DIAGNOSTIC/FEASIBILITY STUDY

LAKE KAMPESKA

CODINGTON COUNTY, SOUTH DAKOTA

South Dakota Clean Lakes Program
Division of Water Resources Management
South Dakota Department of
Environment and Natural Resources
Russell L Stone, Acting Secretary

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Prepared By

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EXECUTIVE SUMMARY

Lake Kampeska is a 4,817-acre (1,950-hectare) lake located entirely within the City limits of Watertown, South Dakota. The Big Sioux River is the inlet/outlet to the lake. The Lake Kampeska watershed encompasses 212,707 acres (86,146 hectares) of the Big Sioux River drainage basin. Because the natural outlet from the lake was blocked in the 1940's, the Big Sioux River now acts as the only outlet from the lake.

In July, 1991, the South Dakota Department of Environment and Natural Resources (SD DENR) began a Phase I Diagnostic/Feasibility (D/F) Study at the request of the Kampeska Chapter of the Izaak Walton League. The purpose of the study was to assess the water quality of the lake and its tributaries. The study was also intended to identify sources of nutrients and sediment that are causing the lake's degradation, and to propose feasible restoration alternatives to improve water quality in the watershed and the lake.

Tributary monitoring equipment was installed during the fall of 1991, and watershed sampling began in the spring of 1992. Water quality monitoring of the lake began in October, 1991. Water samples were collected by a local employee of the SD DENR, with assistance from members of the Kampeska Chapter of the Izaak Walton League. The tributaries in the watershed were monitored primarily during spring snowmelt runoff, and following major rainstorm events. Samples were also taken periodically during base flow conditions. The in-lake water samples were collected bi-weekly from April to September, and monthly from October to March. Both tributary and in-lake samples were sent to the State Health Laboratory in Pierre, South Dakota, for analysis.

The D/F Study included use of the Universal Soil Loss Equation (USLE) for analysis of the watershed. The USLE was used to estimate soil losses from subwatershed areas in the Lake Kampeska watershed. The information required for the USLE was mainly collected by employees of the Soil Conservation Service (SCS), with assistance from local volunteers.

Like almost all lakes of the Prairie Coteau region, Lake Kampeska has experienced water quality problems due in part to its shallow depth. The shallow depth of the lake results in high turbidity caused by re-suspension of bottom sediments from boat motors, the wind, and bottom-feeding fish. Algae blooms and loadings of sediment from the tributaries add to the turbidity problem. The high levels of turbidity give the water a cloudy, or dirty, appearance. Because of the high turbidity there is an absence of macrophytes, or aquatic weeds. Emergent vegetation presently covers less than five percent of the shoreline, and submergent vegetation is sparse to non-existent.

In spite of high turbidity levels, frequent blooms of nuisance blue-green algae occur in Lake Kampeska. The blue-green algal species form floating mats typical of nutrient-rich lakes. The mats of algae accumulate along the shoreline and decompose. The resulting odors from decomposition are often quite offensive. In 1993 the intake pipe from the lake, which supplements the City of Watertown's water supply, was shut down for several weeks due to treatment problems and odors caused by nuisance algal blooms.

In-lake sampling results indicate that Lake Kampeska is hypereutrophic. Hypereutrophic is a term which means the lake has an overabundance of nutrients. Nutrients such as nitrogen and phosphorus are used by algae and macrophytes for growth and reproduction. The high levels of nutrients are most likely originating from extensive agricultural practices in the watershed. An analysis of the watershed indicated that over 94% of the watershed area is in agricultural use. The nutrients are carried into the lake mainly through the inlet channel from the Big Sioux River. Although there is a strong hydraulic connection between Lake Kampeska and the Big Sioux Aquifer, nutrient concentrations in the ground water are very low compared to the concentrations found during the surface water monitoring program in the watershed. Therefore, ground water recharge of Lake Kampeska is not considered a significant source of nutrients.

The water quality monitoring of the tributaries showed high concentrations of phosphorus, nitrogen, and solids. Loadings of these materials into the lake were found to be the greatest during periods of high water flow. High flows occurred twice during the D/F Study. The first time was in June, 1992, following extensive rainfall events. The second occurrence was during the spring snowmelt runoff in March and April, 1993. Both of these flooding events caused poor water quality in the tributaries, and resulted in high loadings of sediment and nutrients into Lake Kampeska. High fecal coliform bacteria results were also found during periods of high flow. The most probable sources of the high fecal coliform bacteria results were feedlots. An aerial survey indicated that there are at least 75 livestock feeding operations in the watershed. Other possible sources of fecal coliform bacteria in the watershed may be overflows or discharges from septic wastewater systems into ditches, waterways, and field tiles. Time and resources did not permit an analysis of the impact from failing or improperly constructed septic systems in the watershed. The septic systems immediately around the lake itself were replaced by a sanitary sewer system in the mid-1970's.

Because the inlet from the Big Sioux River into Lake Kampeska also serves as the lake outlet, it is difficult at times to determine whether water is flowing into or out of the lake. This is especially true because of the width (175 feet or 53.3 meters) and depth (12 feet or 3.7 meters) of the inlet channel. Despite these complications, quite accurate measurements were made of flows into and out of the lake during the D/F Study. By combining flow measurements with water quality concentrations, loadings of sediment and nutrients could also be calculated. The results of these calculations indicate that Lake Kampeska is acting as a sediment and nutrient retention basin for the Big Sioux River watershed.

The in-lake water quality monitoring program showed high levels of nutrients and solids. In addition, a sediment survey of the lake bottom indicated an accumulation of over 52 million cubic yards of silt. In water depths greater than 12 feet (3.7 meters), the average sediment depth is over nine feet (2.7 meters) deep. A shoreline survey indicated that despite extensive efforts in the past, there are still many areas of shoreline erosion ranging from minor to severe problems. Over 2,000 feet (908 meters) of shoreline areas around the lake have erosion. These erosion areas are directly contributing sediment to the lake.

Based on the results of the D/F Study, the recommendations below are suggested to help control the loadings of sediment, nutrients, and other materials into Lake Kampeska:

Primary Activities

1) Lake shoreline stabilization/management
2) Construction of small ponds and dams on watershed tributaries
3) Construction/repair of grassed waterways in cropland fields
4) Planting of vegetative filter strips/grass seedings along watershed streams
5) Construction of animal waste management systems
6) Streambank stabilization/riparian area management on watershed tributaries
7) Information/Education program to promote Best Management Practices
8) Wetland restoration on prior converted wetlands or farmed wetlands
9) Promotion of the Conservation Reserve Program (CRP)
10) Identification and correction of failing septic systems in the watershed area
11) Investigation into the feasibility of constructing a flow control structure to divert water away from Lake Kampeska during periods of high flow

Secondary Activities

12) Selective in-lake sediment removal
13) Economically feasible methods of flood control in the Big Sioux River drainage basin
14) Investigation into the feasibility of constructing a new lake outlet

The primary and secondary activities listed are the recommendations which the South Dakota Department of Environment and Natural Resources suggest are the best solutions to the water quality problems identified in this report.

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"There are no marshes or muddy banks about it, but both beach and bottom are composed of gravel and sand, so clean that the most violent gale does not soil its crystal waters in the least... . The water of this magnificent lake is not only pure to look upon, but it is as fine tasting and wholesome to drink as spring water;"

Thus was Lake Kampeska described in a 1916 promotional booklet. During the 1920's and 1930's, Lake Kampeska became more and more developed with summer cottages. Some local residents can remember the lake being murky and unclear since the mid-1930's, and it has not been "crystal clear" ever since.

The 1940's and 1950's brought additional problems for the lake as siltation increased due to agricultural practices in the watershed, and development around the lake continued at a rapid pace. By the end of the 1950's, such practices as running raw sewage directly from the cabins to the lake were causing serious water quality problems. "Dog days" could last for weeks, usually in August, when the lake looked like green pea soup due to excessive algae blooms.

Growth around the lake continued in the 1960's, 1970's, and 1980's. By the 1990's, lake lots were nearly impossible to find. Although Lake Kampeska was annexed into the city limits of Watertown in 1974-1975, and city water and sewer services were provided to lake residents, the pressures of extensive development were taking their toll. Intensive agricultural practices in the lake's 212,707-acre (525,348-hectare) watershed were resulting in siltation and high nutrient levels in the lake.

Out of concern for the future of the lake, the Kampeska Chapter of the Izaak Walton League conducted a sediment depth survey during the winters of 1989-1990 and 1990-1991 to determine the extent of siltation. The results of the survey indicated that over 36% of the lake volume was filled with silt. In addition, it was found that 83% of the lake contains measurable silt deposits, and 64% of the lake had silt deposits in excess of 9 feet (2.7 meters) deep.

With this information, the Izaak Walton League applied for a U. S. Environmental Protection Agency (EPA) grant, through the South Dakota Department of Environment and Natural Resources (DENR), to conduct a Diagnostic/Feasibility (D/F) Study of Lake Kampeska and its watershed. The EPA grant was approved on July 29, 1991, and the D/F Study was completed in June, 1993.

The D/F Study indicates that the great majority of the lake's water quality problems originate in the watershed area. A complicating factor is that the original lake outlet was blocked in the 1940's to build the Watertown airport. Consequently, the inlet of the Big Sioux River into the lake also serves as the outlet. This results in the lake acting as a surge pool for floods, with associated loadings of solids and nutrients.

This report will summarize the findings of the D/F Study, and will recommend alternatives for a Phase II Restoration Project for Lake Kampeska.

LAKE IDENTIFICATION AND LOCATION

Lake Name: Lake Kampeska

State: South Dakota

County: Codington County, South Dakota

Nearest Municipality: Watertown, South Dakota

Latitude: 44 Deg. 55 Min. 54 Sec. N

Longitude: 97 Deg. 12 Min. 12 Sec. W

EPA Region: VIII

Major Tributary: Big Sioux River

Receiving Body of Water: Big Sioux River

The Lake Kampeska Watershed is shown in Figure 1.

