINIMUM			8.40000	7.00000	3.00000				335.000	332.000	3.00000
	MEAN			10.5833	7.90909	18.0000				398.416	390.083	8.33333
84/01/00												
00/00/00												
STATION	NUMBER			15	14	15				15	15	15
	MAXIMUM			13.0000	8.60000	80.0000				674.000	660.000	19.0000
	MINIMUM			8.40000	7.00000	3.00000				335.000	332.000	2.00000
	MEAN			10.5200	7.79285	17.4667				391.400	384.200	7.20000
99/99/99												

Table IV-14.

STORET RETRIEVAL DATE 84/01/25

46PI9A
45 29 08.0 097 16 17.0 4
PICKEREL LAKE/INLAKE SW SHORE 123N-53-34 ABA
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673720-0707578

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00608 NH3+NH4- N DISS MG/L	00613 NO2-N DISS MG/L	00620 NO3-N TOTAL MG/L	00623 KJELDL N DISS MG/L	70505 T PO4 P-COL MG/L	70506 SOL PO4- T P-COL MG/L	00671 PHOS-DIS ORTHO MG/L P
82/01/01									
YEAR	NUMBER		3	3	3	3		3	3
	MAXIMUM		.0200000	.0200000	.200000	.970000		.0679999	.0200000
	MINIMUM		.0200000	.0100000	.100000	.340000		.0340000	.0050000
	MEAN		.0200000	.0133333	.133333	.603333		.0463333	.0136667
83/01/00									
83/01/01									
YEAR	NUMBER		12	12	12	12	10	1	12
	MAXIMUM		.0600000	.0100000	.100000	1.84000	.108000	.0270000	.0190000
	MINIMUM		.0200000	.0100000	.100000	.0510000	.0270000	.0270000	.0050000
	MEAN		.0316666	.0100000	.0999999	.696750	.0615000	.0270000	.0077500
84/01/00									
00/00/00									
STATION	NUMBER		15	15	15	15	10	4	15
	MAXIMUM		.0600000	.0200000	.200000	1.84000	.108000	.0679999	.0200000
	MINIMUM		.0200000	.0100000	.100000	.0510000	.0270000	.0270000	.0050000
	MEAN		.0293333	.0106667	.106667	.678066	.0615000	.0415000	.0089333
99/99/99									

Table IV-14. Continued

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 1.SUMMARY.1

46PI01
45 31 47.0 097 16 36.0 2
NORTH TRIB T124N R53W SECTION 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596271-0624701

/TYPA/AMBNT/STREAM/RUNOFF

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/04/10 TO 83/04/18

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	28	26	33	33	26	33	1	33	0	0
MEAN	5.014	7.008	55.8	6.58	421.6	0.01	258.0	0.038	0.0	0.0
MEDIAN	3.650	7.000	7.0	4.00	446.5	0.01	258.0	0.020	*********	*********
NO OF VIOLS	16	3	3	0	5	0	0	0	0	0
PERCENT VIOL	57.	12.	9.	0.	19.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.080	5.600	210.0	0.0	504.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	2.342	6.100	383.3	0.0	527.8	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	4.900	6.400	510.0	0.0	564.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-15.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 2.SUMMARY.1

46PI02
45 31 42.0 097 16 29.0 2
NORTH NORTHEAST TRIB T124W R53W SECTION 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596272-0624702

/TYPA/AMBNT/STREAM/RUNOFF

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/04/10 TO 82/09/08

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	29	32	40	40	32	40	4	40	0	0
MEAN	9.783	7.741	365.0	9.59	448.0	0.01	279.5	0.0383	0.0	0.0
MEDIAN	9.100	8.000	21.5	7.00	470.0	0.01	278.5	0.0300	*********	*********
NO OF VIOLS	0	5	11	0	7	0	0	0	0	0
PERCENT VIOL	0.	16.	28.	0.	22.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	5.800	290.0	0.0	501.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	7.540	1241.8	0.0	519.9	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.600	4100.0	0.0	537.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.500	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-16.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 3.SUMMARY.1

46PI04
45 31 04.0 097 15 05.0 2
TRIB NE INLET SE1/4,NE1/4 SEC 23 T124N R53W
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596273-0624703

/TYPA/AMBNT/STREAM/RUNOFF

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/04/17 TO 83/04/27

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	20	31	38	38	35	38	0	38	0	0
MEAN	7.380	7.626	92.8	7.34	364.1	0.01	0.0	0.0344	0.0	0.0
MEDIAN	8.000	7.700	23.5	5.50	338.0	0.01	*********	0.0200	*********	*********
NO OF VIOLS	7	0	5	0	4	0	0	0	0	0
PERCENT VIOL	35.	0.	13.	0.	11.	0.	0.	0.	0.	0.
MINIMUM VIOL	1.900	0.0	220.0	0.0	503.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	3.214	0.0	476.0	0.0	587.5	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	4.200	0.0	790.0	0.0	834.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-17.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 4.SUMMARY.1

46PI05
45 28 55.0 097 15 39.0 2
LK INLET AT ST FISH HATCHERY T124N R53W SEC 35
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596274-0624704

/TYPA/AMBNT/STREAM/RUNOFF

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/05/22 TO 79/11/15

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	12	18	22	22	21	22	3	21	1	0
MEAN	7.725	7.456	489.7	27.05	394.8	0.01	281.0	0.0259	0.302	0.0
MEDIAN	7.900	7.450	215.0	7.50	423.0	0.01	284.0	0.0200	0.302	*********
NO OF VIOLS	0	0	11	1	1	0	0	0	0	0
PERCENT VIOL	0.	0.	50.	5.	5.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	0.0	250.0	425.00	519.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	0.0	890.0	425.00	519.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	0.0	2400.0	425.00	519.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-18.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 5.SUMMARY.1

46PI06
45 30 15.0 097 17 00.0 2
OUTLET AT STATE PARK T123N R53W SEC 22
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596275-0624705

/TYPA/AMBNT/STREAM/RUNOFF

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/03/29 TO 82/06/17

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS 105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	23	19	26	26	23	26	1	26	0	0
MEAN	9.035	7.984	8.0	11.04	363.9	0.01	186.00	0.8067	0.0	0.0
MEDIAN	8.500	8.300	3.0	6.50	364.0	0.01	186.00	0.0300	*********	*********
NO OF VIOLS	0	9	0	0	0	0	0	0	0	0
PERCENT VIOL	0.	47.	0.	0.	0.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	8.400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	8.522	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-19.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 6.SUMMARY.1

46PI07
45 31 01.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596276-0624706

/TYPA/AMBNT/LAKE

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/05/17 TO 79/12/27

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	16	15	16	16	16	16	0	16	0	0
MEAN	8.956	8.053	3666.1	9.44	378.4	0.01	0.0	0.0327	0.0	0.0
MEDIAN	8.600	8.300	5.0	6.50	369.0	0.01	*********	0.0200	*********	*********
NO OF VIOLS	0	7	3	0	0	0	0	0	0	0
PERCENT VIOL	0.	47.	19.	0.	0.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	8.400	280.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	8.486	19526.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.600	55000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-20.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 7.SUMMARY.1

46PI08
45 30 03.0 097 16 05.0 2
PICKEREL/INLAKE E SHORE T124N R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596277-0624707

/TYPA/AMBNT/LAKE

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/05/17 TO 79/12/27

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	16	15	16	16	16	16	0	16	0	0
MEAN	8.887	8.027	133.7	7.28	372.0	0.01	0.0	0.044	0.0	0.0
MEDIAN	7.900	8.400	3.0	6.50	362.0	0.01	*********	0.020	*********	*********
NO OF VIOLS	0	8	1	0	0	0	0	0	0	0
PERCENT VIOL	0.	53.	6.	0.	0.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	8.400	2000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	8.500	2000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.700	2000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-21.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 8.SUMMARY.1

46PI09
45 28 38.0 097 16 04.0 2
PICKEREL/INLAKE S SHORE T123N R53W SEC34
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596278-0624708

/TYPA/AMBNT/LAKE

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/05/17 TO 79/12/27

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	16	15	16	16	16	16	1	16	0	0
MEAN	8.812	7.780	16.4	14.31	373.3	0.01	182.00	0.036	0.0	0.0
MEDIAN	8.250	8.300	3.0	7.50	367.5	0.01	182.00	0.020	*********	*********
NO OF VIOLS	0	7	0	1	0	0	0	0	0	0
PERCENT VIOL	0.	47.	0.	6.	0.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	3.200	0.0	118.00	0.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	7.714	0.0	118.00	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.600	0.0	118.00	0.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-22.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 9.SUMMARY.1

46PI3Y
45 31 44.0 097 15 00.0 2
NORTHEAST TRIB T124N R53W NE1/4 SEC 14
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
/TYPA/AMBNT/STREAM/RUNOFF 21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596279-0624709

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/05/01 TO 79/07/24

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	8	7	9	9	9	9	0	9	0	0
MEAN	7.025	7.343	118.3	8.00	508.7	0.01	0.0	0.0222	0.0	0.0
MEDIAN	6.150	7.500	63.0	4.00	545.0	0.01	*********	0.0200	*********	*********
NO OF VIOLS	4	1	2	0	8	0	0	0	0	0
PERCENT VIOL	50.	14.	22.	0.	89.	0.	0.	0.	0.	0.
MINIMUM VIOL	1.300	5.600	310.0	0.0	503.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	1.850	5.600	330.0	0.0	534.9	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	2.900	5.600	350.0	0.0	562.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-23.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 10.SUMMARY.1

46PI3Z
45 30 48.0 097 16 04.0 2
NW1/4,NW1/4 SECTION 23 T125N R53W, TRIB
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596280-0624710

/TYPA/AMBNT/STREAM/RUNOFF

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 79/05/15 TO 79/06/05

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	6	7	7	7	7	7	0	7	0	0
MEAN	9.650	8.071	49.4	3.64	510.1	0.01	0.0	0.0214	0.0	0.0
MEDIAN	10.700	8.100	10.0	4.00	515.0	0.01	*********	0.0200	*********	*********
NO OF VIOLS	0	1	1	0	4	0	0	0	0	0
PERCENT VIOL	0.	14.	14.	0.	57.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	8.400	240.0	0.0	515.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	8.400	240.0	0.0	530.2	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.400	240.0	0.0	541.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-24.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 11.SUMMARY.1

46PI7A
45 30 55.0 097 17 22.0 4
PICKEREL LAKE/INLAKE NW SHORE 124N-53W-16 DDD
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673718-0707576

/TYPA/AMBNT/LAKE

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 82/10/06 TO 83/10/18

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	15	15	16	16	16	16	0	16	0	0
MEAN	10.300	7.827	18.0	5.00	371.3	0.01	0.0	0.0256	0.0	0.0
MEDIAN	10.000	8.100	10.0	3.00	377.0	0.01	*********	0.0200	*********	*********
NO OF VIOLS	0	3	0	0	0	0	0	0	0	0
PERCENT VIOL	0.	20	0.	0.	0.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	8.400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	8.433	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA	*********	8.300	200.0	90.00	500.0	50.00	*********	*********	*********	0.0400

Table IV-25.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 12.SUMMARY.1

46PI8A
45 29 55.0 097 16 00.0 4
PICKEREL LAKE/INLAKE E SHORE 124N-53W-S26 BBD
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673719-0707577

/TYPA/AMBNT/LAKE

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 82/10/06 TO 83/10/18

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	14	14	14	14	14	14	0	14	0	0
MEAN	10.521	7.771	12.8	5.79	347.7	0.01	0.0	0.0643	0.0	0.0
MEDIAN	10.050	8.200	10.0	5.00	360.5	0.01 *********		0.0250 *********	*********	*********
NO OF VIOLS	0	2	0	0	0	0	0	0	0	0
PERCENT VIOL	0.	14.	0.	0.	0.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	6.400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	7.450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500 *********	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA*********		8.300	200.0	90.00	500.0	50.00 *********	*********	*********	*********	0.0400

Table IV-26.

STORET RETRIEVAL DATE 84/01/25 - STAND - VERSION OF APR. 1983 STN 13.SUMMARY.1

46PI9A
45 29 08.0 097 16 17.0 4
PICKEREL LAKE/INLAKE SW SHORE 123N-53-34 ABA
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 821211
0000 FEET DEPTH CLASS 00 CSN-RSP 0673720-0707578

/TYPA/AMBNT/LAKE

SUMMARY OF VIOLATIONS ON SAMPLES COLLECTED FROM 82/10/06 TO 83/10/24

	00300 DO MG/L	00400 PH SU	31616 FEC COLI MFM-FCBR /100ML	00530 RESIDUE TOT NFLT MG/L	00515 RESIDUE DISS-105 C MG/L	00613 NO2-N DISS MG/L	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00608 NH3+NH4- N DISS MG/L	00619 UN-IONZD NH3-NH3 MG/L
NO OF VALUES	15	14	15	15	15	15	0	15	0	0
MEAN	10.520	7.793	17.5	7.20	384.2	0.01	0.0	0.0293	0.0	0.0
MEDIAN	10.700	7.850	10.0	6.00	364.0	0.01 *********		0.0200 *********	*********	*********
NO OF VIOLS	0	3	0	0	1	0	0	0	0	0
PERCENT VIOL	0.	21.	0.	0.	7.	0.	0.	0.	0.	0.
MINIMUM VIOL	0.0	8.400	0.0	0.0	660.0	0.0	0.0	0.0	0.0	0.0
MEAN VIOL	0.0	8.500	0.0	0.0	660.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM VIOL	0.0	8.600	0.0	0.0	660.0	0.0	0.0	0.0	0.0	0.0
MIN CRITERIA	5.000	6.500 *********	*********	*********	*********	*********	*********	*********	*********	*********
MAX CRITERIA*********		8.300	200.0	90.00	500.0	50.00 *********	*********	*********	*********	0.0400

Table IV-27.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
STATION=21SDLAKE 46PI07					
ORGN	16	0.848	0.545	0.080	2.030
INON	16	0.143	0.029	0.120	0.230
STATION=21SDLAKE 46PI08					
ORGN	16	0.596	0.282	0.170	1.070
INON	16	0.154	0.070	0.116	0.410
STATION=21SDLAKE 46PI09					
ORGN	16	0.675	0.316	0.000	1.410
INON	15	0.147	0.045	0.120	0.290
STATION=21SDLAKE 46PI7A					
ORGN	16	0.832	0.335	0.280	1.630
INON	16	0.142	0.028	0.130	0.240
STATION=21SDLAKE 46PI9A					
ORGN	15	0.649	0.399	-0.009	1.820
INON	15	0.147	0.029	0.130	0.240
STATION=21SDLAKE 46PI8A					
ORGN	14	0.817	0.693	0.270	3.100
INON	14	0.225	0.269	0.130	1.150

Table IV-28.

Site	LB	X	UB
46PI07			
1979	17.45	<27.30	<37.15
46PI17A			
1981	32.74	<55.34	<78.04
1982	15.40	<20.95	<26.50
1983	12.35	<16.62	<20.89
46PI08			
1979	12.87	<28.72	<44.57
46PI8A			
1981	35.39	<62.34	<89.29
1982	12.62	<19.67	<26.72
1983	10.19	<12.70	<15.21
46PI09			
1979	15.73	<31.34	<46.95
46PI9A			
1981	28.74	<76.94	<125.14
1982	12.80	<27.94	<43.08
1983	9.64	<14.54	<19.44

Table IV-29. 95% confidence intervals of in-lake ratios of total nitrogen to total phosphorus. LB=lower bound, x=mean, UB=upper bound.

Site	LB	X	UB
46PI07			
1979	51.04	<54.45	<57.87
46PI7A			
1981	43.67	<46.88	<50.09
1982	53.77	<56.22	<58.67
1983	59.37	<61.92	<64.47
46PI08			
1979	47.90	<53.09	<58.28
46PI8A			
1981	47.51	<51.18	<54.85
1982	55.34	<57.96	<60.58
1983	59.98	<64.64	<69.30
46PI09			
1979	48.02	<52.61	<57.20
46PI9A			
1981	41.78	<44.72	<47.66
1982	52.18	<56.25	<60.32
1983	57.09	<61.49	<65.89

Table IV-30. 45% confidence for mean total phosphorus trophic state indices (Carlson, 1977) in Pickerel Lake. LB=lower ground, x=mean, UB=upper bound.

A.