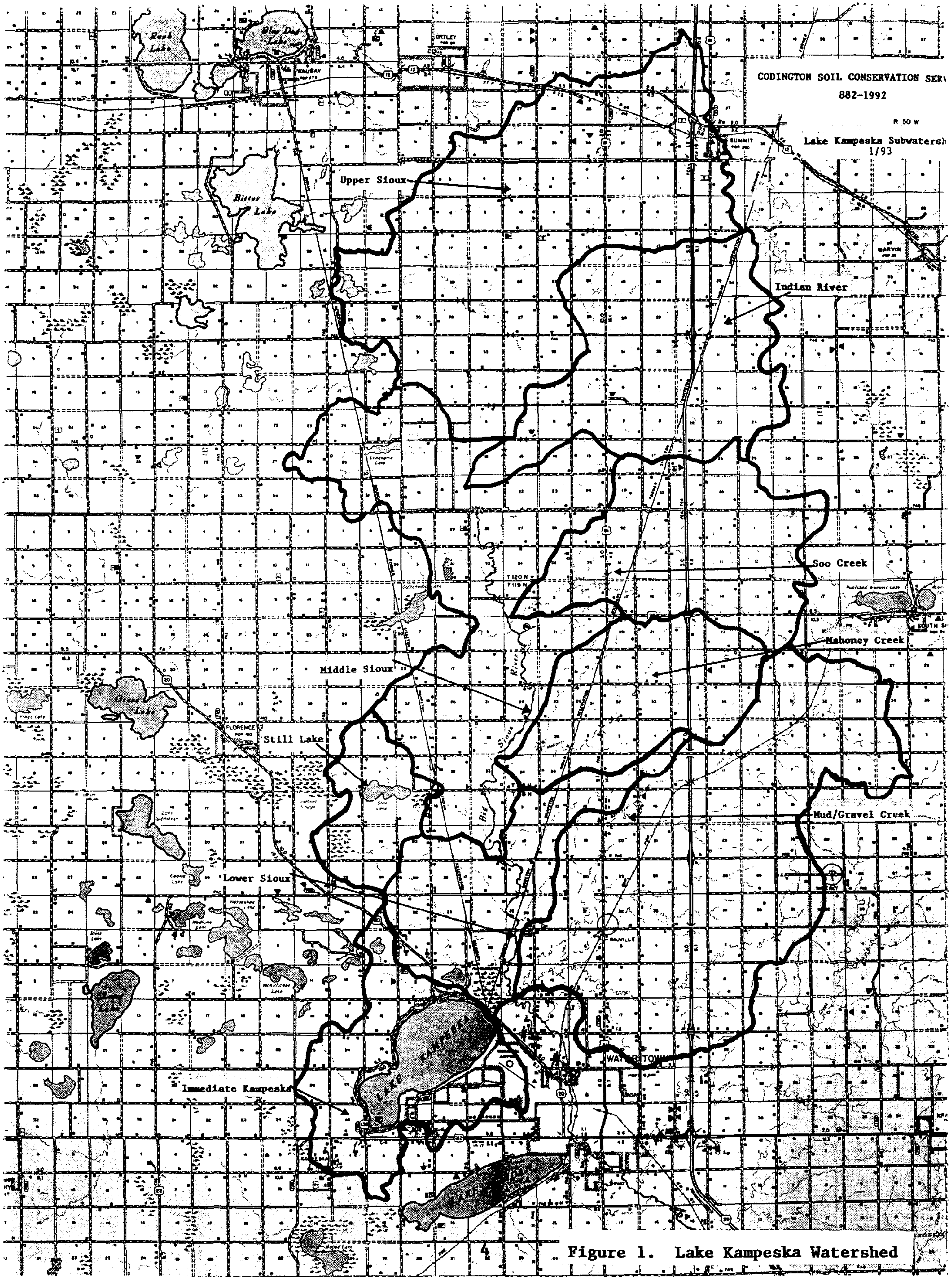


Figure 1. Lake Kampeska Watershed

Water Quality Standards

The water quality standards for Lake Kampeska are shown below:

1. Designated Uses

   a. Domestic Water Supply: waters which are suitable for human consumption, culinary or food processing purposes and other household purposes after suitable treatment by conventional processes.

   b. Warmwater Permanent Fish Life Propagation: lakes and streams which support aquatic life and are suitable for the permanent propagation or maintenance, or both, of warmwater fish.

   c. Immersion Recreation: waters which are suitable for uses where the human body may come in direct contact with the water, to the point of complete submersion and where water may be ingested accidentally or where certain sensitive organs such as the eyes, ears, and nose may be exposed to water.

   d. Limited Contact Recreation: waters which are suitable for boating, fishing, and other water related recreation other than immersion recreation where contact may be made with the water but the person's eyes, mouth, and ears would not likely be immersed.

   e. Wildlife Propagation and Stock Watering: streams and lakes which are satisfactory as habitat for aquatic and semi-aquatic wild animals and fowl and are of suitable quality for watering domestic and wild animals.

2. Applicable Criteria

   Water quality criteria for the maintenance of these beneficial uses are shown in Table 1, Lake Kampeska Water Quality Standards.

Table 1. Lake Kampeska Water Quality Standards

Parameter	Standard
Total Dissolved Solids	<1000 mg/L
Nitrates	<10 mg/L
pH	>6.5 & <9.0 units
Fecal Coliform Organisms	<200 per 100 mL
Barium	<1 mg/L
Chloride	<250 mg/L
Sulfate	<500 mg/L
Total Chlorine Residual	<0.02 mg/L
Un-ionized Ammonia	<0.04 mg/L
Dissolved Oxygen	>5.0 mg/L
Undisassociated Hydrogen Sulfide	<0.002 mg/L
Suspended Solids	<90 mg/L
Temperature	<80 deg. F
Total Alkalinity	<750 mg/L
Total Dissolved Solids	<2500 mg/L
Conductivity	<4000 micromhos/cm

GEOLOGICAL AND SOILS DESCRIPTION OF DRAINAGE BASIN

Geology

Lake Kampeska is a natural lake of glacial origin (Rothrock, 1933). Its existence is due to the action of glacial ice which covered northeastern South Dakota in the geologic past. Surficial deposits in the Lake Kampeska study area can be divided into two main groups--(1) glacial deposits and (2) stream deposits (Barari, 1971).

Glacial deposits: During the Pleistocene Epoch of geologic time, ice moved into the Lake Kampeska area and deposited glacial drift. Drift can be divided into till and outwash deposits. Till consists of a heterogeneous mixture of boulders, pebbles, and sand in a matrix of clay and silt directly deposited by the ice. Outwash material, on the other hand, is a sorted deposit consisting of mostly sand and gravel with minor amounts of clay deposited by meltwater streams originating from the ice.

Stream deposits: The Big Sioux River and some of its tributaries have deposited alluvium in their channels. Alluvium in the study area consists of sand, gravel, and clay.

No bedrock is exposed in the Lake Kampeska study area. Data obtained from well logs in the area indicate that Cretaceous sedimentary rocks underlie the glacial drift. These deposits in descending order are the Pierre Shale, Niobrara Marl, Carlile Shale, Greenhorn Limestone, Graneros Shale, and the Dakota Formation. Beneath the Dakota Formation are granitic rocks of Precambrian age.

Topography

The topography of the Lake Kampeska area ranges from nearly flat, well-drained, and gently undulating to rugged, poorly drained knob and kettle topography. Maximum relief in the study area is 150 feet with land elevations ranging from 1860 MSL northwest of the study area to 1710 MSL southeast of the study area.

The main stream in the area is the Big Sioux River which controls both surface and shallow ground water movement. Mud Creek (Gravel Creek), Mahoney Creek, Soo Creek, and the Indian River are tributaries to the

Big Sioux River in the Lake Kampeska watershed.

Soils

Glacial drift is the parent material of the soils in the watershed. The drift is approximately 500 feet thick over bedrock. Many of the watershed soils were formed in loess that overlies the drift while some others were formed in alluvium. The Soil Conservation Service has assigned the following general soils classifications for the Lake Kampeska watershed area (Soil Survey of Codington County, South Dakota, 1966).

1. Brookings-Kranzburg-Vienna Association

These soils are well-drained, nearly level to gently undulating, silty soils formed in loess and loamy glacial till. In this association are soils on broad ridgetops and on long, smooth side slopes that end along drainageways. The drainageways empty into the Big Sioux River and its tributaries. The long, smooth slopes of this soil association are well suited to contour farming, contour stripcropping, and terracing, which can help to control runoff and erosion.

2. Estelline-Fordville-Renshaw Association

Soils in this association are well-drained, nearly level to gently sloping, medium-textured and moderately coarse textured soils underlain by sand and gravel. These soils are found on stream terraces and outwash plains. Conserving water and controlling wind erosion are major problems on these soils.

3. Lamoure-Rauville Association

This association consists of soils on the bottomlands of the Big Sioux River and its tributaries. These moderately fine textured soils are nearly level, somewhat poorly drained to very poorly drained, and occasionally flooded.

4. Poinsett-Buse-Parnell Association

A small amount of the soils in the Lake Kampeska watershed are of the Poinsett-Buse Association. Soils in this association are well-drained, undulating to rolling silty and loamy soils.

5. Poinsett-Waubay-Oldham Association

Soils in this association are nearly level or gently undulating and moderately fine to medium textured. Water which collects in these soils forms sloughs and lakes in closed depressions.

6. Vienna-Lismore

The soils in this association are deep and moderately well-drained, level to strongly sloping when adjacent to entrenched drainways. They are silty soils usually occurring in upland areas.

7. Renshaw-Fordville-Divide Association

This association consists of soils that are somewhat excessively drained to poorly drained, and that are nearly level to moderately steep. They are shallow to moderately deep, occurring over sands and gravels on upland areas and terraces.

8. LaDelle-Dovray-Playmoor

Soils of this association are deep, moderately to poorly drained, and level to nearly level. They are composed of soils that are silty with intermittent clay that occur on flood plains, low terraces, and upland flats.

9. Renshaw-Fordville

This association is made up of somewhat excessively to well-drained soils which occur in nearly level to steep areas. The soils in this association are shallow to moderately deep occurring over outwash sand and gravel.

10. Vienna

This association occurs mainly in the northern reaches of the Big Sioux River watershed in areas of well-drained, nearly level to sloping soils. soils of this association are silty and formed in loess and glacial till.

11. Forman-Buse-Parnell

This association is found in areas of undulating to rolling formations. Soils are medium to moderately fine textured, and are formed from clay loam and glacial till.

12. Buse-Barnes

This association is composed of loamy soils that are well drained, and rolling to steep. These soils are found primarily on moraines.

Hydrology of Lake Kampeska Watershed Basin

Information in this section was researched from documents published by the South Dakota Geological Survey. The documents -- Hydrology of Lake Kampeska (Barari, 1971) and Water Supplies and Geology of Lake Kampeska (Rothrock, 1933)--were reviewed to obtain the following information.

The water resources of Lake Kampeska include three main gravel channels which furnish the majority of the recharge to Lake Kampeska. One source which enters Lake Kampeska from the northwest originates one mile west of Medicine Lake. This channel, six miles (9.66 km) in length and averaging two miles (3.22 km) in width, contains a large amount of sand and gravel in which rainwater sinks readily and slowly moves southeastward into Lake Kampeska. A second channel follows the present Big Sioux River, and originates in lower Roberts county in the vicinity of Summit. Five miles (8.05 km) north of Lake Kampeska a side channel with an area of five square miles or more joins the Big Sioux channel. It may possibly extend further west as the valley it occupies can be traced past Florence where it is also gravel filled. A third channel enters the junction from the east following the course of Mud (Gravel) Creek. These gravels were evidently furnished by ice which lay in the vicinity of Punished Woman's Lake during the Pleistocene epoch of geologic time. At the mouth of this narrow channel, gravels were spread over an area of approximately fifteen square miles and joined the gravels of the other two channels a mile (1.61 km) southeast of Rauville. As the slope of these gravel deposits is southward, all water collecting in these channels eventually runs into the junction at Lake Kampeska. These channels recharge the lake through springs at the northeast end of the lake. When the water levels in the gravels reach a certain point, they raise the lake level to correspond to the level of water in the channels. Because of an extensive connection between the surface and ground water northeast of the lake, the quantity of ground water and surface water recharge cannot be differentiated. No channels enter the lake from the southwest as it is surrounded by long clay slopes which rise westward for a distance of a mile and a half (2.4 km). Water can also enter the lake through a channel which extends from the southeast section of the lake, although this area usually allows for the discharge of lake water through its large gravel beds.