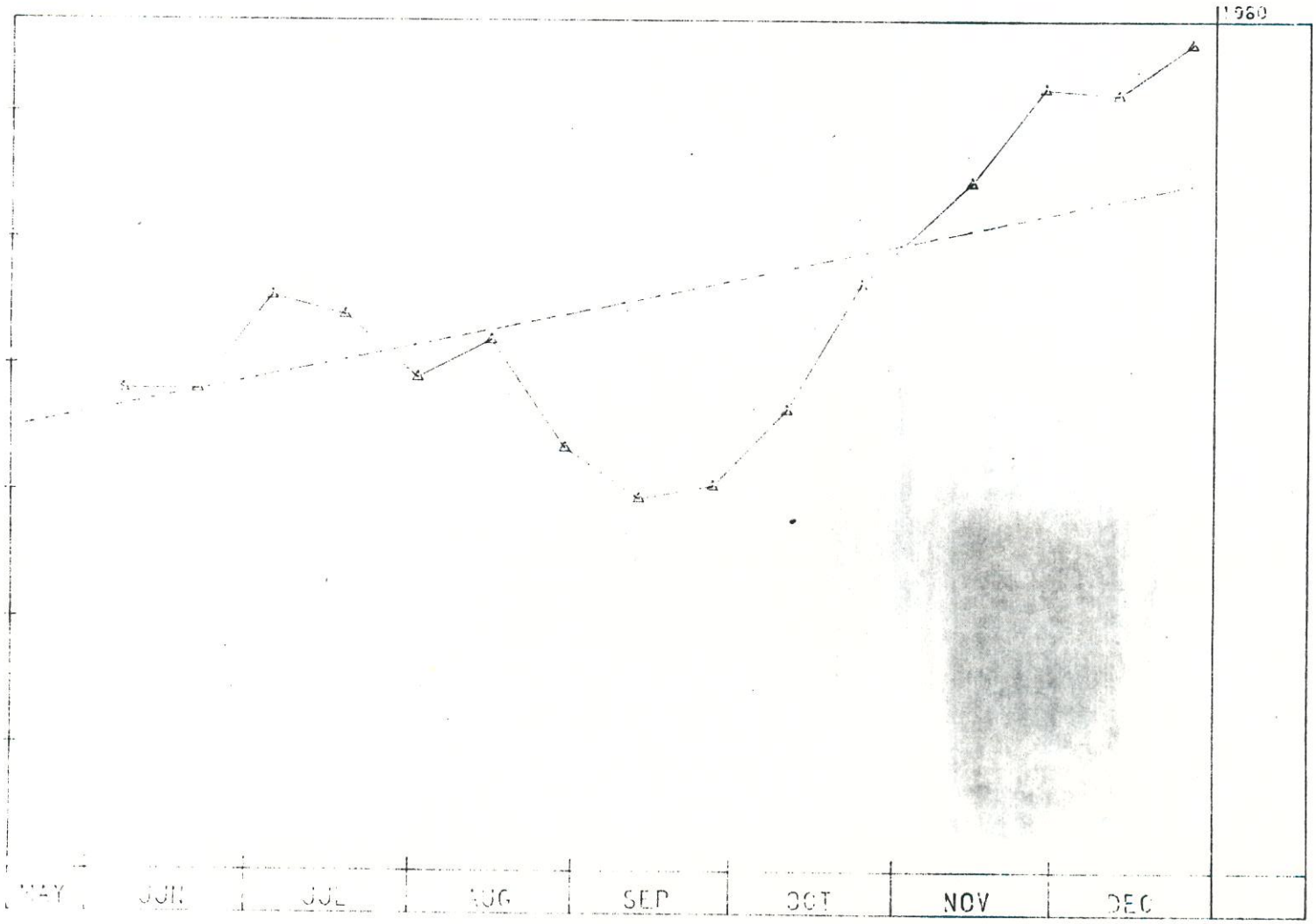
	46PI04		46PI05	
	Total Phosphorus (g/yr)	Total Nitrogen (g/yr)	Total Phosphorus (g/yr)	Total Nitrogen (g/yr)
1979	730653.52	10,093,842.43	7416.95	45,769.7
1982	295283.0	11052127.3	-	-

B.

	Total Load (g/yr)		Areal Load ($g/m^2/yr$)	
	Total Phosphorus	Total Nitrogen	Total Phosphorus	Total Nitrogen
1979	730653.52	10239612.13	.19	2.65
1982	295283.0	11052127.3	.08	2.86

Table IV-31. Total phosphorus and total nitrogen loads and areal loads to Pickerel Lake.

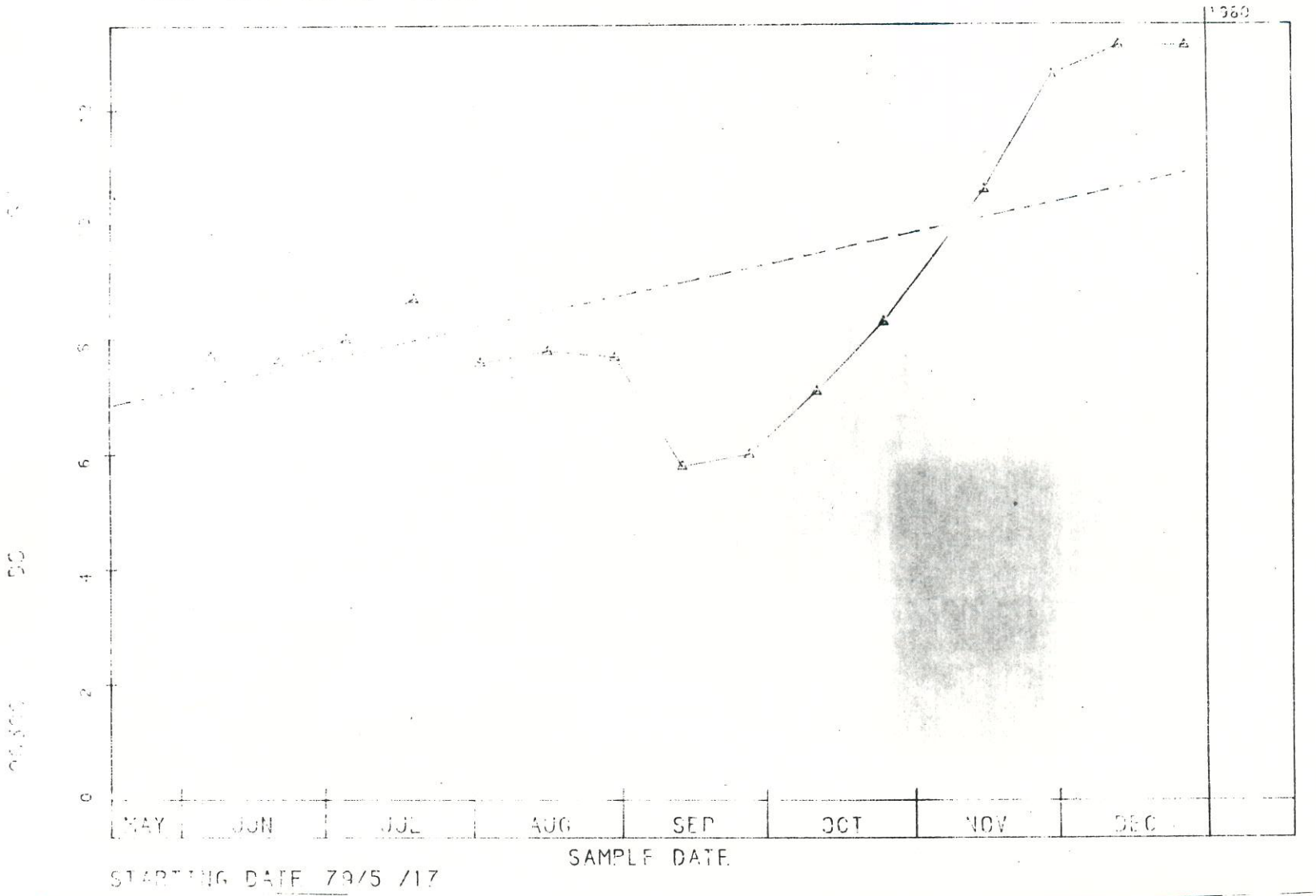
STORET
46P107
45 31 01.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596276-0624706



STARTING DATE 7905 /17

Figure IV-1.

STORET
46P138
45 30 03 0 097 16 05.0 2
PICKEREL/IN LAKE E SHORE T124N R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810906
0000 FEET DEPTH CLASS 00 OSN-RSP 0596277-0624707



STARTING DATE 79/5 /17

Figure IV-2.

STORET

46P109

45 28'38.0 097 16 04.0 2

PICKEREL LAKE S SHORE T123N R53W SEC34

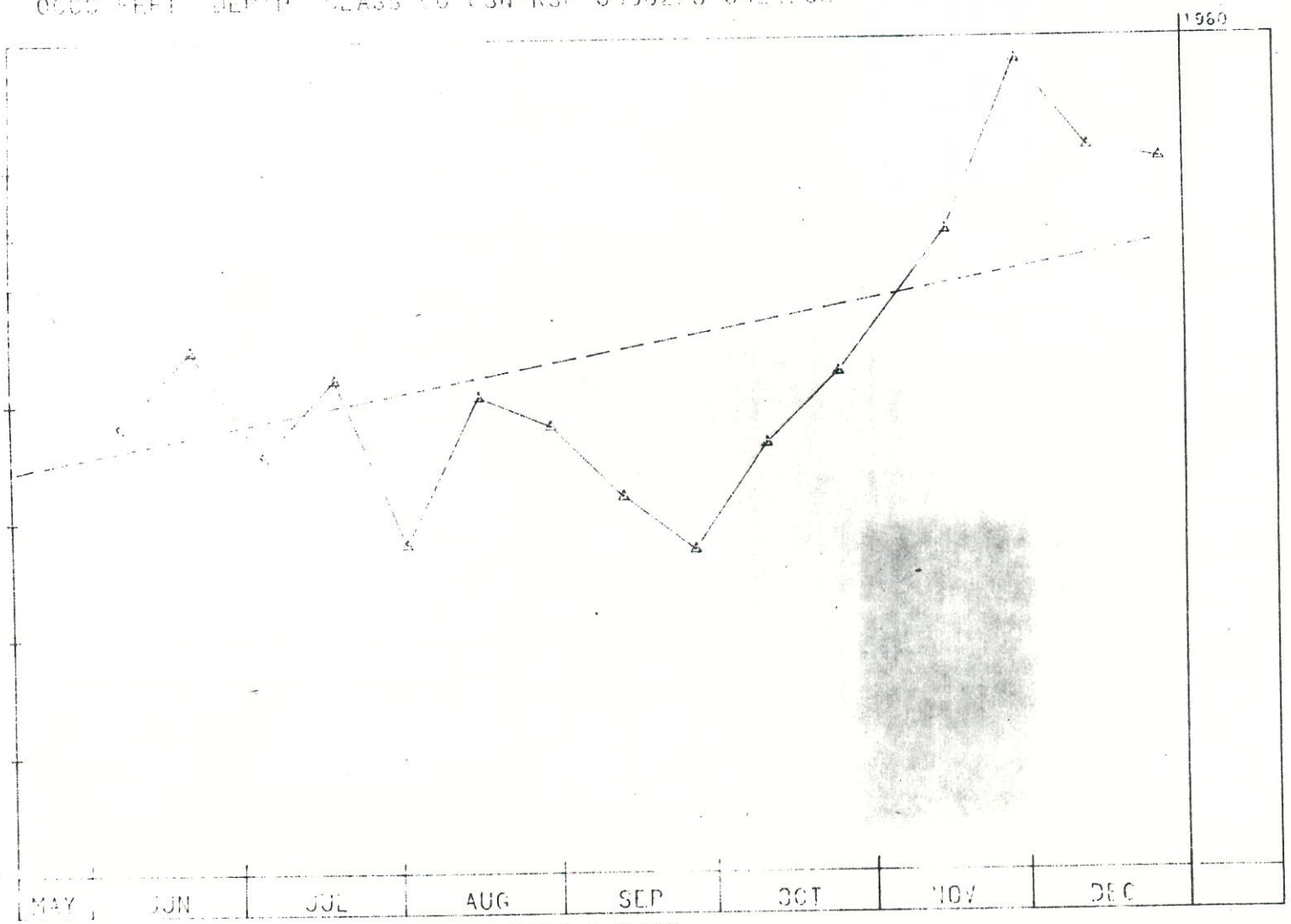
46037 SOUTH DAKOTA DAY

MISSOURI RIVER 090700

BIG SIOUX RIVER

21SDLAKE SL0609

0000 AREA DEPTH GLASS 00 FSN-RSP 0990278-0024708



STARTING DATE 79/5 /17

Figure IV 3

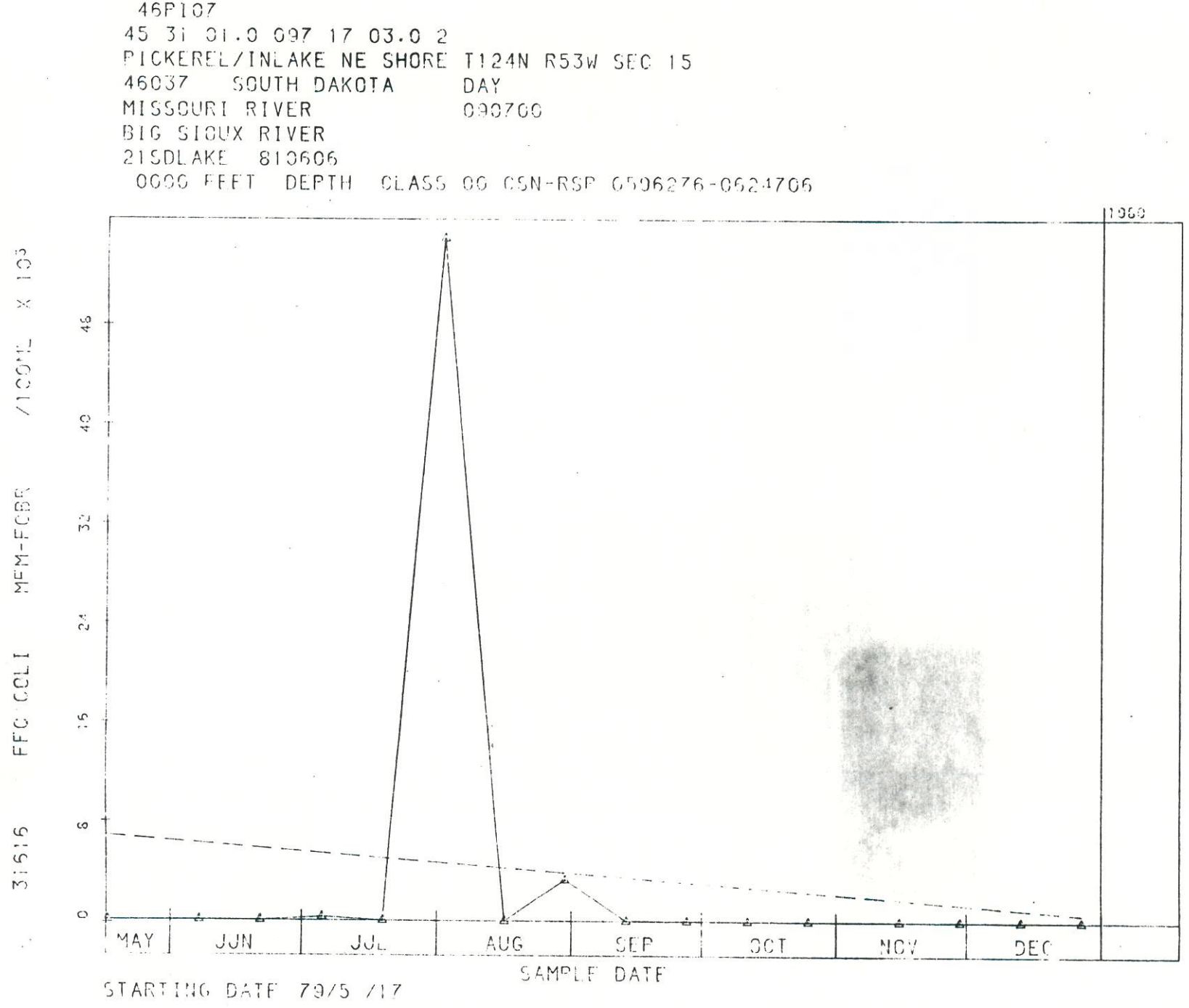

STORET
46P107
45 3i 31.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0506276-0624706
3151S FFC COLI MEM-FCBR /100ML X 10S
0
8
24
32
40
48
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 79/5 /17

Figure IV-4.