Surface water recharge to the lake is accomplished through the Big Sioux River inlet/outlet located in the northern reaches of the lake. This recharge occurs mainly during the spring when large amounts of water flow down the Big Sioux River. This causes the lake to fill to capacity. Later water is diverted downstream after the lake and river levels stabilize. This causes a portion of the lake water to flow out, allowing the lake level to stabilize with the decreased level of the river. During periods of normal runoff the flow into and out of the lake is dependent upon ground water discharge as well as wind driven gradients across the lake. These wind gradients can force water out of, or allow water to enter, the lake on a very small scale (approximately 0.5 cfs).

Natural discharge from the lake is dependent upon the level of water in the gravel channels in the lake basin. If the water level in the channels is low, water is discharged out of the "outlet" gravel channel on the southeast side of the lake. If water levels in the lake are high enough, as in the spring after a flooding event, water can be discharged out of the Big Sioux River inlet/outlet on the northeast end of the lake. Normal evapotranspiration which occurs on Lake Kampeska can result in a loss of 33 inches (83 cm) of water per year (Kohler and others, 1959).

Artificial discharge from the lake takes place by the removal of municipal water by the City of Watertown. Currently the city obtains 36 to 45 percent (350 thousand gallons or 1.3 million liters per year) of its water supply from the lake. Additional sources of water include wells one mile (1.61 km) northeast of Lake Kampeska, as well as other sources within the City of Watertown.

DESCRIPTION OF PUBLIC ACCESS

Lake Kampeska has eight public access areas that have been developed to provide recreational opportunities such as boating, fishing, swimming, and camping. In addition, there are several other public access areas that are undeveloped, but which provide access to the lake for activities such as shoreline fishing. The access areas are served by major city, county, and state roads, and are located on all sides of the lake (Figure 2, Public Access Map).

Approximately 170 acres (68.85 hectares) of land and two miles (3.22 km) of shoreline are included in the developed public access areas. The total shoreline area around the lake is 13.5 miles (21.72 km). Consequently, 15% of the total shoreline area is included in access areas. Descriptions of the ownership, size, and facilities of the access areas are included in Table 2, Description of Public Access Areas at Lake Kampeska.

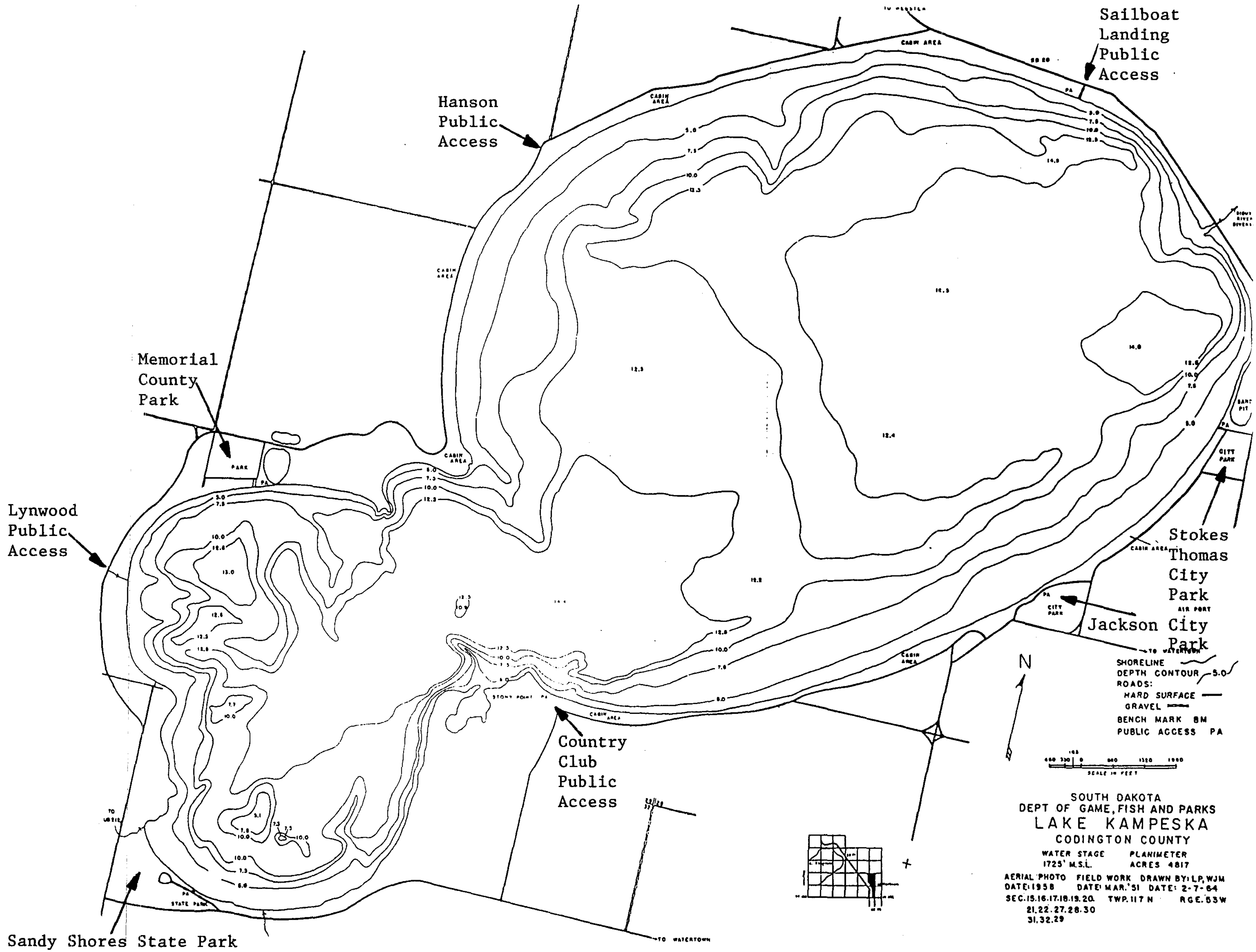


FIGURE 2. PUBLIC ACCESS MAP

Table 2. Description of Public Access Areas at Lake Kampeska

Name	Responsible Agency	Type	Land Area (ac.)	Lake Front (ft.)	Type and Capacity of Facilities
Sailboat Landing	SD Game, Fish & Parks	Boat Launch	1.5	222	28' ramp with dock, parking for 60 vehicles
Hanson	SD Game, Fish & Parks	Boat Launch	<1.0	75	12' ramp with dock, parking for 20 vehicles
Lynnwood	SD Game, Fish & Parks	Boat Launch	5.5	50	12' ramp with dock, parking for 20 vehicles
Sandy Shores State Park	SD Game, Fish & Parks	Boat Launch, 20 Camp Sites, Swimming Beach	8.0	1100	24' ramp with dock, parking for 20 vehicles
Memorial County Park	Codington County	Boat Launch, 65 Camp Sites, Swimming Beach, Picnicking	83.0	5000	28' ramp with dock, parking for 20 vehicles
Stokes Thomas City Park	City of Watertown	Boat Launch, 48 Camp Sites, Swimming Beach	37.0	1920	28' ramp with dock, parking for 80 vehicles
Jackson City Park	City of Watertown	Boat Launch, Swimming Beach	33.0	2060	28' ramp with dock, parking for 40 vehicles
Country Club Access	City of Watertown	Boat Launch	<1.0	30	12' ramp, no parking

Sources: South Dakota Game, Fish and Parks
City of Watertown, Park and Recreation Department

SIZE AND ECONOMIC STRUCTURE OF POTENTIAL USER POPULATION

Lake Kampeska lies within the City limits of Watertown, which is located in Codington County, South Dakota. In analyzing the size and economic structure of the potential user population for Lake Kampeska, it is helpful to examine the characteristics of the City of Watertown, Codington County, and the surrounding area.

A study of the City of Watertown and its surrounding trade area was completed by the State Data Center Division of the Business Research Bureau, School of Business, University of South Dakota, Vermillion, South Dakota, in September, 1992 (Dykstra, 1992). The "Watertown Trade Area Capture Study" provides demographic profiles and economic characteristics for the City of Watertown, Codington County, and the area surrounding Lake Kampeska.

Population Characteristics

South Dakota grew during the 1970's and continued to gain population during the decades of the eighty's and ninety's. However, that growth has been in pockets of the state. Only one in five of South Dakota's 66 counties grew between 1980 and 1990. Codington County was one of the growing areas in South Dakota during the 1980's with an 8.7 percent increase. The 1990 population of Codington County was 22,698, making it the fifth largest county in the State of South Dakota. The growth of Codington County during the 1980's was due to the population increase in the City of Watertown. Watertown grew at a rate of 12.4 percent between 1980 and 1990, giving it a 1990 population of 17,592. This ranks Watertown as the fourth largest City in the State of South Dakota.

Figure 3, Watertown Trade Area Map, shows the primary retail trade area for the City of Watertown. The estimated 1990 trade area population was 65,274. Although the trade area map is mainly used to give an indication of the retail area for the City of Watertown, it also gives a good indication of the potential user population for Lake Kampeska.

As discussed later in this report, the recreational facilities at Lake Kampeska compare very favorably to the facilities at other lakes in the region. It is assumed that the population within the Watertown trade area is probably willing to drive the same distance for excellent water-based recreational opportunities as they are for favorable retail trade opportunities. Therefore, the potential user population for Lake Kampeska includes not only the populations of the fifth largest county and fourth largest city in the state, but also the Watertown trade area population of over 65,000 people.

Economic Characteristics

The economic characteristics of the potential user population for Lake Kampeska are best portrayed by the socio-economic data from the 1990 Census for the City of Watertown. The number of persons in Watertown's labor force has increased by 19.5 percent from 7,506 in 1980 to 8,966 in 1990. This increase has resulted from more women and men entering the labor force. This differs from the South Dakota trend where the number of males in the labor force declined while the number of females increased for an overall labor force increase of 7.6 percent during the

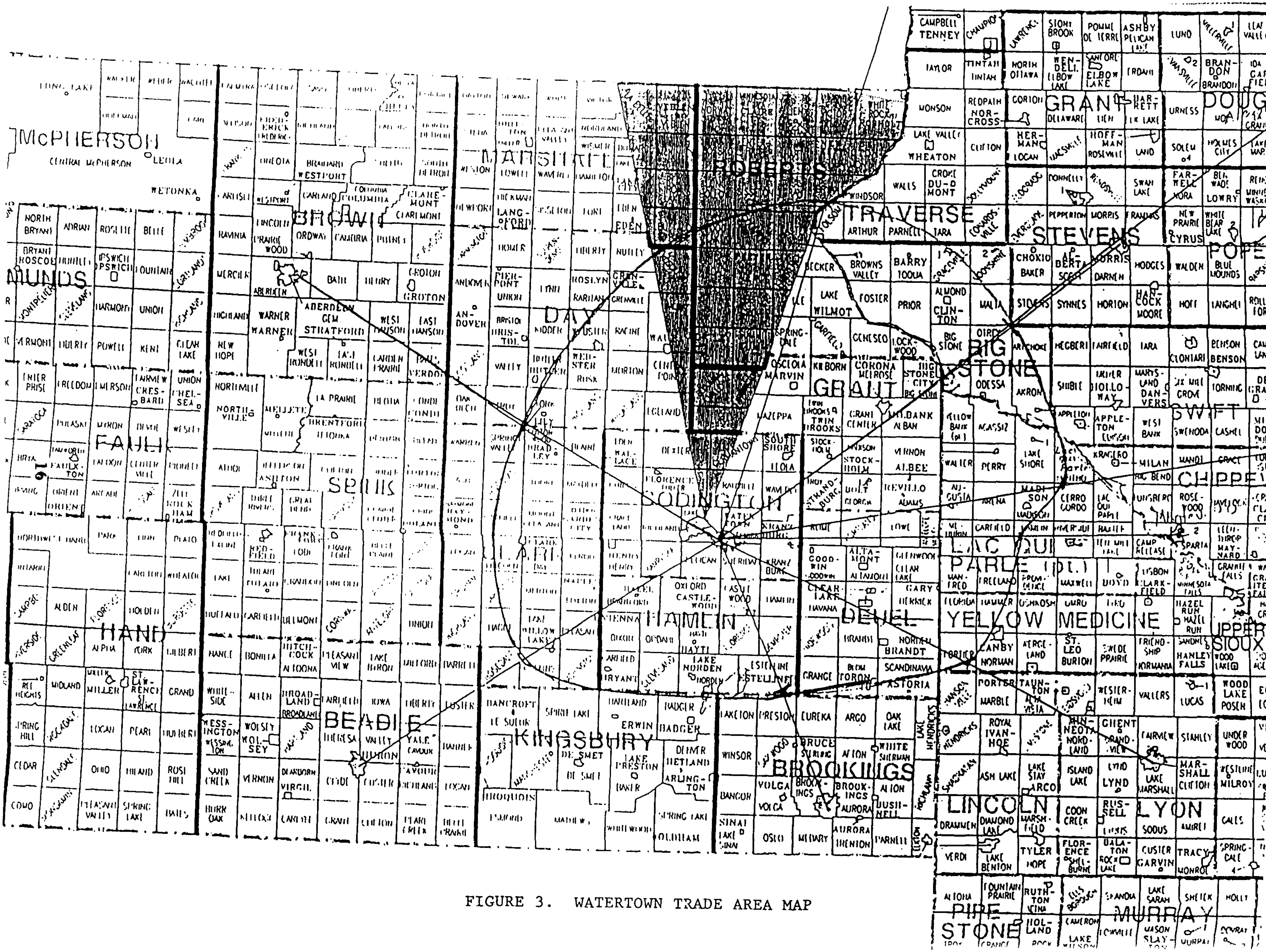


FIGURE 3. WATERTOWN TRADE AREA MAP

decade. The unemployment rate for Watertown during this same period dropped from 6.1 percent to 5.5 percent.

The most chosen jobs for Watertown residents are the sales occupations, with nearly as many occupied in the service occupations. However, the fastest growing job fields in Watertown are farming, forestry and fishing. This is in direct contrast to the South Dakota trend of a 22.6 percent drop in the farming, forestry and fishing occupations. It is probable that much of this growth in Watertown is due to semi-retired farmers moving into town or taking on a second job. This migration of semi-retired farmers into town would account for the growth of the farming occupation at Watertown.

Other areas of significant occupation for Watertown residents are the retail trade and durable goods manufacturing industries. Over thirty-six percent of the employed persons in Watertown (3,067 persons) work in these industries.

There is very little difference between Watertown and South Dakota with respect to income measurements. Watertown's per capita income of $10,660 in 1989 was nearly identical to the statewide per capita income of $10,661. Median household and family incomes for Watertown residents in 1989 were $20,606 and $27,602 respectively. These compare to 1989 median household and family incomes in South Dakota of $22,503 and $27,602 respectively.

In further analyzing the economic characteristics of the potential user population for Lake Kampeska, it is useful to look at assessed tax valuations for property around Lake Kampeska. This information is valuable, since the lake property owners are the primary user population. As of May 20, 1993, the assessed valuations for properties immediately adjoining Lake Kampeska are as follows:

Buildings		
	Residential	$39,703,420
	Commercial	485,470
Land		
	Residential	17,398,820
	Commercial	308,860
Total Assessed Property Value		$57,896,570

Source: Codington County Director of Equalization

It should be noted that the total assessed property value indicated in the previous table does not represent true market value, which would be significantly higher.

Based on the results of a recent survey of property valuations around South Dakota lakes, the value of property around Lake Kampeska is higher than the value of property around any other natural lake in the state. This can be attributed in part to the popularity of the lake as a recreational resource. Recreational activity on Lake Kampeska is higher, on a per-acre basis, than any other lake in the state. High property values can also be attributed to the sustained growth of the City of Watertown. Economic development has continued at a rapid pace, spurred in part by relocation of businesses and industries to Watertown. The associated population growth has created a high demand for homes and property. Nearly all the land around the lake has been developed, creating an even greater demand for lake homes and property.

In summary, the demographic and economic characteristics of the potential user population for Lake Kampeska indicate that the City of Watertown and the surrounding area is a thriving community that is continuing to expand and grow. The recreation and economic base provided by Lake Kampeska has been, and will continue to be, a key factor in the continued success of this community.

SUMMARY OF HISTORICAL LAKE USES

The word Kampeska is Sioux Indian and means "bright and shining", like a "shell or glass". People recall hearing the lake referred to as "The Lake of the Shining Shell", from the many fresh water clam shells that washed up on the beaches of the lake. No definite information has been located as to when and by whom the lake was named. However, on Nicolett and Fremont's map of 1842 it is called "L. Kampeska." Lake Kampeska apparently was included in the cession of lands by the Yankton Sioux under the treaty of April 19, 1858.

Recreation

At the turn of the century Lake Kampeska was the most popular resort area within hundreds of miles. It was known as the Lake Minnetonka of the west. The center of all the fun revolved around the summer playground of the upper midwest, Stony Point. Stony Point was started from a boxcar in the 1880's by C. M. Williams. It progressed, and eventually became the hub of activity around the lake. As the Stony Point Resort expanded, it came to include a dance hall, a roller skating rink, a water slide and an excursion boat. The resort reached its peak in 1937 after the drought years when an estimated 70,000 visitors gathered to watch what was known as the Carn Aqua Festival.

Besides the Stony Point Resort, there were other centers of activity as well. For example, the M. & St. L. Railway ran three shuttle trains to and from the lake outlet each Sunday during the summer months. There was also a side wheeler steamboat that provided inspiring tours of the lake.

Today, there are several park areas around Lake Kampeska that still serve as centers of recreational activity. Lake Kampeska is incorporated within the city limits of Watertown, so all of these park areas are technically within the City of Watertown. The City of Watertown owns and operates two of the park areas. One of these parks, on the east side of Lake Kampeska, is known as City Park. City Park provides camping facilities, a swimming beach and bath house, picnic facilities, and a boat ramp. The other city-owned park, known as Jackson Park, is located on the southeast side of Lake Kampeska. Jackson Park provides picnic facilities and a boat ramp.

Codington County owns and operates a park on the northwest side of Lake Kampeska known as Memorial Park. Memorial Park has camping sites, a swimming beach and bath house, a convenience store, meeting facilities, and a boat ramp.

On the south side of Lake Kampeska, the State of South Dakota owns and operates a state park called Sandy Shores. The Sandy Shores park provides camping and picnic facilities, a swimming beach and bath house, and a boat ramp.

In addition to the above park areas, which are well-maintained and extensively used, there are two 18-hole golf courses located next to Lake Kampeska. One of the courses is owned and operated by the City of Watertown, while the other course is privately owned and operated.

Flood Control

Lake Kampeska has historically served the purpose of flood control for the City of Watertown, especially since the diversion, or channelization, of the Big Sioux River into the lake in the 1930's. Most major floods have occurred during the spring of the year. During periods of flooding, the Big Sioux River floods low-lying farmland, as well as some areas in the City of Watertown. In addition, major flows from the Big Sioux River discharge into Lake Kampeska at the lake inlet/outlet.

The greatest flood on record occurred during the spring in 1943. At that time the peak lake elevation was recorded at 1723.8 feet above sea level. The next greatest flood of record occurred in 1969. During that flood the peak elevation at Lake Kampeska was recorded at 1723.7 feet. The normal full elevation of Lake Kampeska is 1717.8 feet. Therefore, the lake was 6.0 feet above full during the 1943 flood, and 5.9 feet above full during the 1969 flood.

More recently, major flooding at Lake Kampeska and the City of Watertown has occurred during the spring in 1986, and again during the spring of 1993. Following the flooding in 1986, a major study has been undertaken by the U.S. Army Corps of Engineers to determine the feasibility of constructing a flood control structure on the Big Sioux River north of Watertown. Other participants in the study include the Lake Kampeska Water Project District, the City of Watertown, Codington County, the East Dakota Water Development District, and the South Dakota Department of Environment and Natural Resources.

Presently a site known as the Mahoney Creek site has been selected as a potential location for construction of a flood control structure. This site is located just south of the point where Mahoney Creek flows into the Big Sioux River. It is approximately twelve miles north of the City of Watertown (Figure 4, Mahoney Creek Dam Site).

According to information from the "Draft Feasibility Report, Flood Control for Watertown and Vicinity" (Corps of Engineers, 1991), the proposed flood control structure would consist of two embankments. The main embankment would be 52 feet high, 4,900 feet long, with a crest width of 20 feet. The west embankment would be 41 feet high, 4,500 feet