STORET
46P109
45 28 38.0 097 16 04.0 2
PICKEREL/INLAKE S SHORE T123N R53W SEC34
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 000700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 QSN-RSP 0506278-0624708

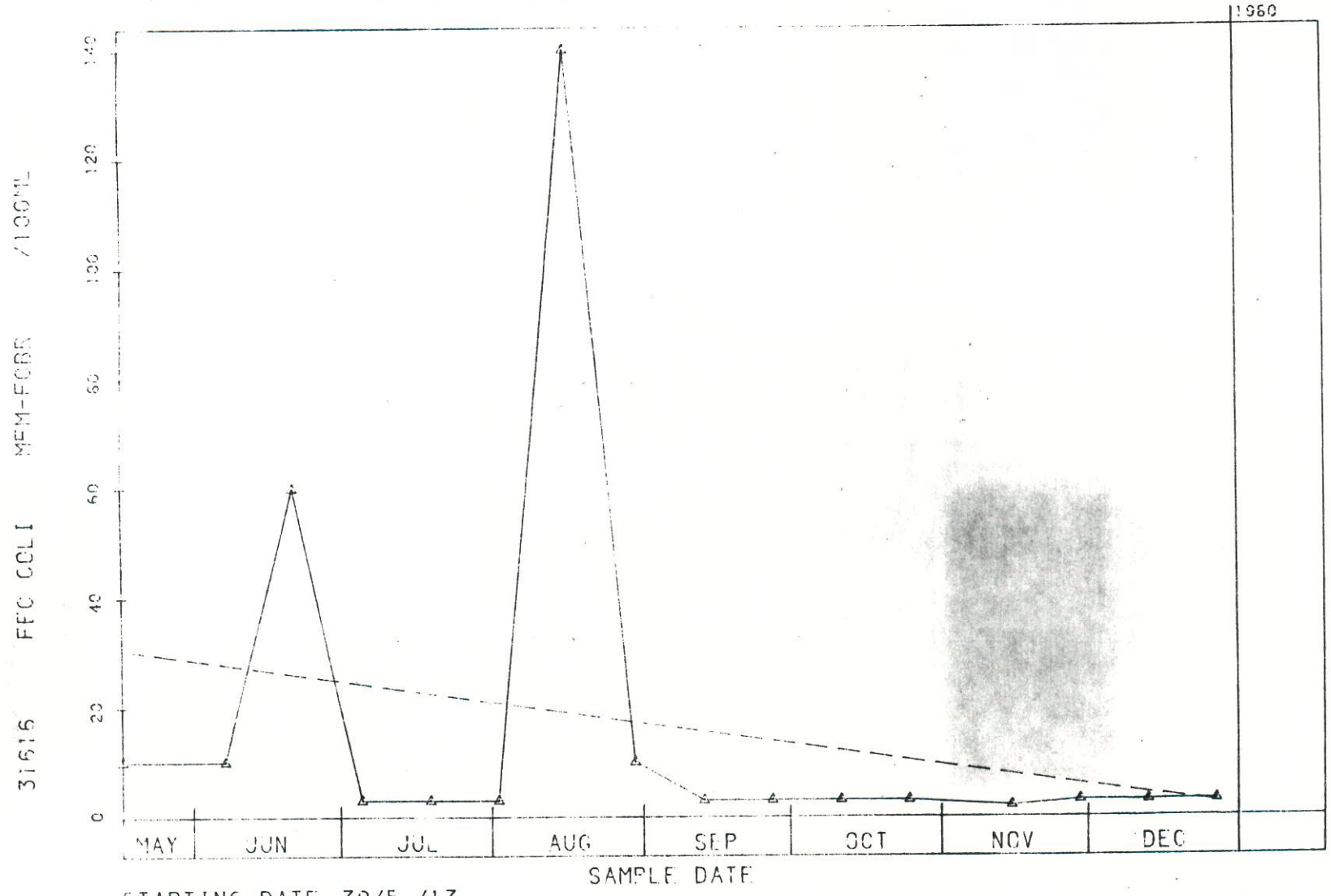
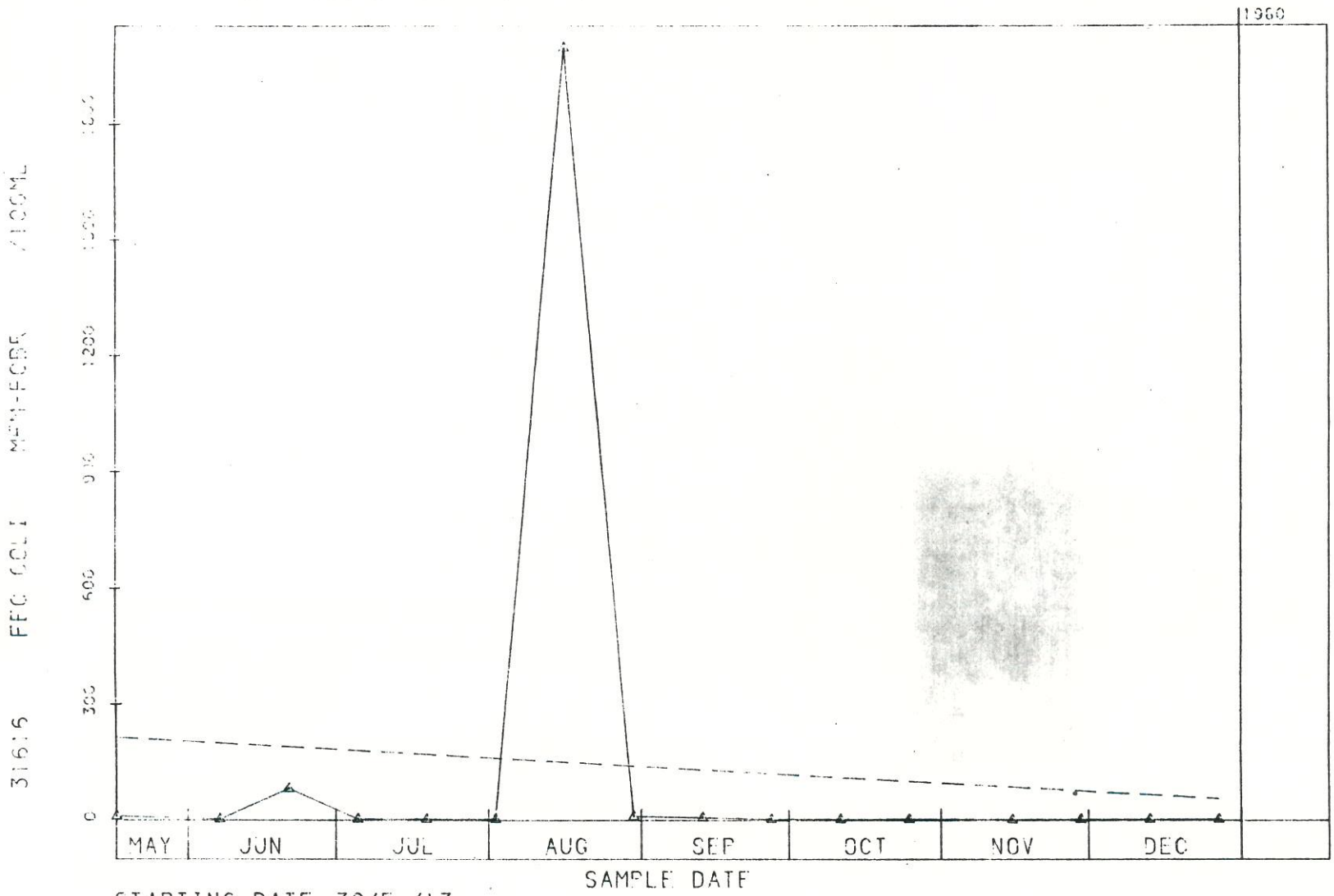


Figure IV.5.

STORET
46P108
45 30 03.0 097 16 05.0 2
PICKEREL/INLAKE E SHORE T124N-R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 000700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 OSN-RSP 0596277-0624707



STARTING DATE 79/5 /17

Figure IV-6

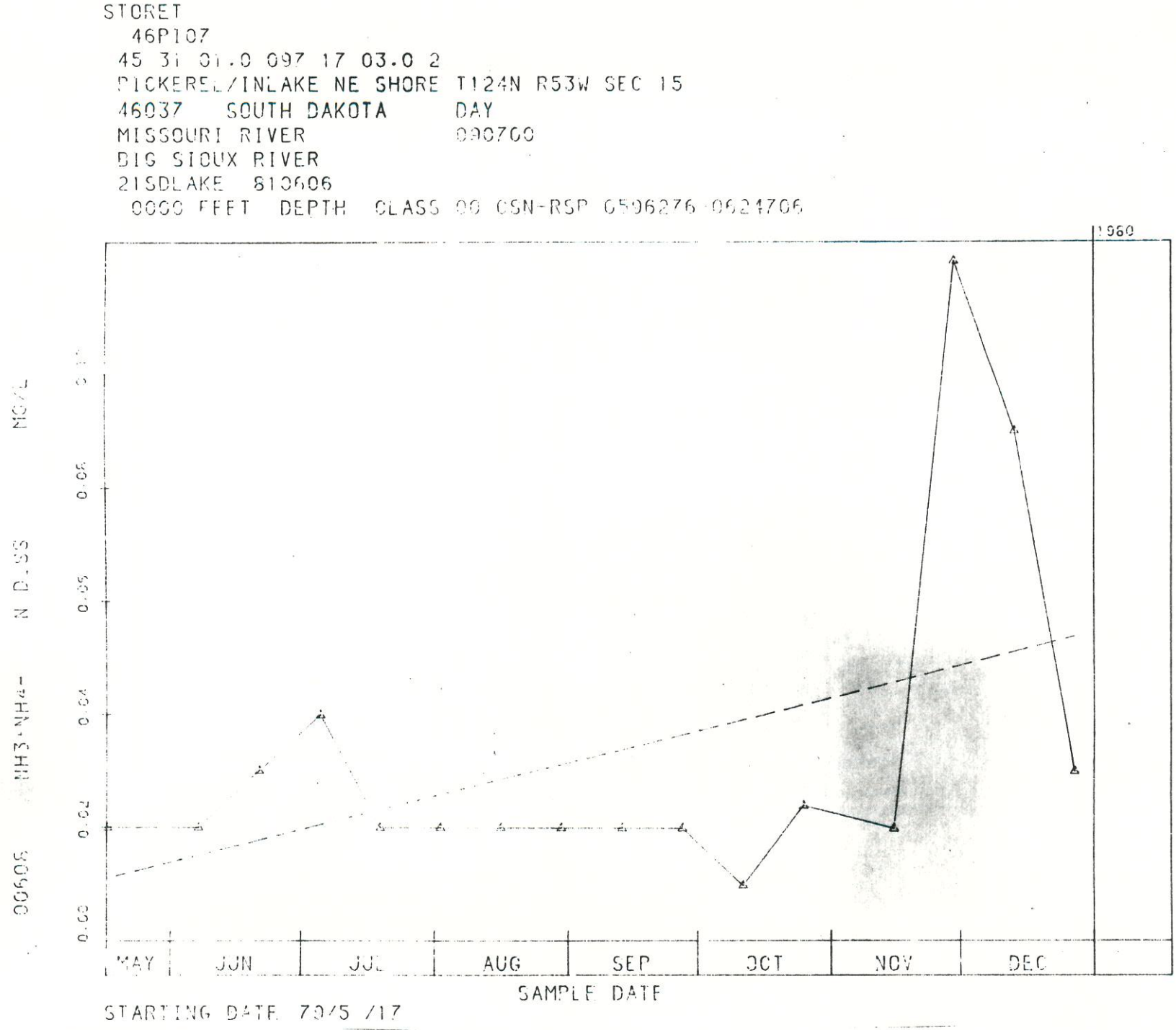

STORET
46P107
45 31 01.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 OSN-RSP 0506276 0624706
1980
00608 NH3-NH4- N D.SS MG/L
0.00
0.02
0.04
0.06
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 7945 /17

Figure IV-7.

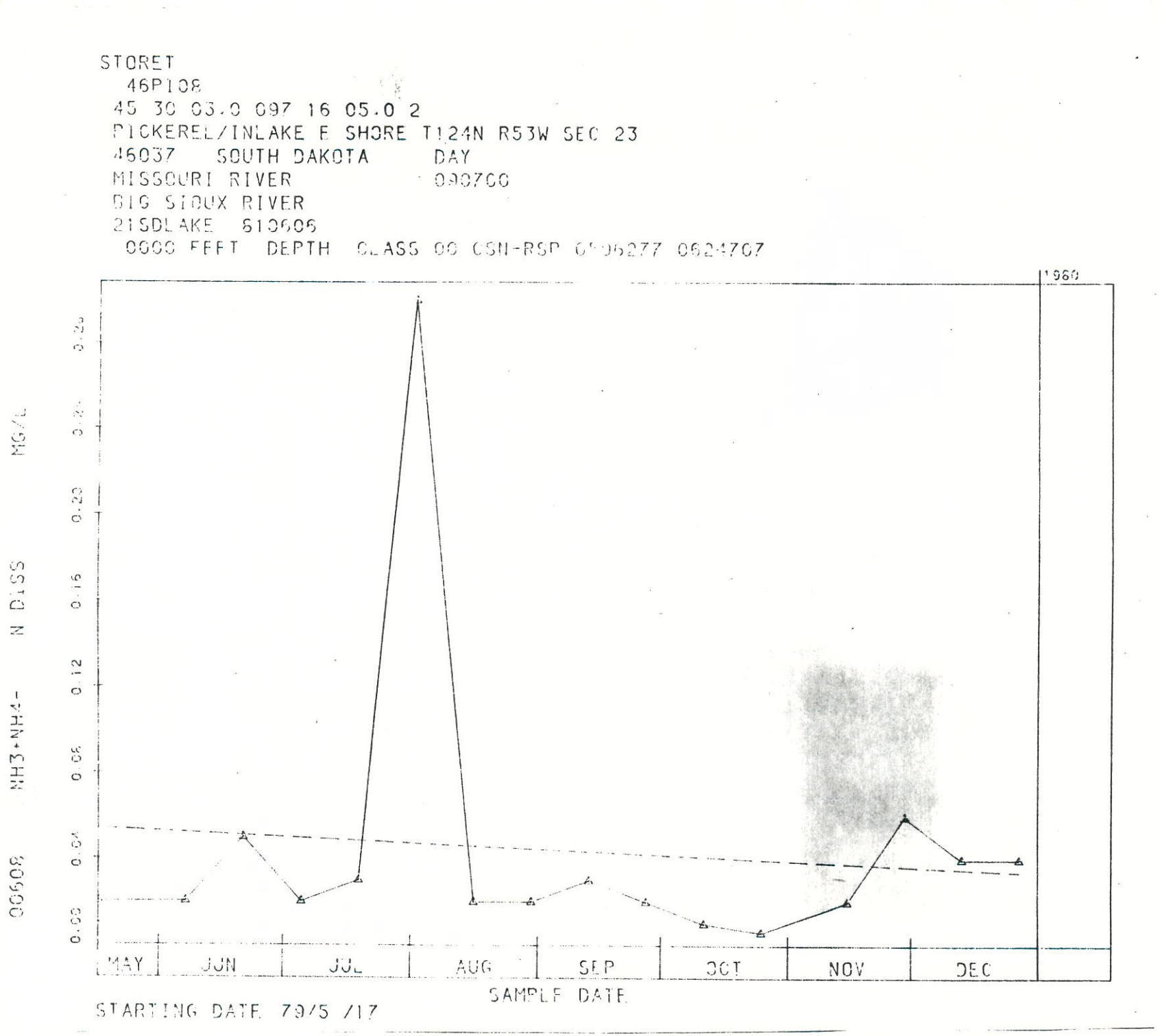
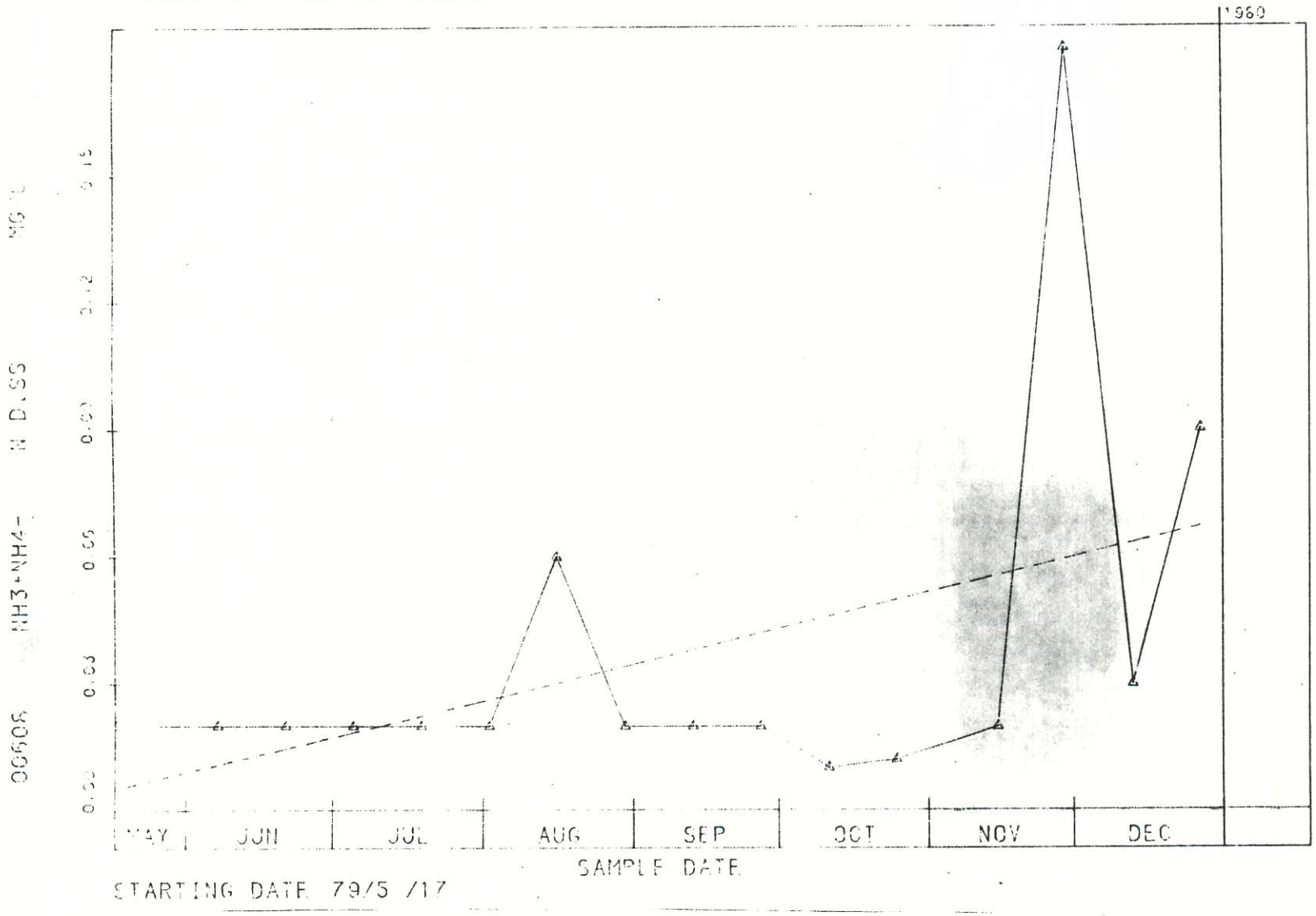

STORET
46P108
45 30 03.0 097 16 05.0 2
PICKEREL/INLAKE E SHORE T124N R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSD 0706277 0624707
1960
00608 NH3+NH4- N DISS MG/L
0.03
0.08
0.12
0.16
0.20
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 79/5 /17

Figure IV-8.