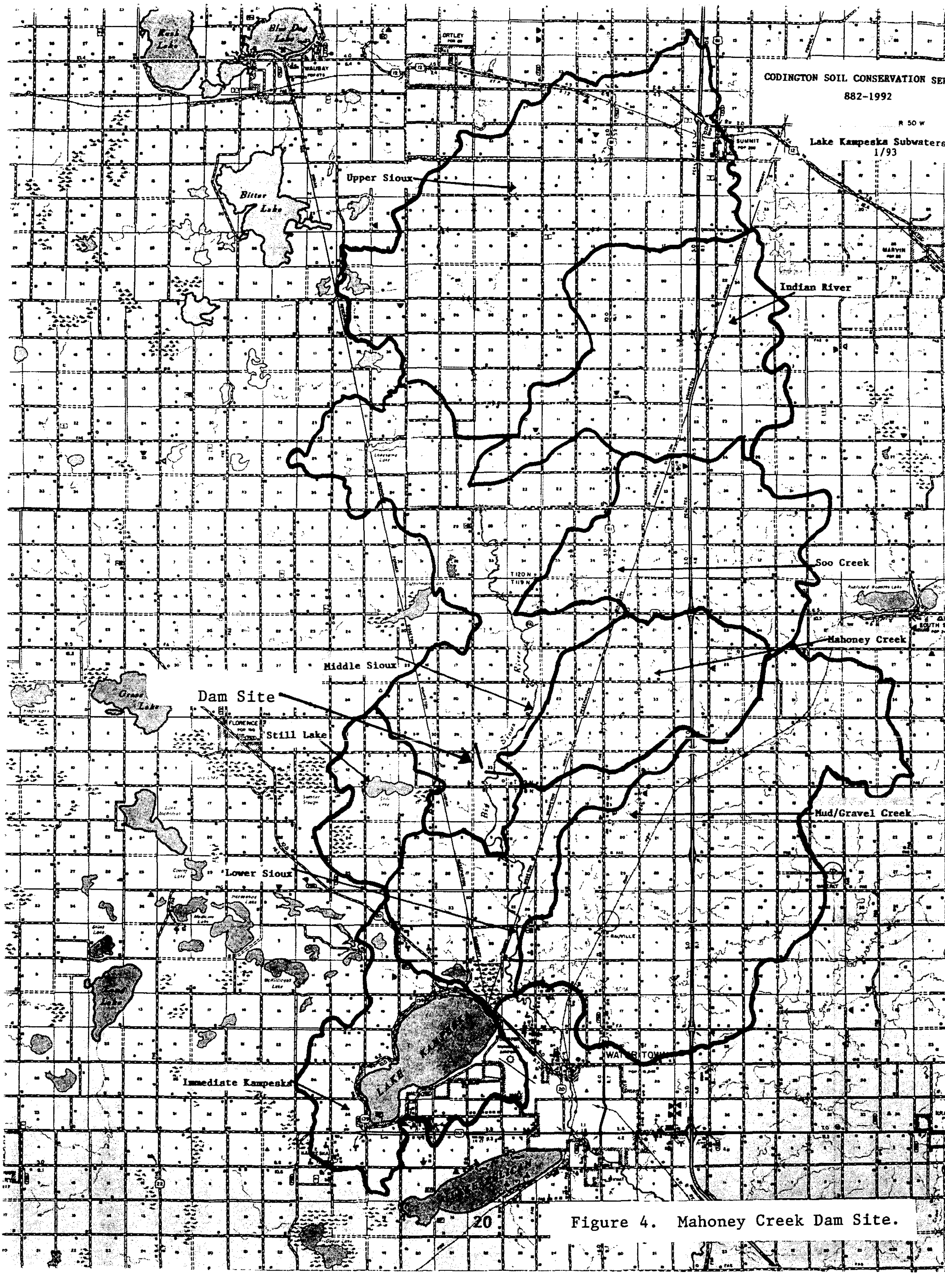


Figure 4. Mahoney Creek Dam Site.

long, with a crest width of 20 feet. There would be two conduits in themain embankment for release of water. The lower conduit, twelve inches in diameter, would be for the release of low flows. The upper conduit, sixty inches in diameter, would be for the release of water during high flow periods. In addition to the conduits, there would be a spillway 600 feet wide at the east end of the main embankment for the release of water during periods of very high flows. The maximum pool depth behind the main embankment would be forty feet.

Based on the design specifications of the proposed flood control structure, the trapping efficiency for sediment has been estimated to be in the range of eighty to ninety percent. In other words, 80% to 90% of the sediment loadings in the Big Sioux River, including bedload, would be retained behind the flood control structure. Even at this high retention rate, the structure would not fill with sediment for 50 to 100 years. Removal of sediment from the structure would be much more economical and practical than trying to remove it when it spreads out over the 4,817-acre (1,950-hectare) area of Lake Kampeska.

Because of the high loadings of sediment in the Big Sioux River, as discussed later in this report, this is an important consideration for the future water quality of Lake Kampeska. The loadings of sediment into Lake Kampeska need to be reduced. If a flood control structure is constructed, this goal would be partially accomplished.

The Corps of Engineers' study to determine the feasibility of constructing a flood control structure at the Mahoney creek site is expected to be completed in the near future. The feasibility study will address both the structural and economic feasibility of constructing a flood control structure. When the study is completed, a series of public meetings will be held to explain the results of the study, and to obtain public input. Presently, the tentative schedule for completion of the Corps of Engineers' feasibility study is as follows:

Draft Report............ February, 1994
Public Meetings......... February, March, 1994
Completion.............. June, 1994

Water Supply

In 1877, a pump house was built on the shore of Lake Kampeska, and a pipeline was constructed to supply water to the growing city of Watertown. Since that time, the City of Watertown has obtained a major portion of its drinking water from Lake Kampeska. Ground water wells have been constructed to supplement the supply of water from Lake Kampeska. However, The City of Watertown still obtains 36% to 45% of its total water supply from Lake Kampeska.

Fisheries

Lake Kampeska is a managed warmwater semi-permanent to permanent fishery. Primary species include: walleye, small mouth bass, white bass, yellow perch, black crappie, spottail shiner, johnny darter, log perch, and trout perch (State Threatened). The Lake Kampeska fishery also contains many secondary species such as: northern pike, bluegill, rock bass, white sucker, common carp, big mouth buffalo, black bullhead, green sunfish, as well as orangespotted sunfish. These primary and secondary species provide an abundant sport and commercial fishery.

The following information, tables, and graphs, are from the "SD Game Fish and Parks Statewide Fisheries Survey 2102-F21-R-26 for Codington County, Lake Kampeska" (SD Game Fish and Parks, 1992).

The condition of aquatic vegetation in and around the lake is rather poor. Emergent vegetation presently covers only 5% of the shoreline, and submergent vegetation is sparse to nonexistent. This can be attributed to high turbidity levels in the lake, which prevent the penetration of sunlight required for plant growth.

The sport fishery is centered around the walleye which is the most sought after game fish in the state (McPhillips, 1988). The SD Game, Fish and Parks fisheries program has been aggressively stocking walleye as well as other game fish into Lake Kampeska for many years (Table 3, Stocking Records For Lake Kampeska).

The results of the 1992 survey netting are shown in Tables 4 & 5, Results of Lake Kampeska Assessment Netting (47.5-m and 19-mm experimental gill nets respectively). Walleyes (55%) and yellow perch (11.3%) made up the majority (67.0%) of the gill net catch. Black crappies (19.5%), bluegills (16.0%), white bass (13.6%) and walleyes (10.5%) were the most abundant game fish captured in the trap nets. While the walleye gill net catch-per-unit-effort (CPUE) of 20.5 was relatively high compared to other walleye lakes in northeastern South Dakota, the trap net CPUE for black crappies, bluegills, white bass, and walleyes was relatively low. Although the time of sampling may have had an effect, Tables 4 & 5, Results of Lake Kampeska Assessment Netting (47.5-m and 19-m exp. gill nets respectively), indicate low density northern pike and panfish populations. The small mouth bass CPUE of 0.3 is misleading, since they would be better sampled with electrofishing. Unfortunately an electrofishing sample was not obtained for this fishery. Small mouth bass appear to be gaining popularity with anglers (personal communication of Game Fish and Parks personnel). Commercial fishing of common carp, bigmouth buffalo, and white bass does not appear to be a management problem.

The walleye was exploited in such large numbers, especially those under 14 inches (356 mm), that a 356 mm length minimum on catchable walleyes was put into effect on January 1, 1990. This made management of larger year class fish possible. Assessment netting for the monitoring of this practice was established and the results are summarized in Table 6, Results of Lake Kampeska Walleye Assessment Netting. These numbers allow us to see that since 1989, adult walleye catch rates have remained constant, proportional stock density (PSD) and relative stock density - preferred (RSD-P) values have increased significantly, and the condition factor (Wr) is now within the objective range of 95-105.

Table 3. Stocking Record for Lake Kampeska, Codington County.

Year	Number	Species	Size
1980	30	walleye	fingerling
1981	1,000	walleye	fingerling
1982	2,000,000	walleye	fry
	200	black crappie	adult
	30,000	black crappie	fingerling
1983	157,224	walleye	fingerling
	15,000	yellow perch	fingerling
1984	72,000	tiger muskie	fry
	1,000,000	walleye	fry
	101,000	walleye	fingerling
	100,000	black crappie	fingerling
	72,500	yellow perch	fingerling
	33,800	yellow perch	adult
1985	102,480	walleye	fingerling
	30,000	tiger muskie	fry
	47,000	smallmouth bass	fingerling
	5,370	black crappie	adult
	101,000	black crappie	fingerling
	37,500	yellow perch	adult
1986	500,000	black crappie	fingerling
	62,000	smallmouth bass	fingerling
	4,250	walleye	fingerling
	2,500,000	walleye	fry
1987	500,000	black crappie	fingerling
	35,000	smallmouth bass	fingerling
1988	500,000	black crappie	fingerling
	35,000	smallmouth bass	fingerling
	7,000,000	walleye	fry
1989	100,000	black crappie	fingerling
	5,000,000	walleye	fry
	125,000	walleye	fingerling
	23,000	walleye	lar. finger.
1990	5,000,000	walleye	fry
	100,000	walleye	fingerling
	127,570	walleye	lar. finger.
1991	7,000,000	walleye	fry
	200,000	walleye	sma. finger.
	50,650	walleye	lar. finger.
	400,000	black crappie	fingerling
1992	7,500,000	walleye	fry
	500,000	walleye	sma. finger.
	10,000	black crappie	fingerling
1993	5,000,000	walleye	fry

Table 4. Results of Lake Kampeska Assessment Netting. Assessment netting was conducted using six 47.5-m experimental gill nets during July, 1992.

Species	%COMP	CPUE 80%C.I	X YEAR MEAN CPU	PSD	WR
WAE	55.70	20.5+-3.1	20.5(4)	76	98
YEP	11.30	4.2+-1.3	7.2(4)	42	97
BLC	5.90	2.2+-1.0	1.0(4)	--	--
WHS	5.90	2.2+_0.9	1.9(4)	--	--
WHB	5.40	2.0+-0.7	6.5(4)	--	--
CARP	4.10	1.5+-0.6	0.5(4)	--	--
TRP	3.60	1.3+-0.6	0.3(4)	--	--
NOP	3.20	1.2+-0.6	0.7(4)	--	--
BBH	3.20	1.2+-0.6	0.8(4)	--	--
SPT	1.80	0.7+-0.4	0.5(4)	--	--

Table 5. Results of Lake Kampeska Assessment Netting. Assessment netting was conducted using thirty 19-mm double-frame trap nets during July, 1992.

SPECIES	%COMP	CPUE 80%C.I	X YEAR MEAN CPU	PSD	WR
BLC	19.50	3.3+-0.8	3.3(1)	48	91
BLG	16.00	2.7+-0.8	2.7(1)	29	104
BMB	13.80	2.4+-0.7	2.4(1)	96	92
WHB	13.60	2.3+-0.7	2.3(1)	78	97
WAE	10.50	1.8+-0.5	1.8(1)	70	100
RCB	7.60	1.3+-0.5	1.3(1)	--	--
WHS	7.20	1.2+-0.4	1.2(1)	--	--
YEP	5.60	1.0+-0.4	1.0(1)	32	91
SMB	1.80	0.3+-0.1	0.3(1)	--	--
CARP	1.40	0.2+-0.1	0.1(1)	--	--
NOP	1.20	0.2+-0.1	0.2(1)	--	--
BBH	1.2	0.2+-0.1	0.2(1)	--	--
OSPT	0.4	0.1+-0.1	0.1(1)	--	--
GSF	0.4	0.1+-0.1	0.1(1)	--	--

Key:

WAE......	Walleye	YEP......	Yellow Perch
BLC......	Black Crappie	WHS......	White Sucker
WHB......	White Bass	CARP.....	Common Carp
TRP......	Trout-Perch	NOP......	Northern Pike
BBH......	Black Bullhead	SPT......	Spottail Shiner
BLG......	Bluegill	BMB......	Bigmouth Buffalo
RCB......	Rock Bass	SMB......	Smallmouth Bass
GSF......	Green Sunfish	OSPT.....	Orangespotted Sunfish

Table 6. Results of Lake Kampeska Walleye Assessment Netting. Assessment netting was conducted using experimental gill nets during July/August of 1989 through 1992. Catch rate is adult walleyes only.

	1989	1990	1991	1992
CATCH RATE	19.2	22.0	20.5	20.5
PSD	15	16	63	76
RSD-P	6	3	2	14
CONDITION (Wr)	88	90	100	98
MEAN LENGTH (mm)	325	338	384	423
MEAN WEIGHT (g)	409	409	636	886

The 1992 adult walleye CPUE of 20.5 remains consistent with the CPUE of the previous three years, and is among the highest when compared to other northeastern South Dakota natural lake walleye fisheries. The 1992 PSD of 76 is above the objective range of 30-60, indicating a walleye population that is comprised mainly of large fish. Figure 5, Length Frequency of Walleyes Captured with Experimental Gill Nets in July 1992, shows this to be the case with the adult walleyes in Lake Kampeska. In 1992, adult walleyes had a mean length and weight of 423 mm and 886 g, respectively (Table 6, Results of Lake Kampeska walleye assessment netting). Although there were walleyes age 3 and younger, walleyes age 4 and older made up approximately 58% of the 1992 sample (Table 7, Age Frequency of Walleyes Captured in Experimental Gill Nets in Lake Kampeska). However, Figure 5, Length Frequency of Walleyes Captured with Experimental Gill Nets in July 1992, shows the apparent strong 1992 year class that was present in late July. A year class this strong has never been documented previously on Lake Kampeska. The last strong year class was established in 1986 (Table 7, Age Frequency of Walleyes Captured in Experimental Gill Nets in Lake Kampeska). However, no historical data can be found that documents their abundance as young of the year fish. Due mainly to the movement of the 1986 year class through the fishery, the 1992 RSD-P of 14 (Table 6) is significantly higher than the three previous years, and is within the objective range of 10-40.

Length frequency of walleyes captured with experimental gill nets in Lake Kampeska during July 1992. Catch rate is adult walleyes only.

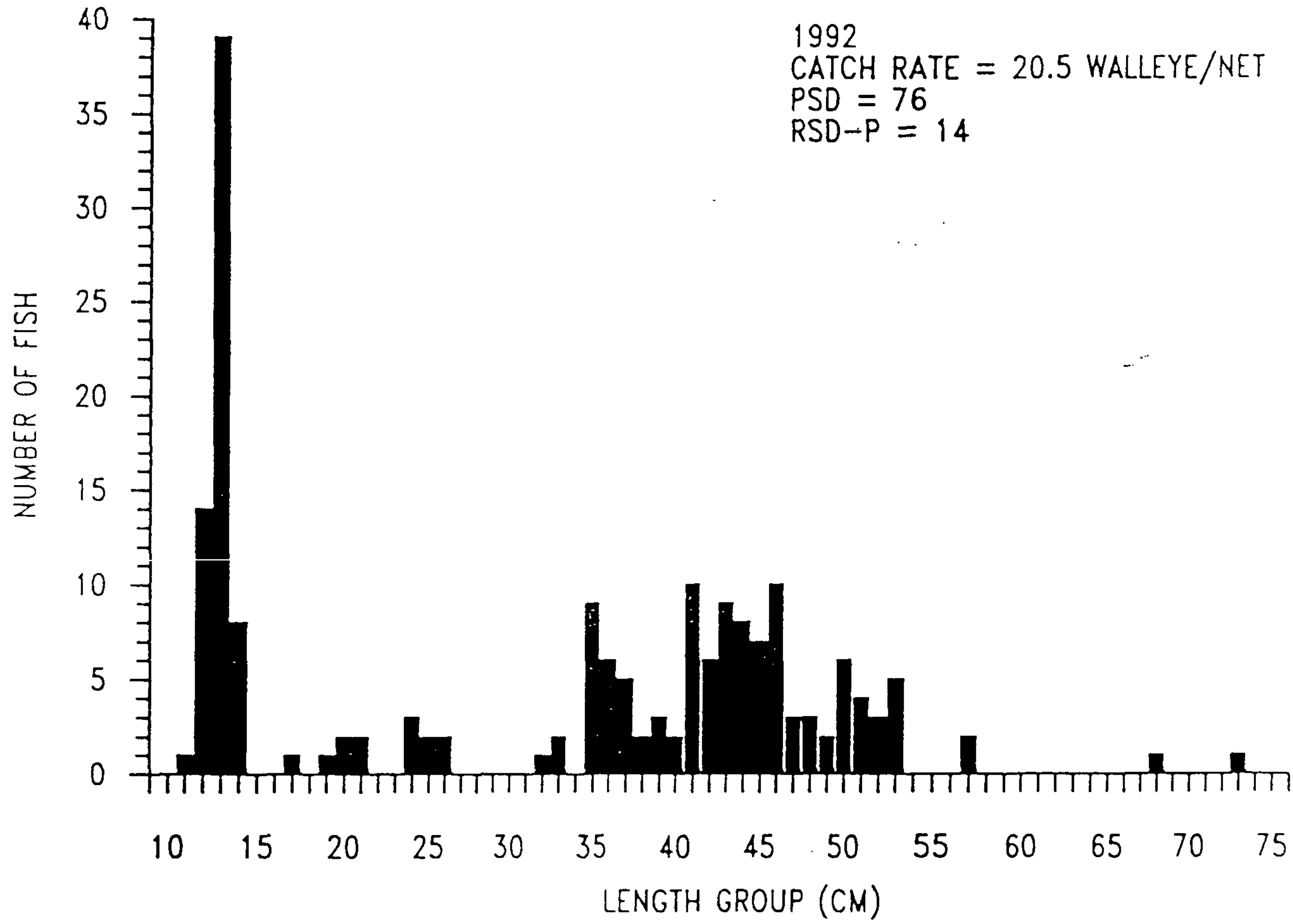


Figure 5. Length Frequency of Walleyes Caught During July, 1992

Table 7. Age Frequency of walleyes captured in experimental gill nets in Lake Kampeska during the summers of 1989 through 1992.

AGE	1989	1990	1991	1992
I	19	14	8	12
II	4	12	28	28
III	61	19	26	12
IV	4	59	23	15
V	9	12	29	29
VI	1	6	5	22
VII	4	7	1	4
VIII	2	2	1	1
IX	0	0	0	2

Commercial Fishing

Commercial fishing for nongame species from Lake Kampeska (Table 8) is documented in this report between 1972 and 1992, with 1993 data included but not finalized due to the fact that winter fishing in 1993 will not be completed by publication of this report. In comparison to other lakes included in this report Lake Kampeska is relatively low in the ranking for pounds removed (Table 9, Pounds of Fish Removed by Commercial Fishermen from Big Stone, Pelican, Traverse, Poinsett and Kampeska 1988-1992)(South Dakota Game Fish and Parks, Webster Office, 1993). This may be due to the relatively low numbers of catchable non-game fish or the difficulty in establishing netting locations.

Table 8. Commercial Fish Removal From Lake Kampeska (Pounds)

YEAR	CARP	BIGMOUTH BUFFALO	WHITE BASS	WHITE SUCKER	BLACK BULLHEAD
1972	6080	25280			
1973	54260	126500			
1974	71850	112810			
1975	8300	22600			
1976	53600	35760			
1977f	4600	8520			
1978	47600	96450		2150	
1979	18000	10600		250	
1980	17375	9020		875	
1981	13000	18720	100		
1982	27300	47170	6635		
1983	24700	69690	5275		
1984	300	200	950		
1985	-----NO DATA FOR THIS YEARS HARVEST----				
1986	45700	5200	900		
1987	16400	3900	1900		
1988	51900	34000	4800		
1989	1200		1100		
1990f	19500		7500		19500
1991	9500	7350			
1992					
1993	1200				
TOTAL	492365	633770	29160	3275	19500

f -Denotes fiscal year all others are calendar year

Table 9. Pounds of Fish Removed by Commercial Fishermen From Big Stone, Pelican, Traverse, Poinsett, and Kampeska, 1988-1992.

LOCATION

BIG STONE	YEAR	CARP	F.WATER DRUM
	1988	25000	0
	1989	267000	0
	1990	449000	29000
	1991	416000	27200
	1992	--NO DATA YET AVAILABLE--	
	TOTALS	**1157000**	**56200**

PELICAN	YEAR	CARP	BIGMOUTH BUFFALO	BLACK BULLHEAD
	1988	0	0	0
	1989	0	0	242500
	1990	0	0	262500
	1991	171000	31000	0
	1992	45500	7800	0
	TOTALS	**216500**	**38800**	**505000**

POINSETT	YEAR	CARP	BIGMOUTH BUFFALO	BLACK BULLHEAD	WHITE BASS	WHITE SUCKER
	1988	416000	68200	100150	0	0
	1989	925745	54425	0	18550	21130
	1990	541700	143800	0	5150	0
	1991	640500	23100	0	19968	5705
	1992	246100	6400	0	10075	0
	TOTALS	**2770045**	**295925**	**100150**	**53743**	**26835**

TRAVERSE	YEAR	CARP	BIGMOUTH BUFFALO	F. WATER DRUM	WHITE BASS	CARP SUCKER
	1988	289500	19700	49900	4000	2800
	1989	329000	25900	103200	0	0
	1990	107000	36000	42000	0	1000
	1991	290000	17000	38000	0	0
	1992	121500	5200	17400	0	0
	TOTALS	**1137000**	**103800**	**250500**	**4000**	**3800**

KAMPESKA	YEAR	CARP	BIGMOUTH BUFFALO	WHITE BASS
	1988	51900	34000	900
	1989	1200	0	1900
	1990	19500	0	4800
	1991	9500	7350	1100
	1992	7100	0	7500
	TOTALS	**89200**	**41350**	**16200**

In summary, available fisheries data indicates that current management practices are meeting their objectives. The walleye fishery will continue to be monitored for adverse effects of the 14 inch (356mm) size limit and the four fish creel limit. These adverse effects may include limited growth or reduction in survival rate, although none of these effects are anticipated. Current small mouth bass and white bass populations will be observed more closely due to their increased popularity with local sportsmen. White bass populations will also be monitored to prevent over-exploitation by commercial fishing. Current fisheries indicate a strong game and non-game fish population that will continue to support the sport and commercial fishing priorities of the area.

POPULATION SEGMENTS ADVERSELY AFFECTED BY LAKE DEGRADATION

The population segments adversely affected by the degradation of water quality in Lake Kampeska can be determined from the "Watertown Trade Area Capture Study" recently completed by the State Data Center Division of the Business Research Bureau, School of Business, University of South Dakota, Vermillion, SD (Dykstra, 1992). Presently, the City of Watertown is growing rapidly, with a 12.4 percent increase between 1980 and 1990. New businesses and industries are being attracted to the city, with associated growth in population and the housing industry. Much of this growth and expansion is directly attributed to the recreational opportunities provided by Lake Kampeska. Therefore, a continued decline in water quality in Lake Kampeska will have a definite adverse effect on the population of Watertown.

In recent years, the City of Watertown has obtained 36 to 45 percent of its drinking water supply from Lake Kampeska. The remainder of the drinking water supply is provided from ground water wells. The surface water supply from Lake Kampeska is provided more economically than the ground water supply. Therefore, a decline in lake water quality that would force more reliance on ground water would have a detrimental effect on the City's water supply budget.