STORET
46P109
45 28 38.0 097 16 04.0 2
PICKEREL/INLAKE S SHORE T123N R53W SEC34
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 000700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0506276-0524708



STARTING DATE 79/5 /17

Figure IV-9

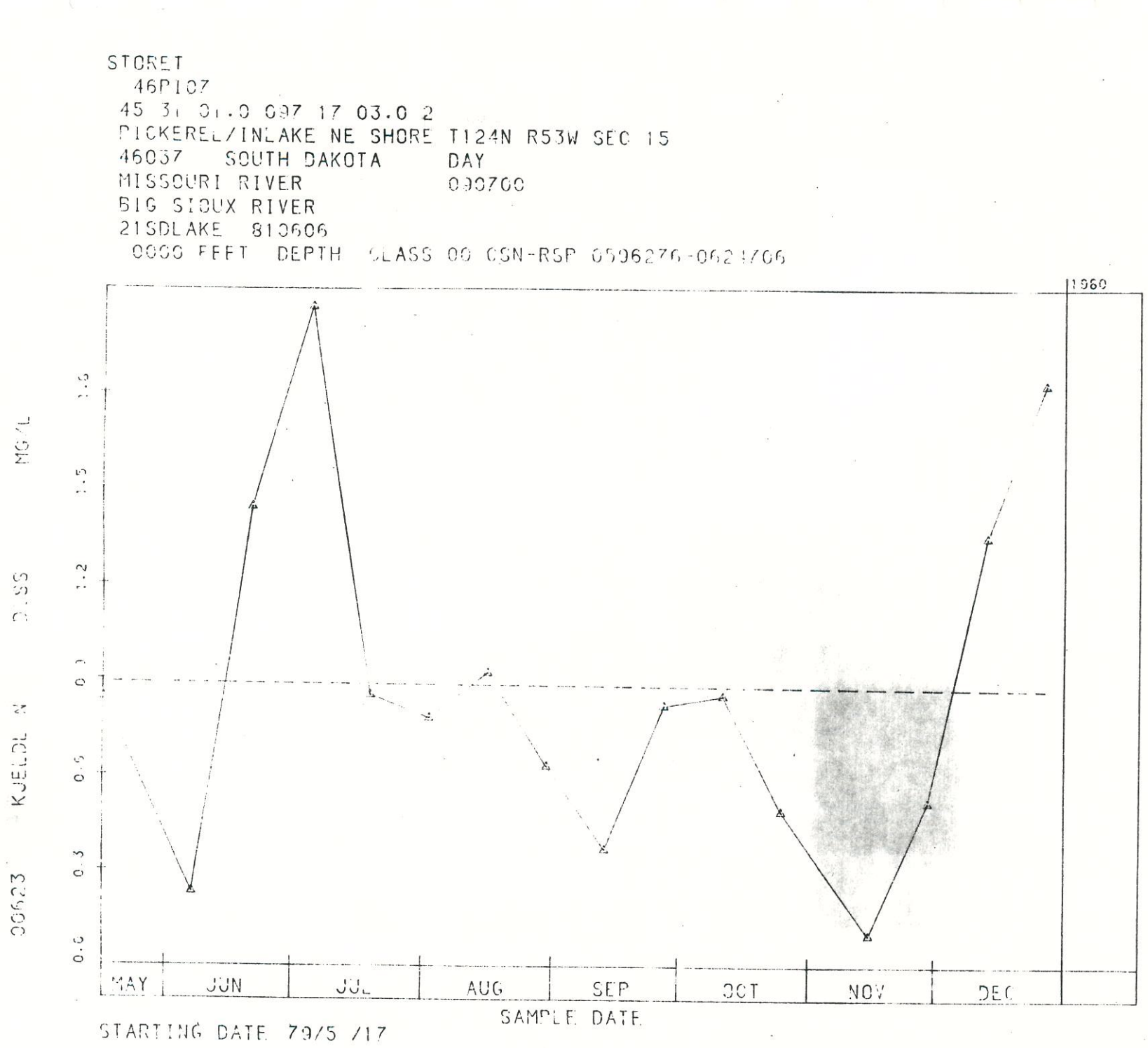
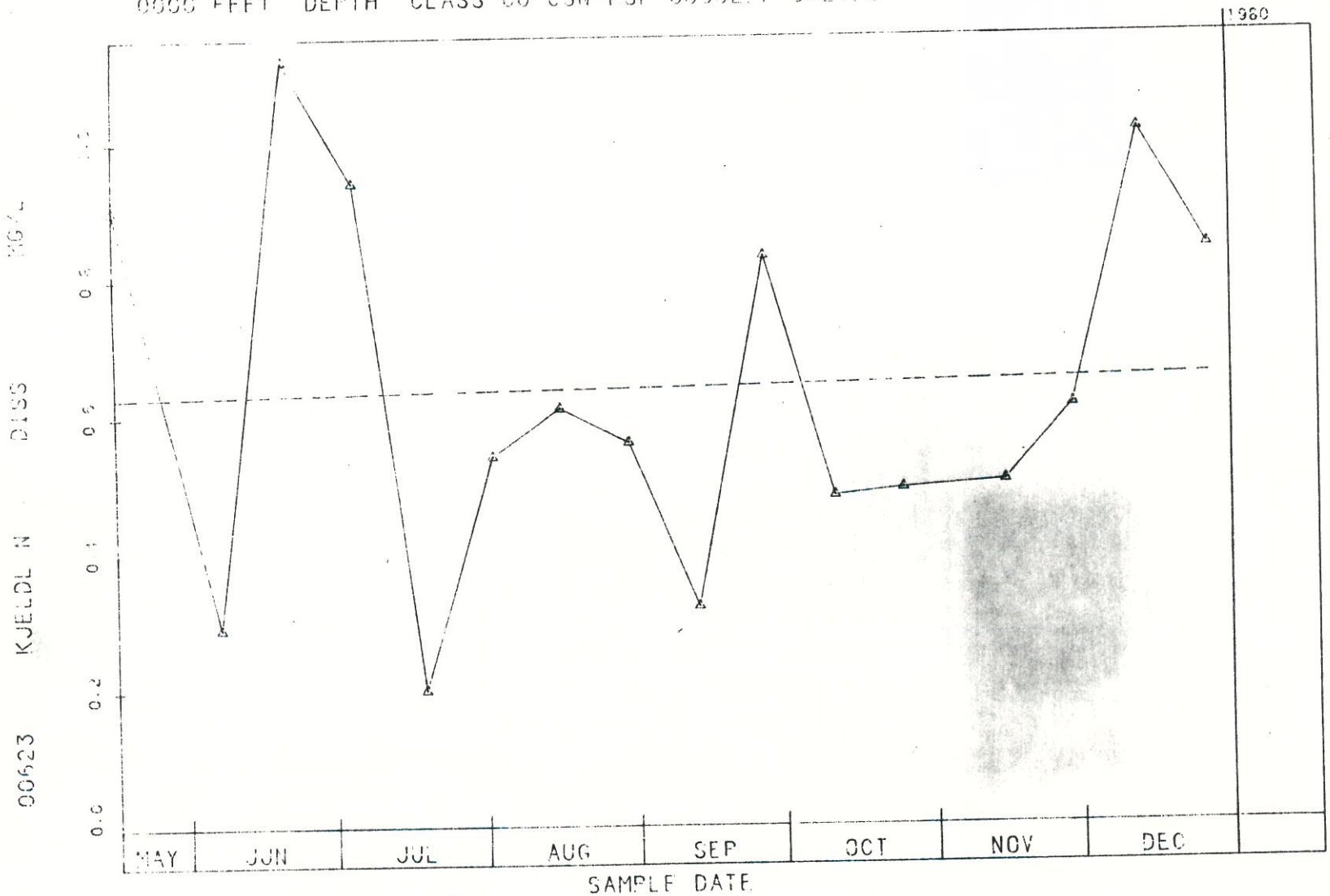

STORET
46P107
45 31 01.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 OSN-RSP 0596276-0624706
1960
00623 KJELDL N TOTAL MG/L
0.0
0.3
0.6
0.9
1.2
1.5
1.8
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 79/5 /17

Figure IV-10.

STORET
46P108
45 30 03.0 097 16 05.0 2
PICKEREL/INLAKE E SHORE T124N R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-PSP 0596277 0[illegible]24707



STARTING DATE 79/5 /17

Figure IV-11.

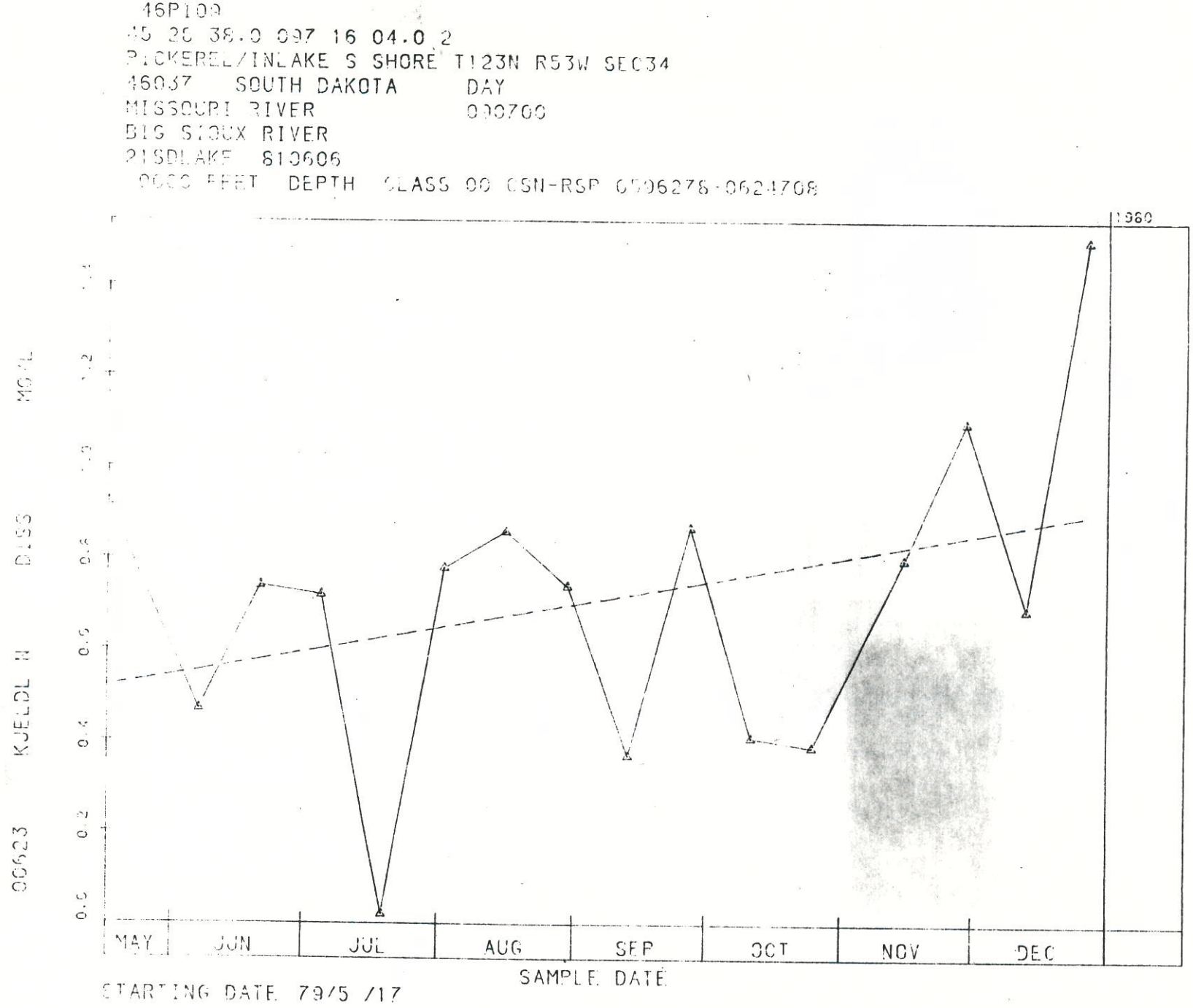

STORET
46P109
45 28 38.0 097 16 04.0 2
PICKEREL/INLAKE S SHORE T123N R53W SEC34
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 000700
BIG SIOUX RIVER
PISDLAKE 810606
0000 FEET DEPTH CLASS 00 OSN-RSP 0006278-0624708
1980
00623 KJELDL N DISS MG/L
0.0
0.2
0.4
0.6
1.2
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 79/5 /17

Figure IV-12.

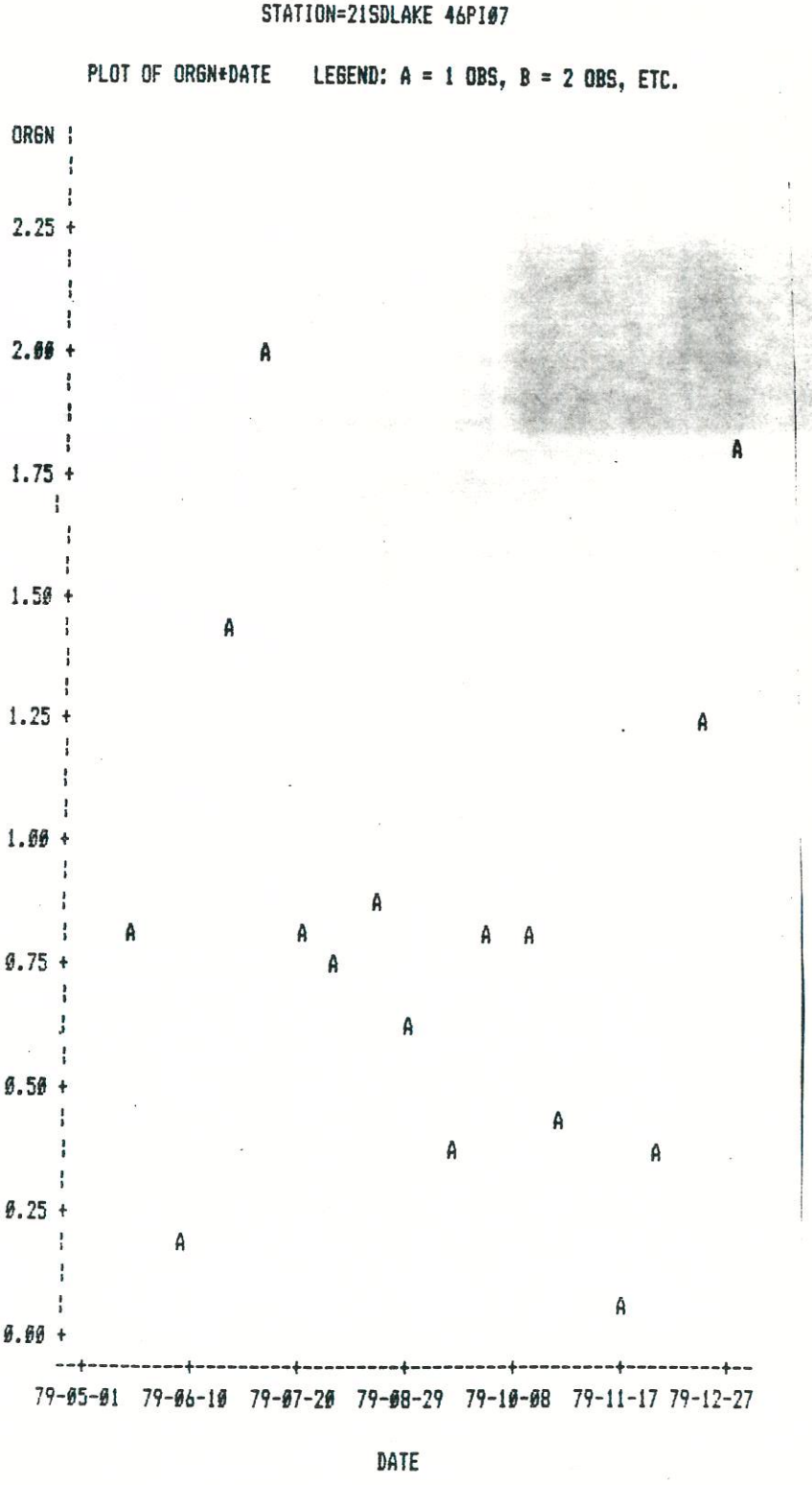

STATION=21SDLAKE 46PI07
PLOT OF ORGN*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
ORGN
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
79-05-01 79-06-10 79-07-20 79-08-29 79-10-08 79-11-17 79-12-27
DATE

Figure IV-13.

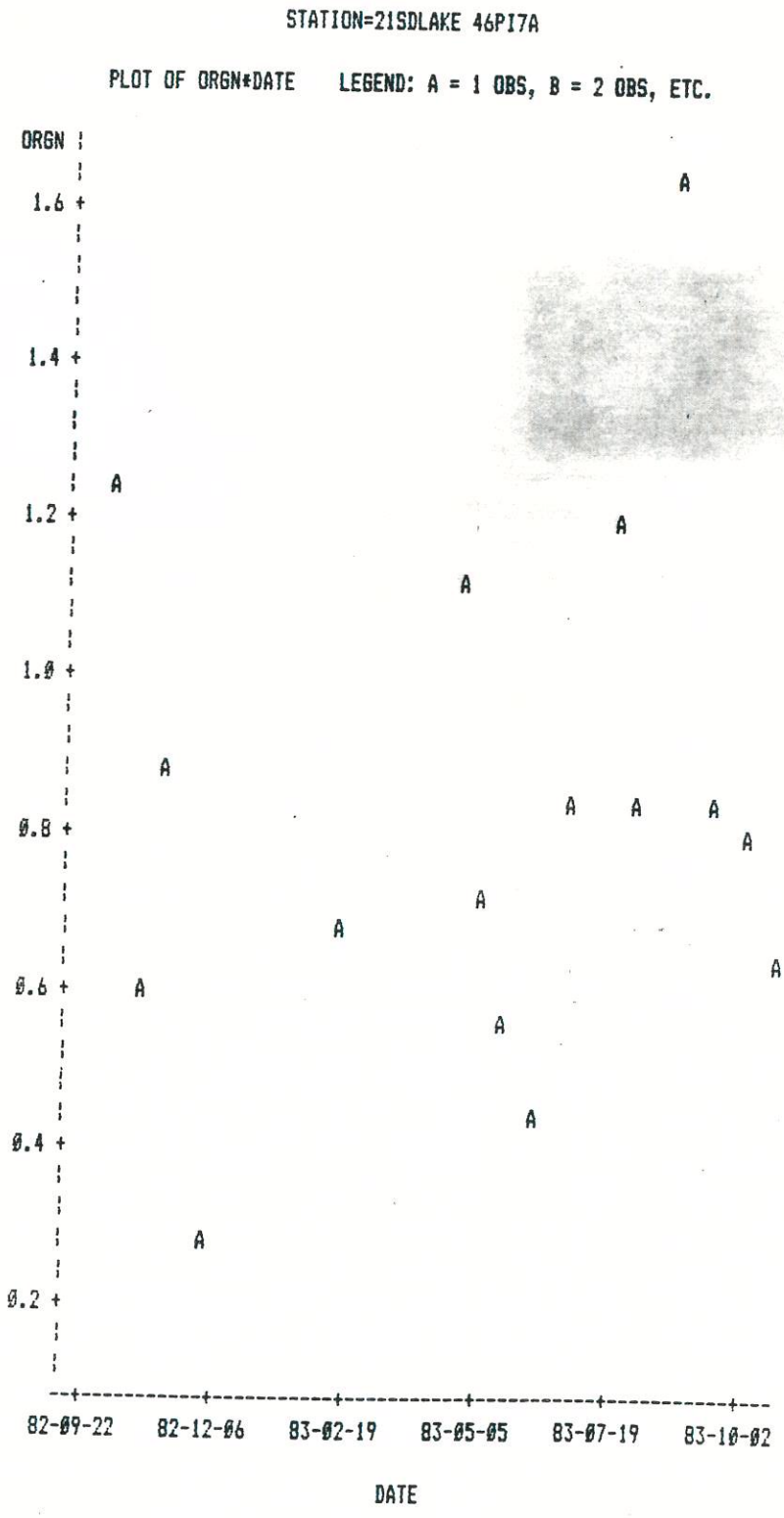

STATION=21SDLAKE 46PI7A
PLOT OF ORGN*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
ORGN
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
82-09-22
82-12-06
83-02-19
83-05-05
83-07-19
83-10-02
DATE

Figure IV-14.

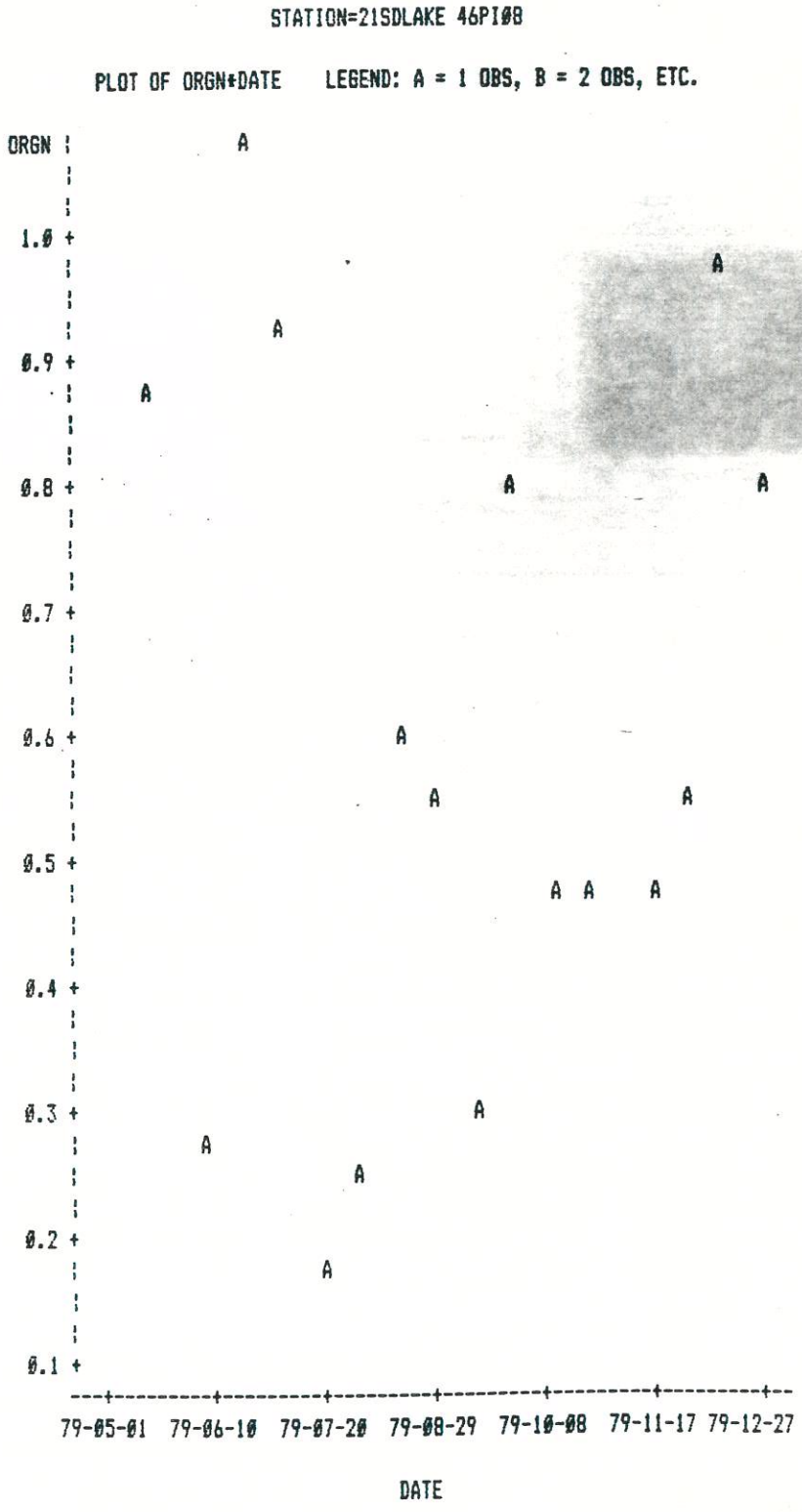

STATION=21SDLAKE 46PI08
PLOT OF ORGN*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
ORGN
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
79-05-01 79-06-10 79-07-20 79-08-29 79-10-08 79-11-17 79-12-27
DATE

Figure IV-15.

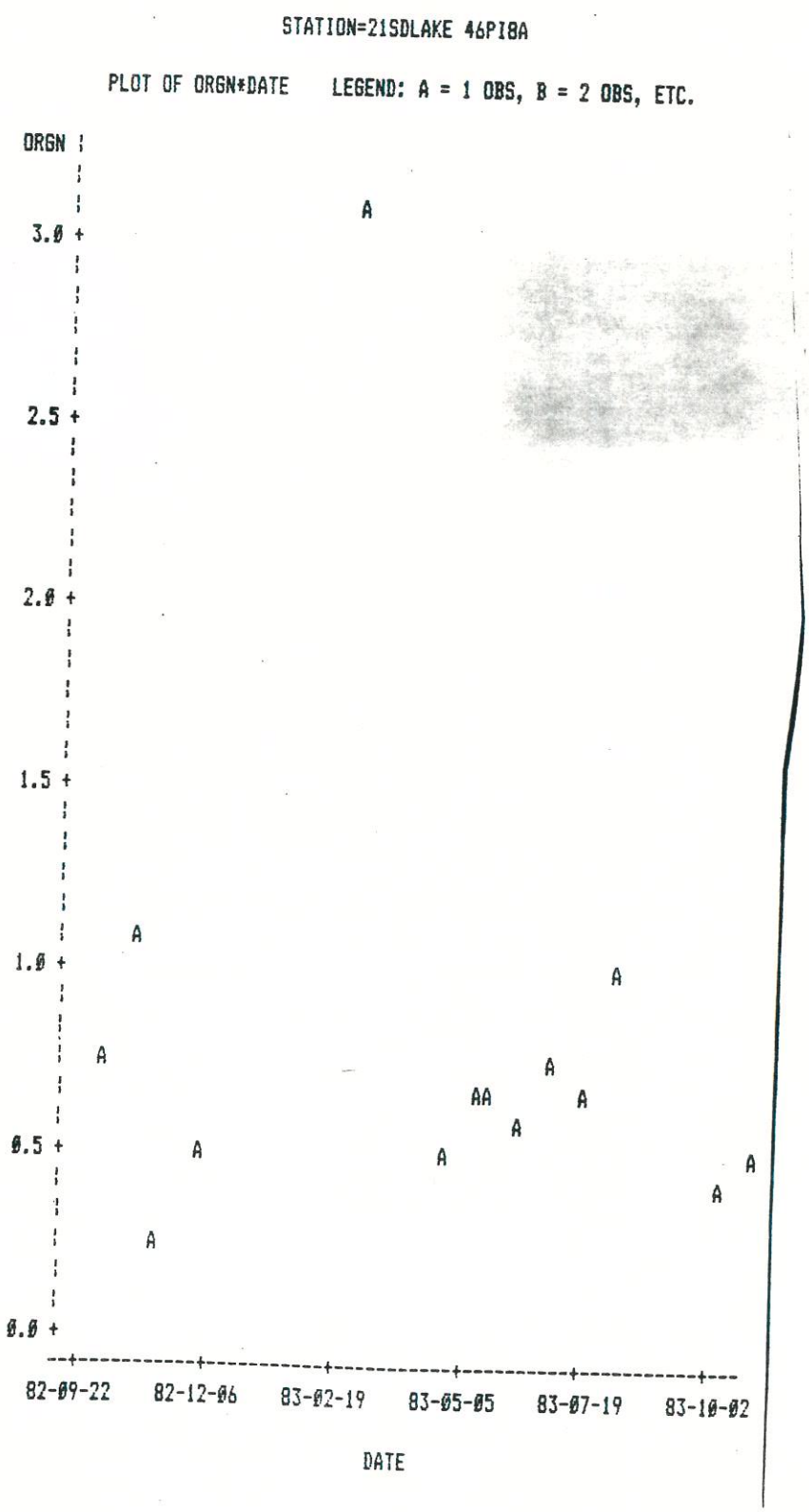

STATION=21SDLAKE 46P18A
PLOT OF ORGN*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
ORGN
3.0
2.5
2.0
1.5
1.0
0.5
0.0
82-09-22
82-12-06
83-02-19
83-05-05
83-07-19
83-10-02
DATE

Figure IV-16.

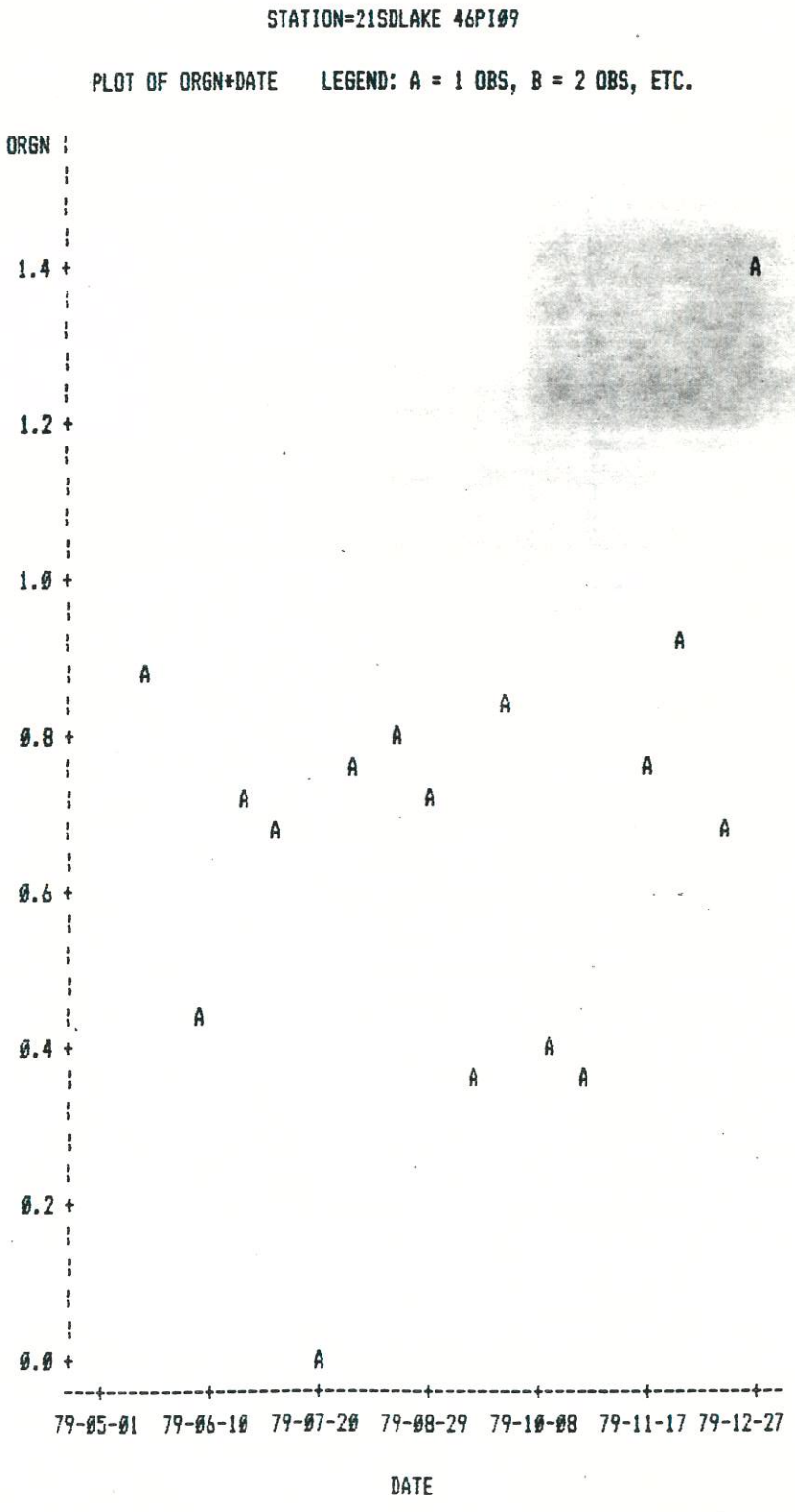

STATION=21SDLAKE 46PI09
PLOT OF ORGN*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
ORGN
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
79-05-01 79-06-10 79-07-20 79-08-29 79-10-08 79-11-17 79-12-27
DATE

Figure IV-17.