In addition to the detrimental effects on the City of Watertown, the degradation of water quality in Lake Kampeska would likewise have an adverse impact on the entire population of Codington County. The City of Watertown is the county seat, and the hub of industrial and retail trade activity. Continuing degradation in Lake Kampeska's water quality would likely have an adverse effect on Watertown's economic well-being, and consequently the economic well-being of Codington County.

The "Watertown Trade Area Capture Study" indicates that the primary retail trade population for the City of Watertown was 65,274 in 1990. Lake Kampeska's resources have contributed to the growth and expansion of the City of Watertown, including it's retail trade facilities. Consequently, a decline in the water quality of Lake Kampeska would potentially have an adverse impact on a retail trade population exceeding 65,000 people.

COMPARISON OF LAKE USES TO USES OF OTHER LAKES IN REGION

Lake Kampeska is larger than most neighboring lakes in the region. Like most of the Prairie Coteau lakes, Lake Kampeska was formed by glacial melting during the late Wisconsin Era, and is currently in a hypereutrophic condition.

The Prairie Coteau and surrounding region contain approximately two-thirds of all the lakes in South Dakota. Many of these lakes are shallow and eutrophic, so they do not support water-based recreation. Therefore, lakes in this region that provide recreational resources are extremely valuable.

Table 10 lists all area lakes that support permanent recreational opportunities, and the municipalities nearest to the lakes. Lake Kampeska has four parks, and eight boat ramps. The recreational facilities at Lake Kampeska exceed those of all other area lakes with perhaps the exception of Big Stone Lake, which is 50 miles (80 km) away.

Table 10. Lakes Within an 80 km Radius of Lake Kampeska and Their Uses

Lake	Parks	Ramps	Uses*	Nearest Municipality
Lake Hendricks	1	4	B,C,F,P,S	Hendricks, MN
Pelican Lake	2	4	B,C,F,P,S	Watertown, SD
Whitewood Lake		2	B,F	Lake Preston, SD
Spirit Lake		1	B,F	Lake Norden, SD
Lake Albert		1	F	Lake Norden, SD
Lake Shaokatan		3	B,F,P,S	Ivanhoe, MN
Lake Thompson		2	B,F,P	Lake Preston, SD
Lake Sinai		1	B,F	Sinai, SD
Lake Preston			F	Lake Preston, SD
Lake Poinsett	1	6	B,C,F,P,S	Estelline, SD
Oak Lake			F	Astoria, SD
Oakwood Lakes	1	1	B,F,P,S	Bruce, SD
Lake Tetonkaha	1	2	B,C,F,P,S	Bruce, SD
Lake Cochrane	1	1	B,C,F,P,S	Gary, SD
Goldsmith Lake		1	B,F,S	Volga, SD
Lake Campbell	1	2	B,C,F,P,S	Brookings, SD
Lake St. John		1	B,F	Lake Norden, SD
Lake Norden	1	1	B,C,F,P,S	Lake Norden, SD
Willow Lake		1	B,F	Willow Lake, SD
Fish Lake		1	B,F,S	Astoria, SD
Clear Lake	1	1	B,C,F,P,S	Clear Lake, SD
Lake Alice		2	B,C,F,P,S	Altamont, SD
Round Lake		1	B,C,F,P,S	Goodwin, SD
Round Lake	1	1	B,F,S	South Shore, SD
Medicine Lake			C,P,S	Florence, SD
Rush Lake			B,F	Waubay, SD
Waubay Lake		1	B,C,F	Grenville, SD
Pickerel Lake	2	3	B,C,F,P,S	Grenville, SD
Enemy Swim Lake	1	2	B,C,F,P,S	Grenville, SD
Big Stone Lake	4	15	B,C,F,P,S	Ortonville, MN
Punished Woman's	1	2	B,C,F,P,S	South Shore, SD

* B=Boating, C=Camping, F=Fishing, P=Picnicking, S=Swimming

Source: South Dakota Game, Fish & Parks, Watertown Regional Office, 1993

INVENTORY OF POINT SOURCE POLLUTION DISCHARGES

There are no known sources of point source pollution to Lake Kampeska.

LAND USES

Land Uses in the Lake Kampeska Watershed

A detailed analysis of the Lake Kampeska watershed was conducted to arrive at land use acreages with a high degree of accuracy. The boundaries of the entire watershed and its subwatershed areas were traced onto a set of U. S. Geological Survey 7 1/2 minute topographic maps from an original set of maps which delineate the drainage basin boundaries for the Big Sioux River basin. The original set of maps are on file in the U. S. Geological Survey office at the Federal Building in Huron, South Dakota. The set of topographic maps upon which the boundaries were traced is on file in the SD DENR office in Watertown, South Dakota.

All of the Agricultural Stabilization and Conservation Service (ASCS) aerial section photographs (scale: 8" = 1 mile) for the watershed were obtained and filed by legal description. The watershed and subwatershed boundaries were then traced onto each ASCS photo where a boundary crossed the section. The boundaries were also traced onto a composite map of the entire watershed, which covers parts of four counties (Figure 1, Lake Kampeska Watershed).

For purposes of the Phase I Study, the Lake Kampeska watershed was divided into nine subwatersheds. They are as follows:

1) Immediate Kampeska--The subwatershed area immediately surrounding Lake Kampeska.

2) Still Lake--This subwatershed area is self-contained, and contributes to the Lake Kampeska watershed only during periods of very high water flow.

3) Lower Sioux--The portion of the Big Sioux River watershed between monitoring Site 4 (lake inlet/outlet, Figure 6) and monitoring Site 6 (USGS gaging station on the Big Sioux River about 4 miles north of Lake Kampeska, Figure 6).

4) Middle Sioux--The part of the Big Sioux River watershed that lies between monitoring Site 6 and monitoring Site 7 (USGS

gaging station on the Big Sioux River approximately 16 miles north of Lake Kampeska, Figure 6).

5) Upper Sioux--This subwatershed area includes the upper reaches of the Big Sioux River drainage basin upstream of monitoring Site 7.

6) Mahoney Creek--The Mahoney Creek subwatershed is the furthest south of three subwatersheds (Mahoney Creek, Soo Creek, Indian River) that contribute flow to the Middle Sioux subwatershed.

7) Soo Creek--The Soo Creek subwatershed lies between the Mahoney Creek and Indian River subwatersheds and also contributes flow to the Middle Sioux subwatershed.

8) Indian River--This is the furthest north subwatershed that contributes flow to the Middle Sioux subwatershed.

9) Mud (Gravel) Creek--Water from this subwatershed area flows to Lake Kampeska only during periods of very high flow. An inlet channel and dam was constructed in 1933 to divert flow from Mud Creek into Lake Kampeska during a period of low lake levels. In 1969, the diversion dam was opened, and a dike constructed across the inlet channel to block flows from Mud Creek to Lake Kampeska. During periods of normal flow, Mud Creek now flows into the Big Sioux River downstream from Lake Kampeska, as it did originally. However, during periods of flooding, Mud Creek can flow over the dike in the old diversion channel and into Lake Kampeska.

It should be noted that the upper and lower boundaries for the Lower Sioux, Middle Sioux, and Upper Sioux subwatersheds were selected according to monitoring site locations. In actuality, these three subwatersheds compose one large subwatershed area that drains directly to the Big Sioux River, and ultimately Lake Kampeska. However, for purposes of conducting the Phase I Study, it was decided to subdivide this large watershed into smaller subwatershed areas. Because monitoring sites had been selected at the lake inlet/outlet (Site 4), and the two USGS gaging stations on the Big Sioux River (Sites 6 and 7), it was determined that these monitoring sites would be practical locations for lower boundaries of the three subwatershed areas.

Once the subwatershed areas had been determined, a digital planimeter was used to measure various land uses in each of the nine subwatershed areas. Cropland fields with acreages indicated on ASCS aerial photos were counted as Agriculture-Cultivated. Hayland, pastureland, and rangeland areas with no field acreages indicated on the photos were counted as Agriculture-Noncultivated. Farmsteads were included as

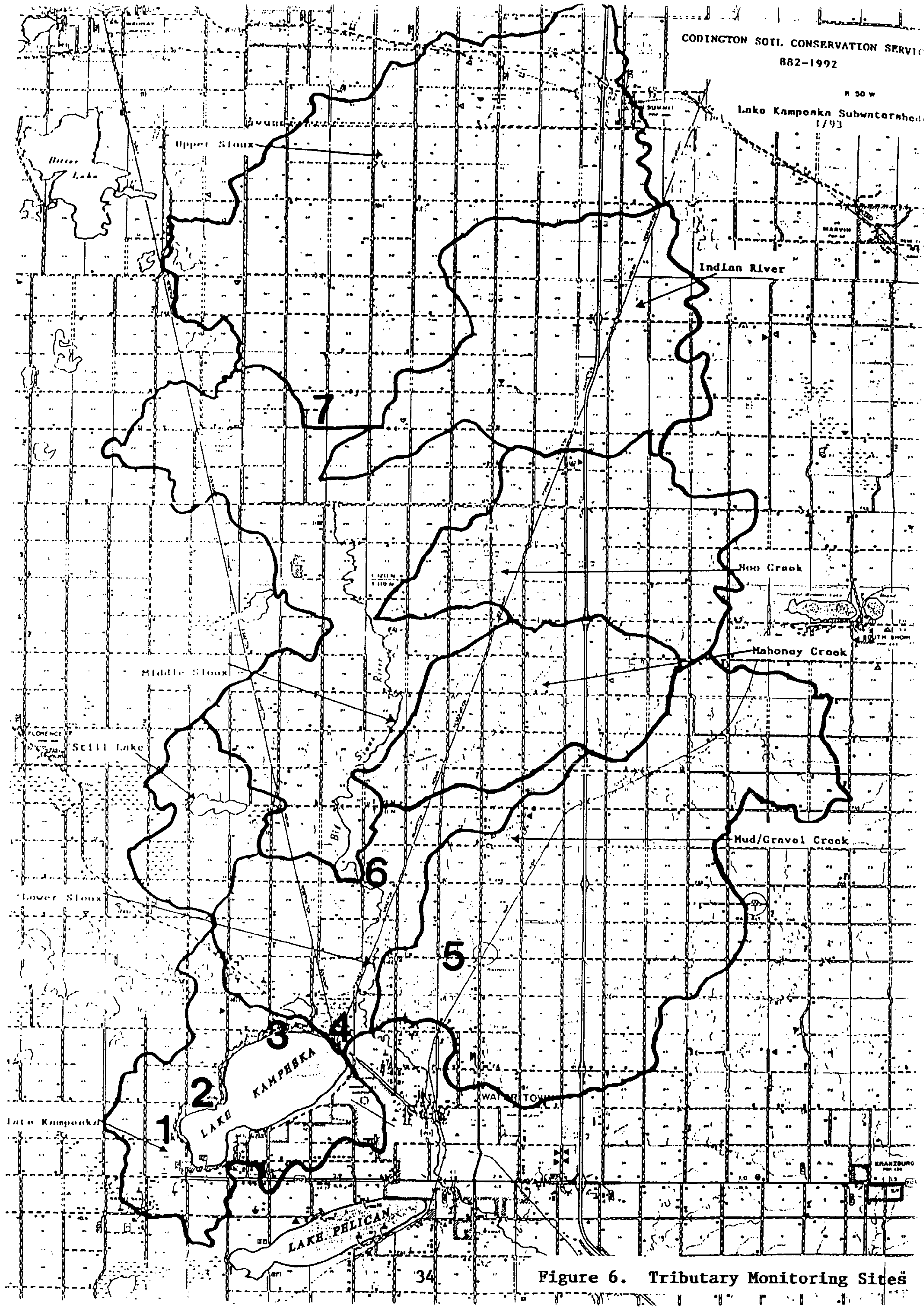


Figure 6. Tributary Monitoring Sites

Residential-Low Density, whereas towns and lake developments were put into a Residential-High Density category. Rivers, lakes, and non-cropped wetlands were classified as Water areas. Fields labeled as CRP on the aerial photos were put into a separate Conservation Reserve Program classification. Large field windbreaks or blocks of trees were included in a category called Forest. A final category referred to as Transportation was used to include the land areas taken up by roads. A factor of 16 acres of county, township, or state roads per section was used to calculate the values for the Transportation classification. In addition, for U. S. Interstate Highway 29, which intersects six of the nine subwatersheds, a value of 300 feet of right-of-way was multiplied by the length of interstate in each subwatershed to determine land areas taken up by the interstate highway.