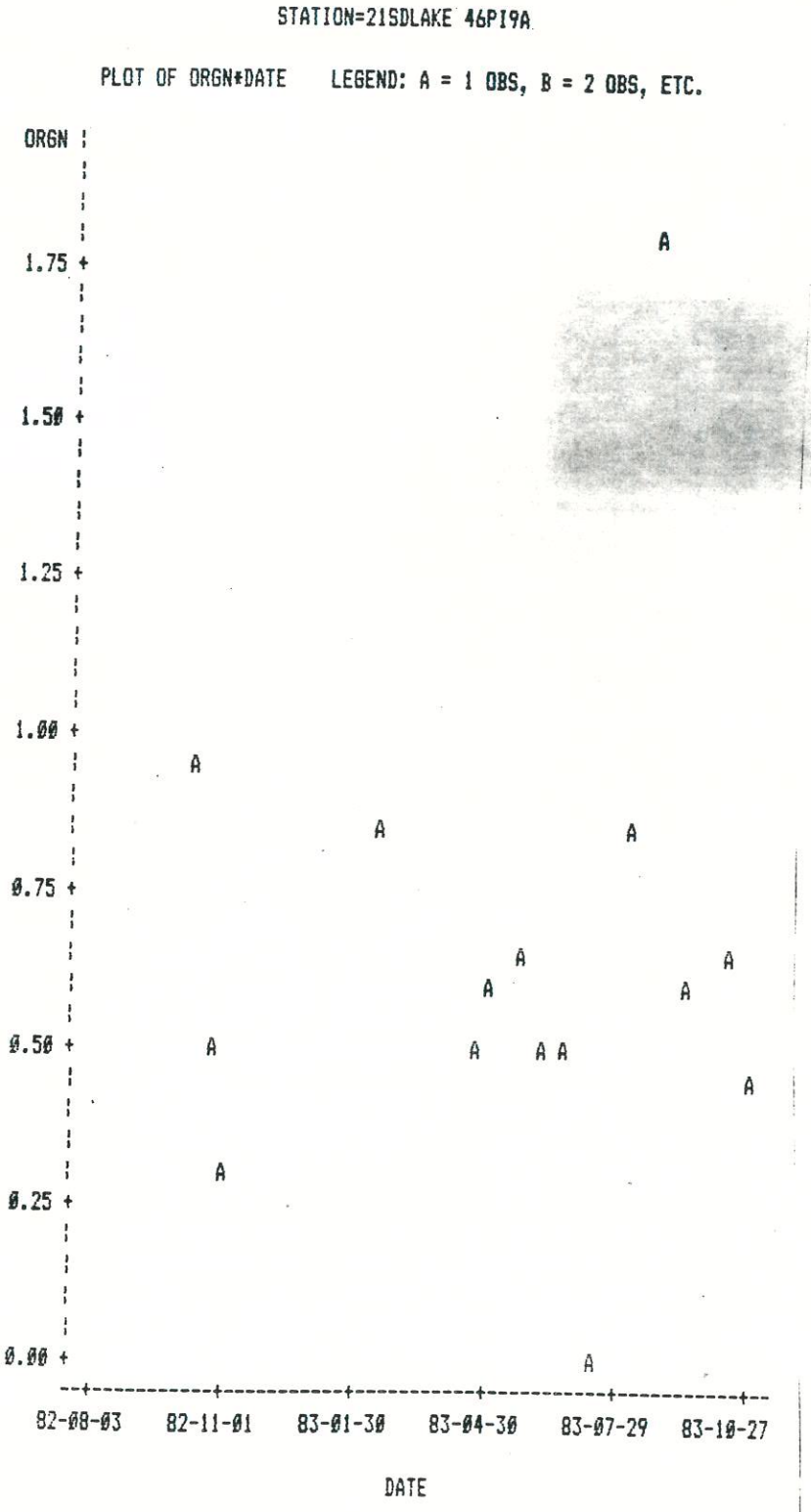

STATION=21SDLAKE 46PI9A
PLOT OF ORGN*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
ORGN
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
82-08-03
82-11-01
83-01-30
83-04-30
83-07-29
83-10-27
DATE

Figure IV-18.

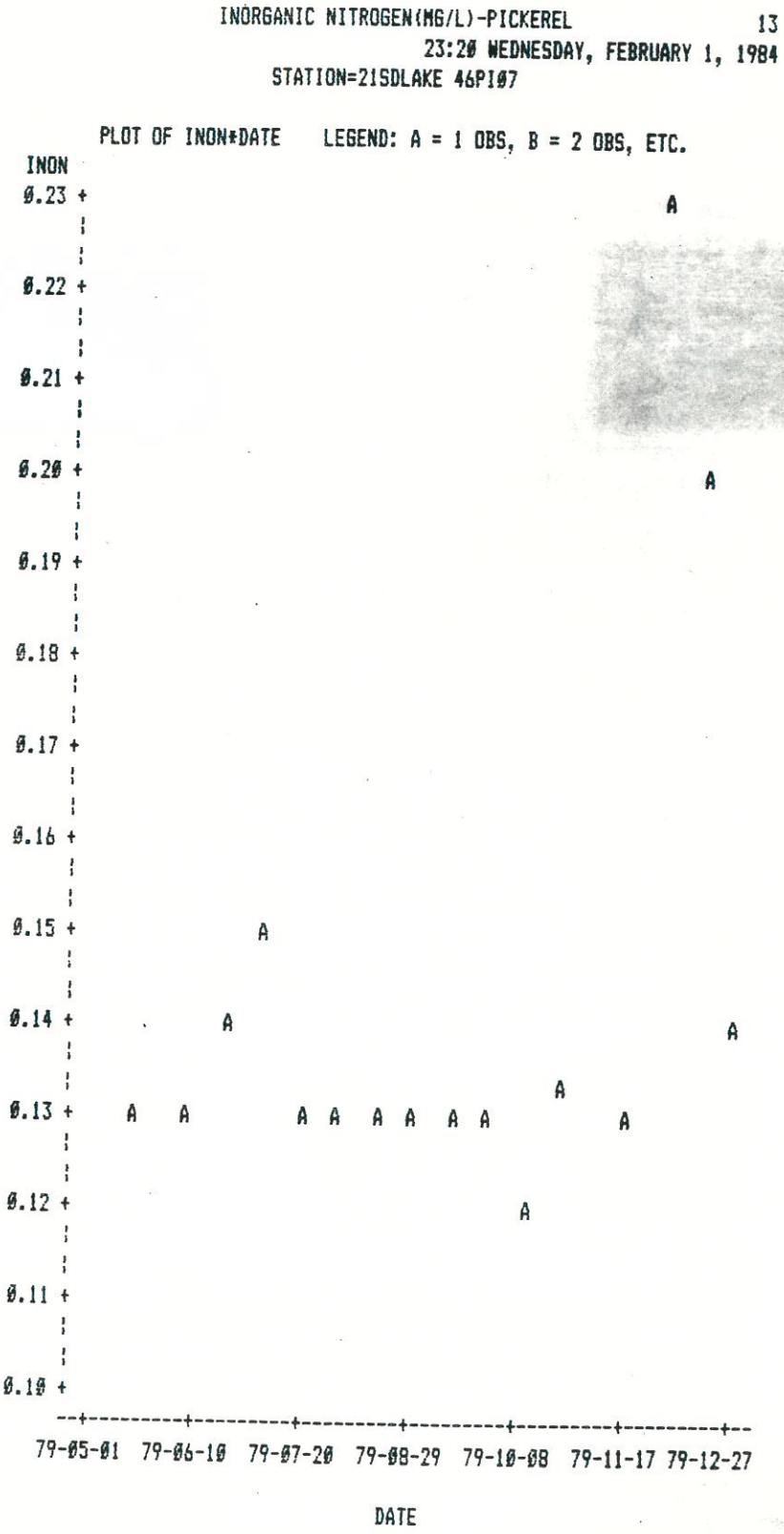

INORGANIC NITROGEN(MG/L)-PICKEREL 13
23:20 WEDNESDAY, FEBRUARY 1, 1984
STATION=21SDLAKE 46PI07
PLOT OF INON*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
INON
0.23
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
79-05-01 79-06-10 79-07-20 79-08-29 79-10-08 79-11-17 79-12-27
DATE

Figure IV-19.

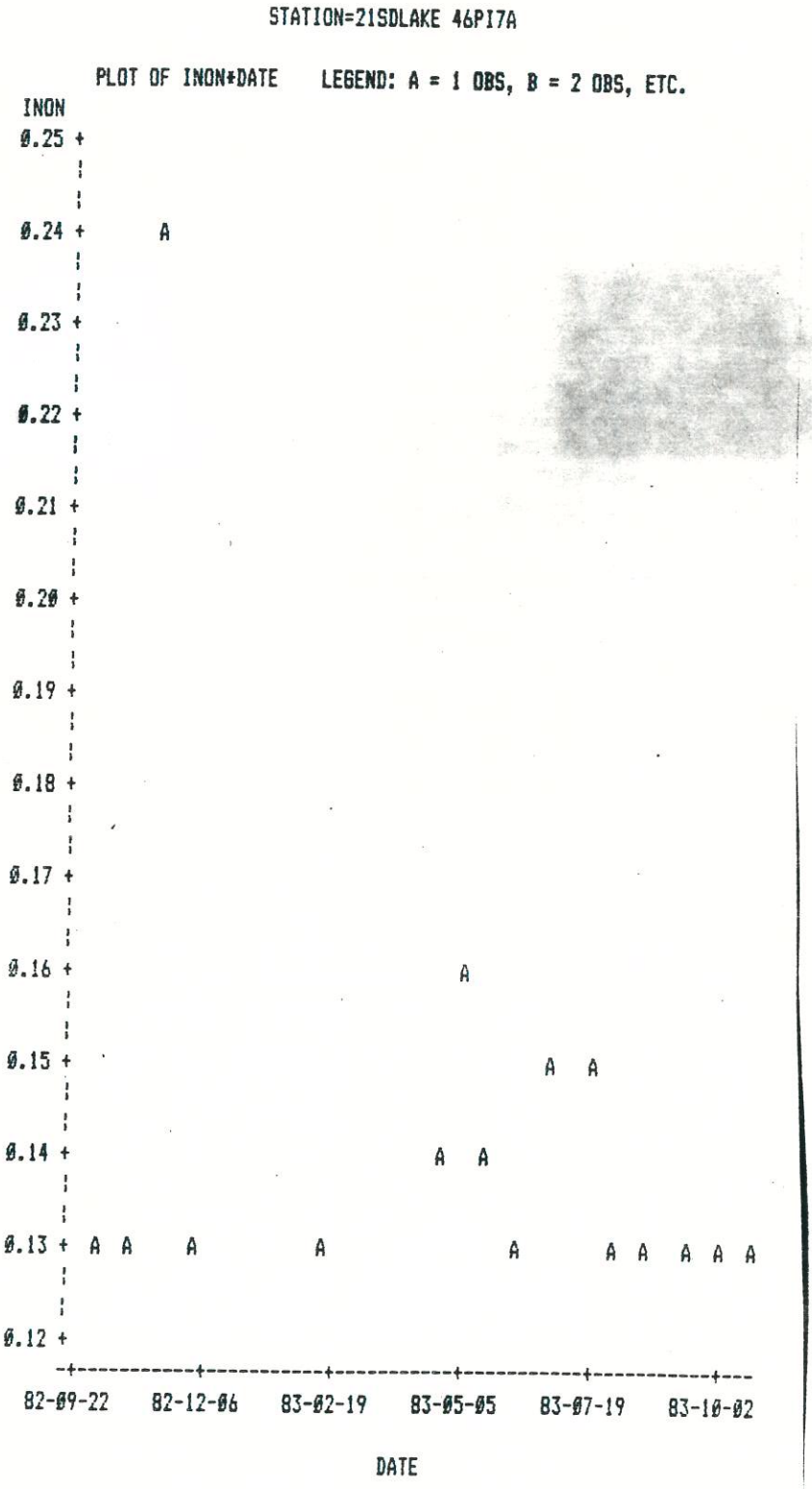

STATION=21SDLAKE 46PI7A
PLOT OF INON*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
INON
0.25
0.24
0.23
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
82-09-22
82-12-06
83-02-19
83-05-05
83-07-19
83-10-02
DATE

Figure IV-20.

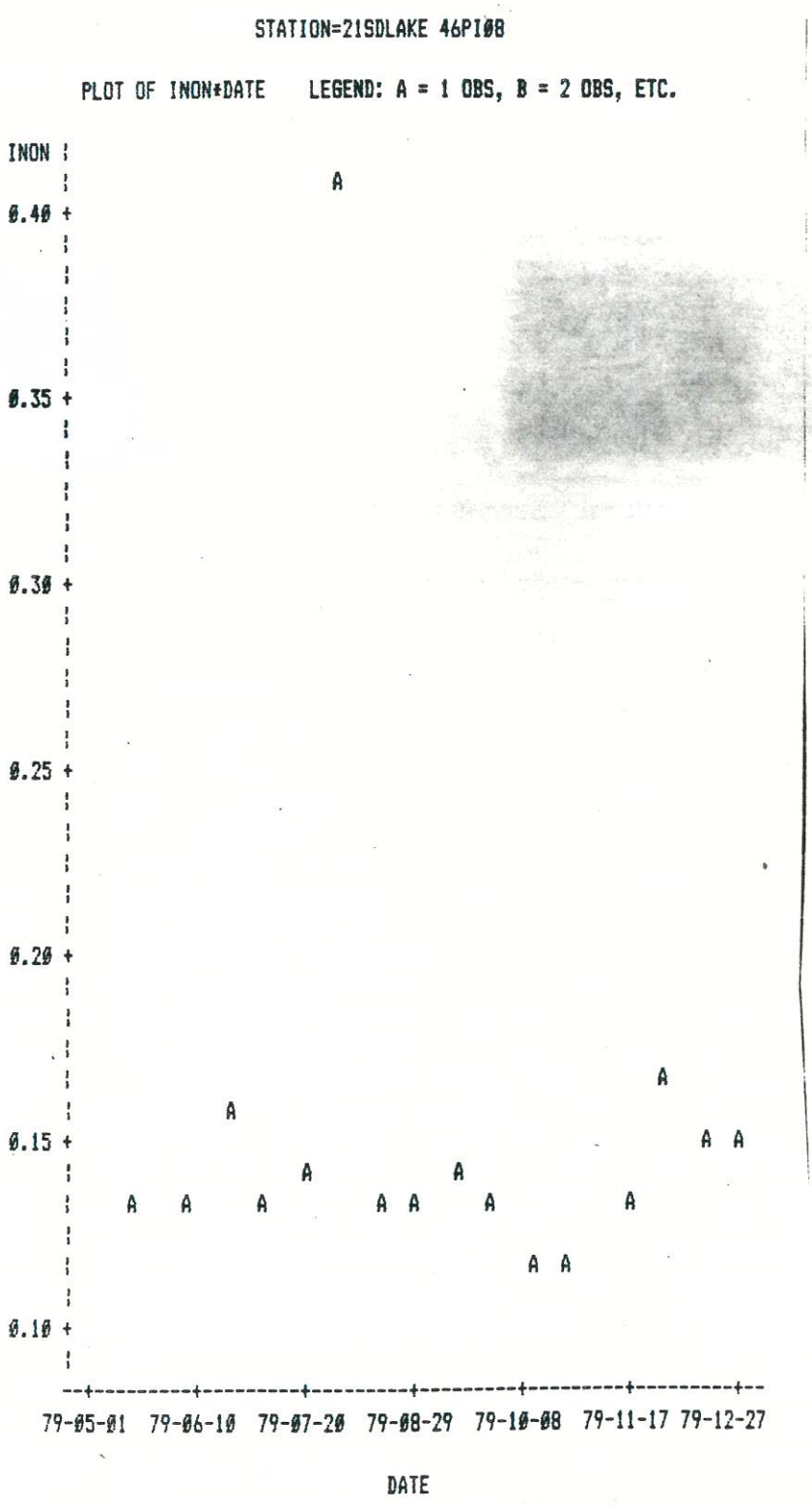

STATION=21SDLAKE 46PI08
PLOT OF INON*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
INON
0.40
0.35
0.30
0.25
0.20
0.15
0.10
79-05-01
79-06-10
79-07-20
79-08-29
79-10-08
79-11-17
79-12-27
DATE

Figure IV-21.

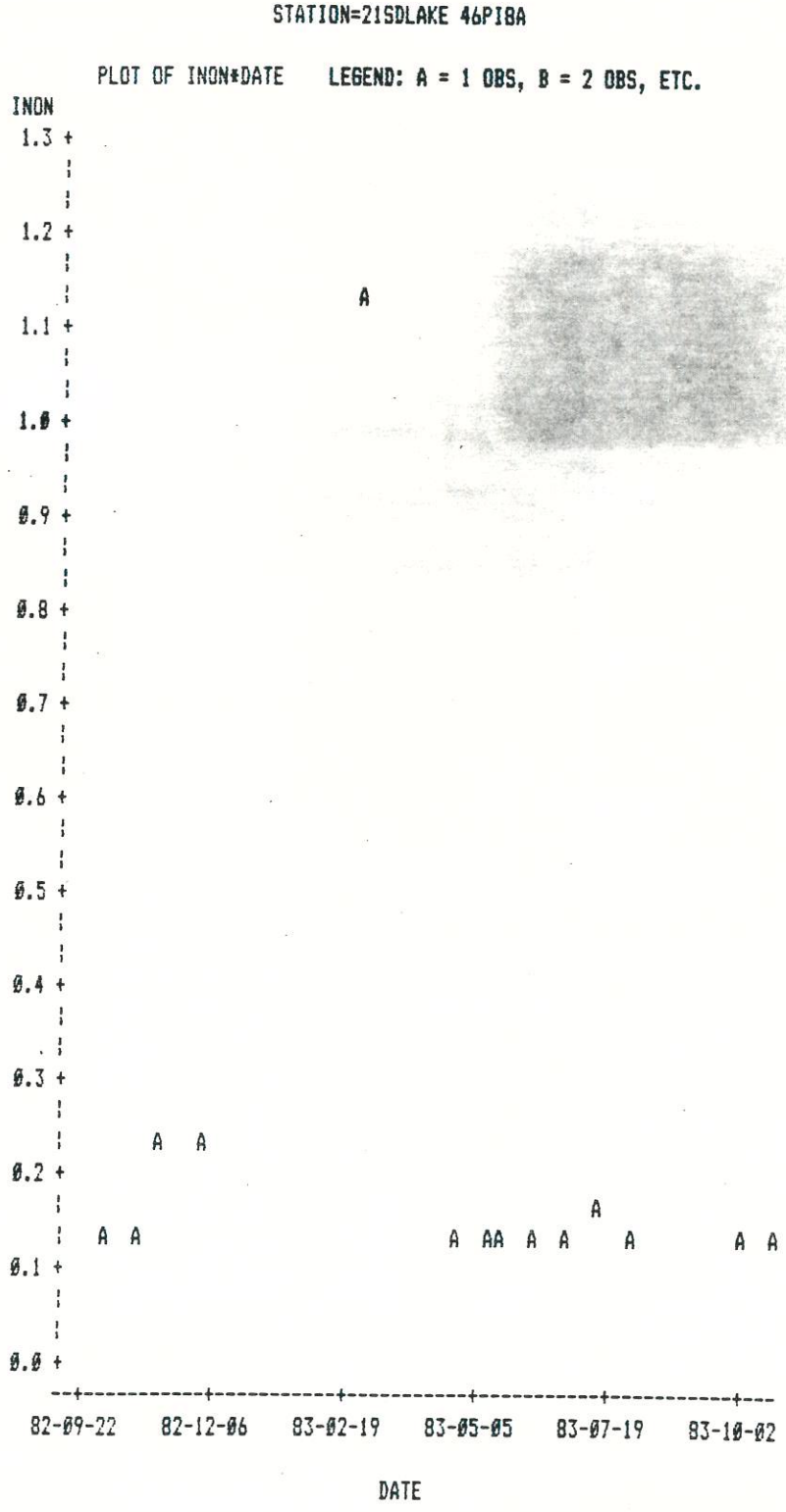

STATION=21SDLAKE 46PI8A
PLOT OF INON*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
INON
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
82-09-22
82-12-06
83-02-19
83-05-05
83-07-19
83-10-02
DATE

Figure IV-22.

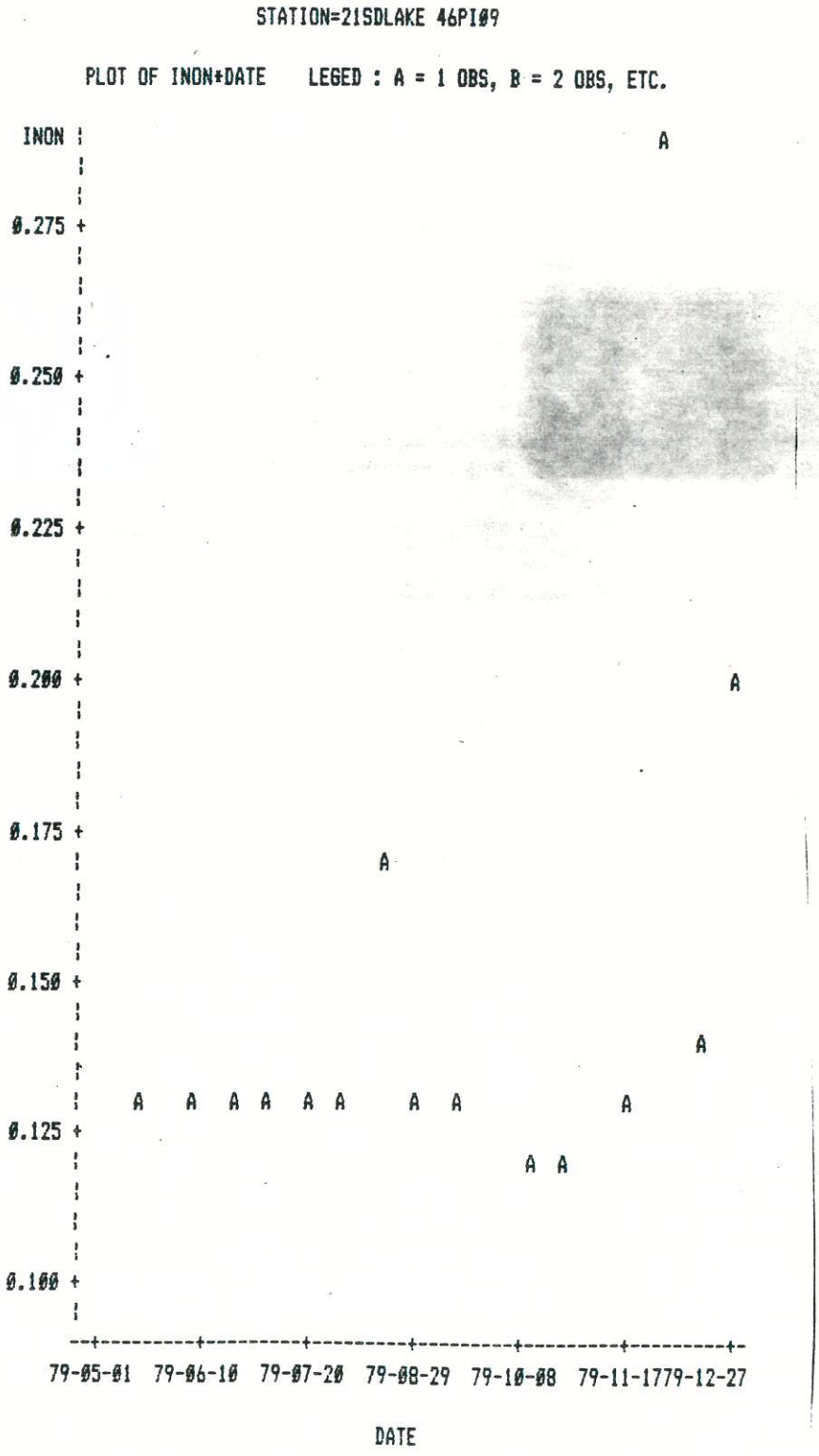

STATION=21SDLAKE 46PI09
PLOT OF INON*DATE LEGED : A = 1 OBS, B = 2 OBS, ETC.
INON
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
79-05-01 79-06-10 79-07-20 79-08-29 79-10-08 79-11-17 79-12-27
DATE

Figure IV-23.

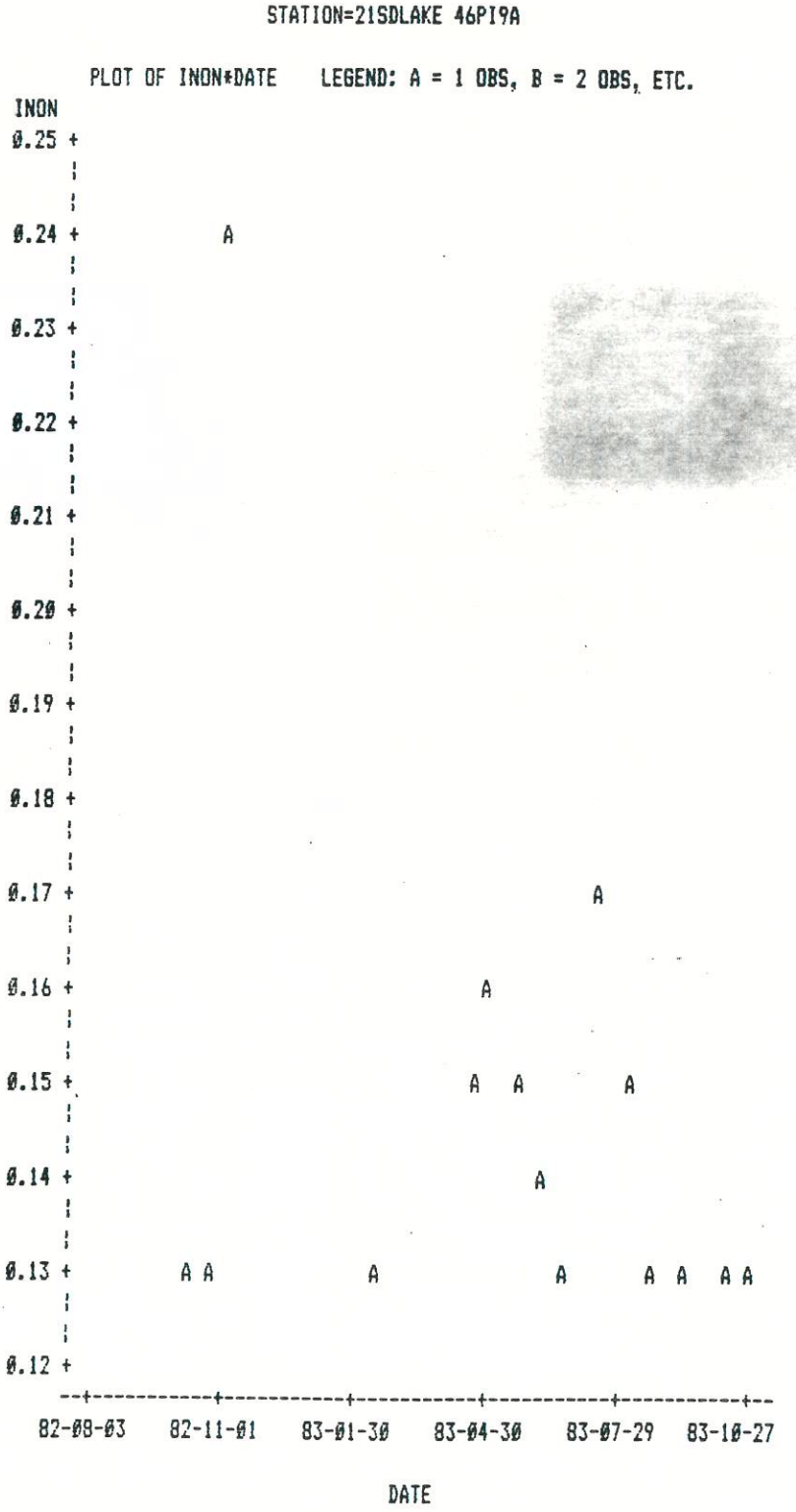

STATION=21SDLAKE 46PI9A
PLOT OF INON*DATE LEGEND: A = 1 OBS, B = 2 OBS, ETC.
INON
0.25
0.24
0.23
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
82-08-03
82-11-01
83-01-30
83-04-30
83-07-29
83-10-27
DATE

Figure IV-24.

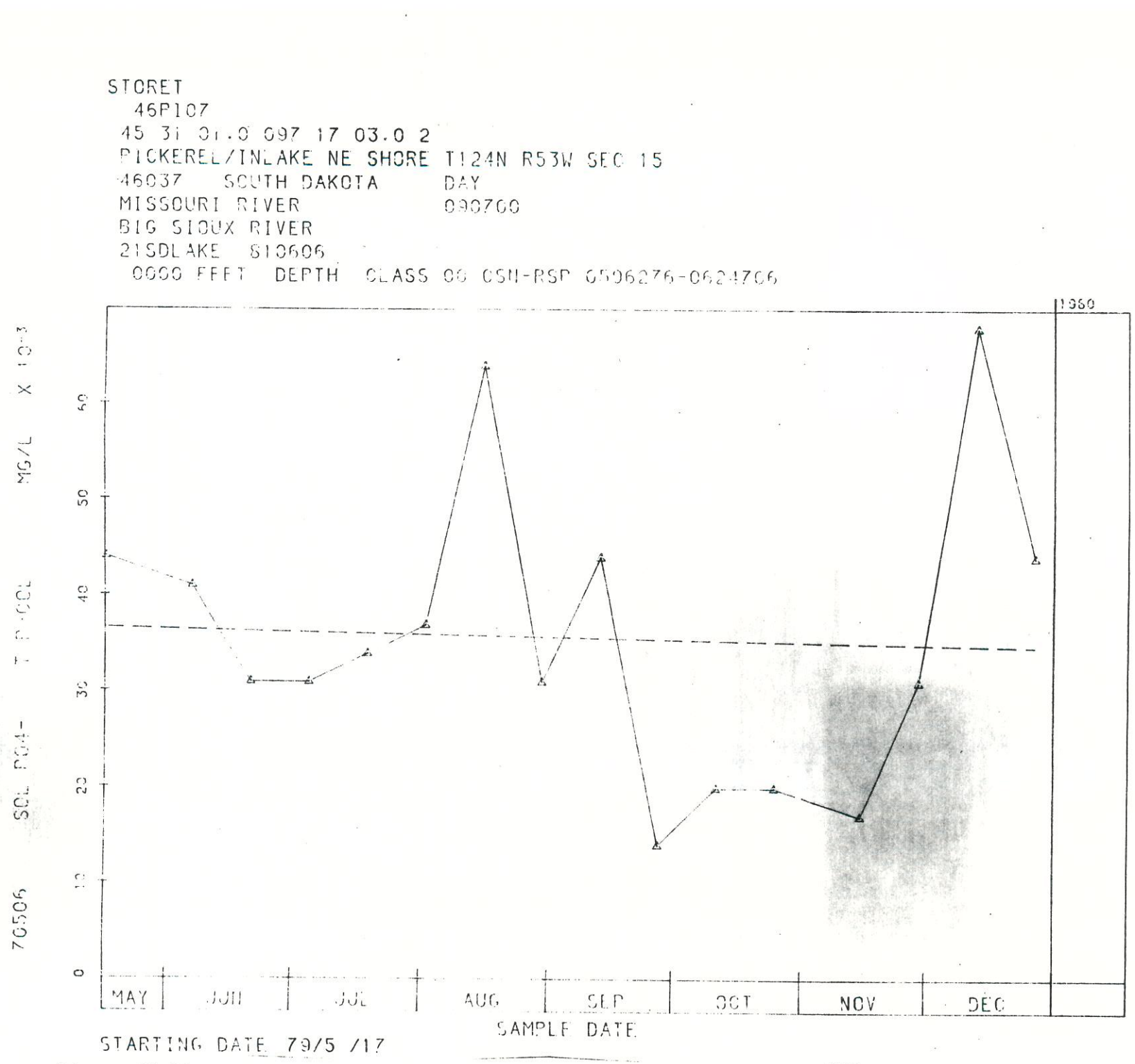

STORET
46P107
45 31 01.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 OSN-RSP 0506276-0624706
1980
70506 SOL PO4- T P 00L MG/L X 10-3
0
10
20
30
40
50
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 79/5 /17

Figure IV-25.

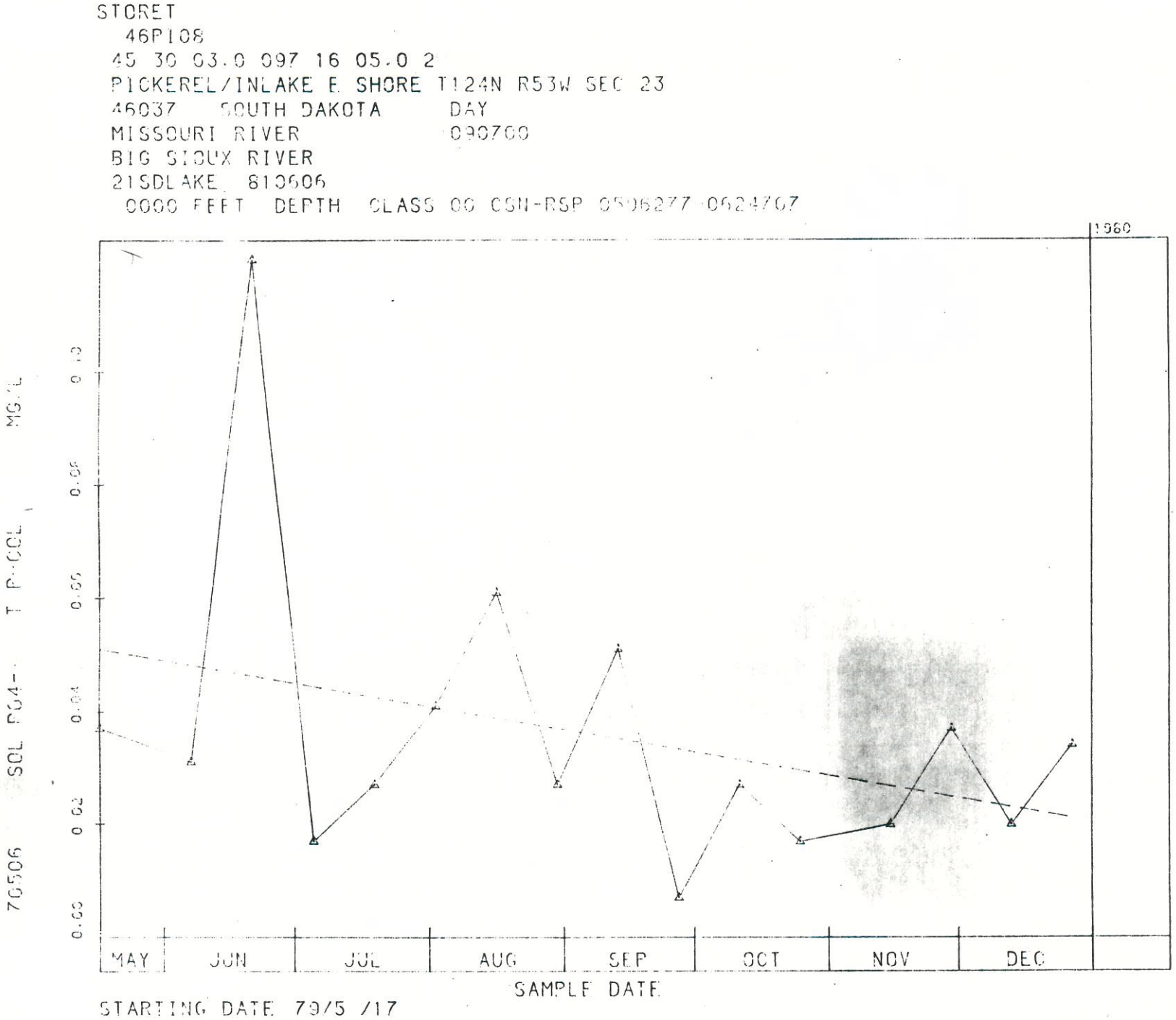

STORET
46P108
45 30 03.0 097 16 05.0 2
PICKEREL/INLAKE E SHORE T124N R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0506277 0624707
1980
70506 SOL PO4- T P-COL MG/L
0.10
0.08
0.06
0.04
0.02
0.00
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 79/5 /17

Figure IV-26.

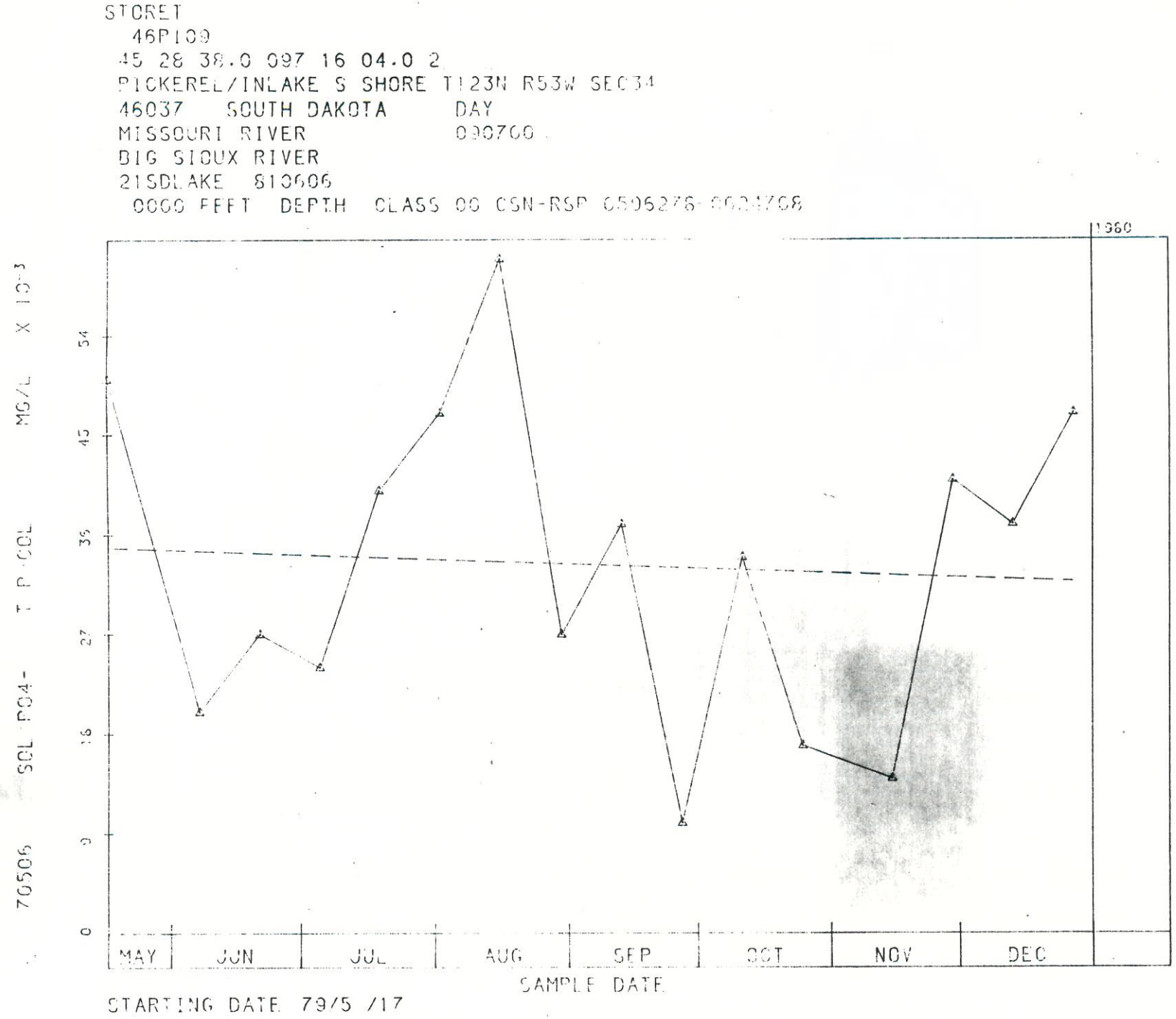

STORET
46P109
45 28 38.0 097 16 04.0 2
PICKEREL/INLAKE S SHORE T123N R53W SEC34
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0506276-0624708
1360
70506 SOL PO4- T P COL MG/L X 10-3
0
9
18
27
36
45
54
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 79/5 /17

Figure IV-27.

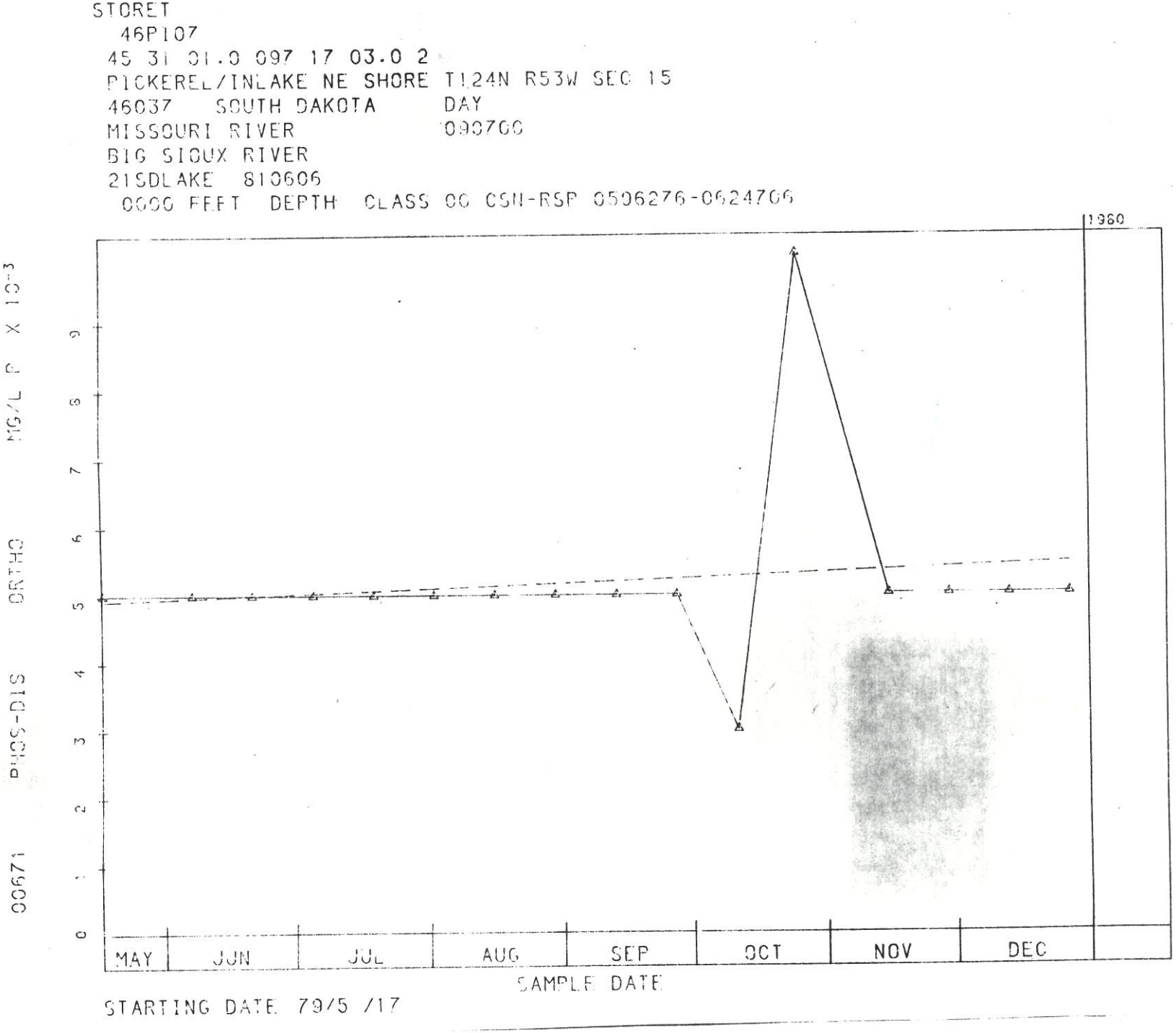
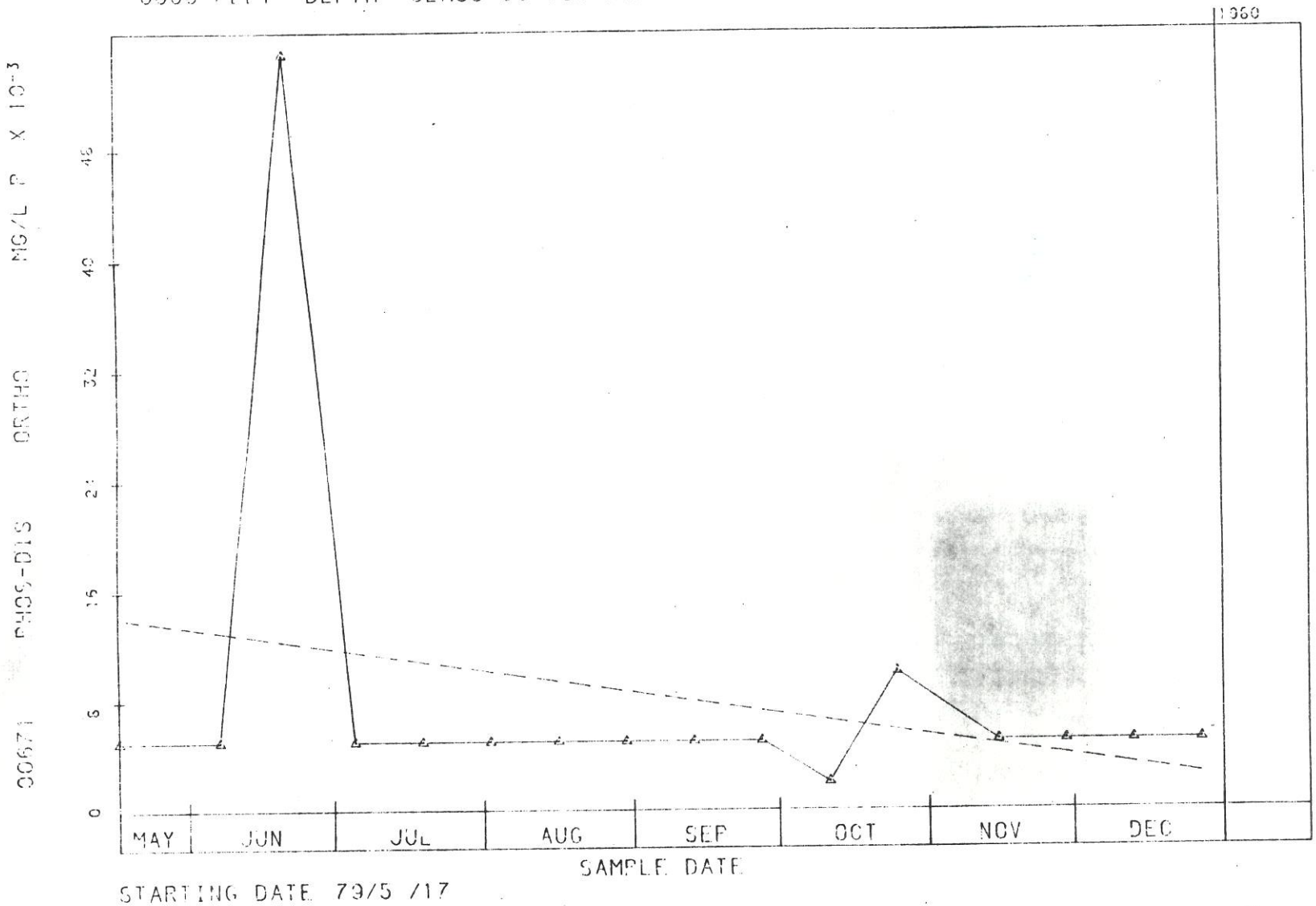

STORET
46P107
45 31 01.0 097 17 03.0 2
PICKEREL/INLAKE NE SHORE T124N R53W SEC 15
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596276-0624706
1980
00671 PHOS-DIS ORTHO MG/L P X 10-3
0
1
2
3
4
5
6
7
8
9
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
SAMPLE DATE
STARTING DATE 79/5 /17

Figure IV-28.

STORET
46P108
45 30 03.0 097 16 05.0 2
PICKEREL/INLAKE E SHORE T124N R53W SEC 23
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 090700
BIG SIOUX RIVER
21SDLAKE 810606
0000 FEET DEPTH CLASS 00 CSN-RSP 0596277 0624707



STARTING DATE 79/5 /17

Figure IV-29

STORET
46P109
45 28 38.0 097 16 04.0 2
PICKEREL/INLAKE S SHORE T123N R53W SEC34
46037 SOUTH DAKOTA DAY
MISSOURI RIVER 000709
BIG SIOUX RIVER
21SDLAKE S10606
0000 FEET DEPTH CLASS 00 OSN-RSD 0506278-0624708