Correction factors were used to adjust some land use totals known to be incorrect. For example, it is recognized by ASCS and SCS officials that many fields which show cropland acreages on ASCS aerial photos are actually grassland, and have been used for pasture and hay for many years. The ASCS 1992 Compliance Reports for Codington and Grant Counties were consulted to determine an appropriate correction factor for this variance. Based on the Compliance Reports, it was found that an average of eight percent of acreages indicated as "cropland" on ASCS aerial photos were actually "grass" or "mixed hay". Therefore, this percentage (8%) was subtracted from the Agriculture-Cultivated acreage for each subwatershed, and added to the Agriculture-Noncultivated acreage for each subwatershed.

Table 11, Lake Kampeska Subwatershed Land Uses, provides a breakdown of land uses for each subwatershed area. As can be seen from this table, the great majority of land in the entire watershed is classified as Agriculture-Cultivated, or Cropland (131,103 acres). The second largest category for land use (58,605 acres) is Agriculture-noncultivated (Pasture/Range). Significantly smaller acreages are included in the categories for CRP (Conservation Reserve Program), Residential (Farmsteads), Residential (Towns), Water (Rivers/Lakes/Wetlands), Forest (Windbreaks), and Transportation (Roads). The total acreage for the Lake Kampeska watershed is 212,707 acres.

Table 12, Land Use Areas and Percentages, summarizes total areas and percentages for the various land use categories for the entire Lake Kampeska watershed.

TABLE 11. LAKE KAMPESKA SUBWATERSHED LAND USES

SUB-WATERSHEDS	AG CULTIVATED (Cropland)		AG NON-CULTIVATED (Pasture/Range)		AG CRP (CONS. RES. P PROG.)		RESIDENTIAL (Farmsteads)		RESIDENTIAL (Towns)		WATER (Lakes/Wetlands)		FOREST (Windbreaks)		TRANSPORTATION (Roads)		TOTALS (All Sub-watersheds)	
	acres	%	acres	%	acres	%	acres	%	acres	%	acres	%	acres	%	acres	%	acres	%
IMMEDIATE KAMPESKA	6058	52.8	3369	29.4	129	1.1	834	7.3	532	4.6	109	1.0	146	1.3	288	2.5	11465	100.0
LOWER SIOUX	10837	69.1	3194	20.4	70	0.4	338	2.1	27	0.2	659	4.2	159	1.0	402	2.6	15686	100.0
MIDDLE SIOUX	19696	65.9	6905	23.1	1522	5.1	329	1	22	0.1	383	1.3	305	1.0	748	2.5	29910	100.0
UPPER SIOUX	24158	55.5	13297	30.5	3309	7.6	686	1.6	149	0.3	266	0.6	396	0.9	1312	3.0	43573	100.0
STILL LAKE	3920	59.7	1539	23.5	326	4.9	83	1.3	0	0.0	478	7.3	52	0.8	163	2.5	6561	100.0
MUD(GRAVEL) CREEK	28338	62.7	13219	29.3	428	1.0	718	1.6	37	0.1	64	0.1	902	2.0	1468	3.2	45174	100.0
MAHONEY CREEK	10894	74.6	2737	18.7	40	0.3	262	1.8	0	0.0	11	0.1	174	1.2	484	3.3	14602	100.0
SOO CREEK	12762	63.4	6085	30.2	53	0.3	276	1.4	0	0.0	24	0.1	251	1.3	668	3.3	20119	100.0
INDIAN RIVER	14440	56.4	8260	32.2	1569	6.1	248	1.0	0	0.0	61	0.2	176	0.7	863	3.4	25617	100.0
TOTAL ACRES	131103		58605		7446		3774		767		2055		2561		6396		212707	

Table 12. Land Use Areas and Percentages

Land Use	Acres	Percentage
Ag Cultivated (Cropland)	131,103	61.6
Ag Non-Cultivated (Pasture/Range)	58,605	27.6
Ag CRP (Conservation Reserve)	7,446	3.5
Residential (Farmsteads)	3,774	1.8
Residential (Towns)	767	0.3
Water (Lakes/Wetlands)	2055	1.0
Forest (Windbreaks)	2,561	1.2
Transportation (Roads)	6,396	3.0
Totals	212,707 ac.	100.0%

From Table 12 it can be seen that less than 6 percent of the watershed is in non-agricultural use (Residential-Towns, Water, Forest, and Transportation). Consequently, over 94% (200,928 acres or 81,348 ha) of the watershed is in primarily agricultural use.

Figure 7 graphically portrays the relative size of the various land uses in the watershed. The large comparative sizes of agricultural land uses in the watershed provide a strong indication why high loadings of solids and nutrients were found in the tributaries during the water quality monitoring portion of the Phase I Study.

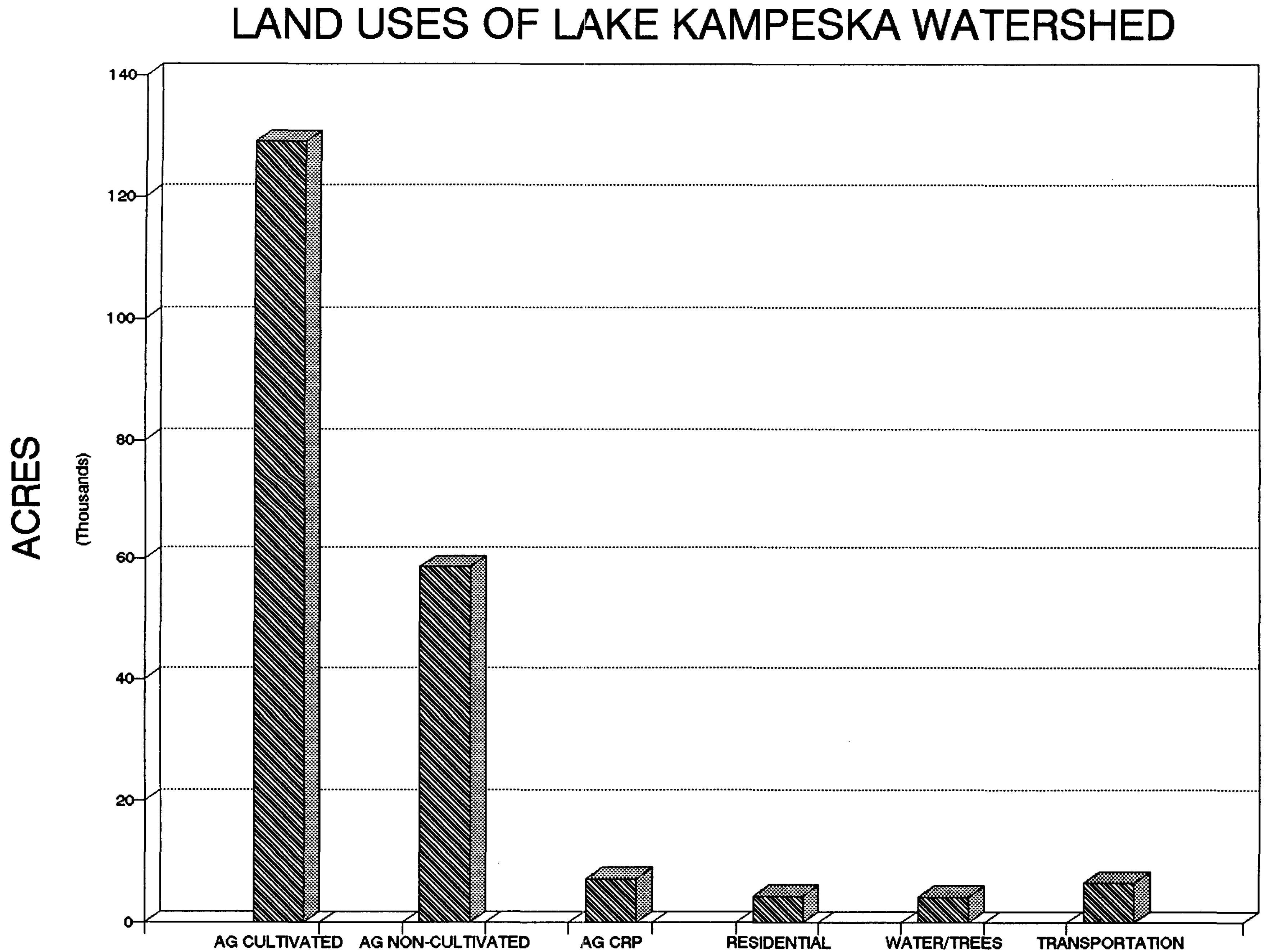


Figure 7. Size Comparison of Land Uses

Nonpoint Source Loadings by Land Use

The Universal Soil Loss Equation (USLE) from the SCS Field Office Technical Guide was used to estimate the average annual soil loss for each land use by soil type within contributing subwatersheds, Appendix A. It should be noted that the USLE provides an estimate of soil loss. Therefore, the loadings results calculated by using the USLE should not be taken completely at face value. The data derived from the USLE is best used as a means of comparison to find areas of highest probable erosion within the watershed. The USLE soil loss results may not correlate directly with the suspended solids loadings calculated from the water quality monitoring program, which is discussed later in this report.

The USLE estimates sheet and rill erosion which results from normal rainfall events. It does not account for large amounts of sediment lost in high-intensity storm events. Sediment contributions from ephemeral, gully, and streambank erosion throughout the watershed were not calculated for this report. Although these are recognized as significant sources of nonpoint loadings, available time and resources prohibited conducting these studies on this extensive watershed area.

The Universal Soil Loss Equation (A=RKLSCP) is a direct equation which estimates sheet and rill erosion by multiplying the following factors:

- R = Rainfall factor
- K = Soil erodibility factor
- LS = Slope length and slope gradient factor
- C = Cropping management factor
- P = Erosion control practice factor

The product of this equation (A) is the estimated annual soil erosion in tons/acre/year. The basis for the selection of the values used is as follows:

- R: Every county has an assigned R factor based on relative rainfall intensity and erosive force.
- K: Each soil association was assigned a K factor based on predominance of individual soil types within the area.
- LS: Assigned values of average length and percent slope of individual soil types exist for other program purposes. In addition, data from the 1992 SCS National Resources Inventory (NRI) for randomly selected points within the watershed was consulted. An average LS factor was determined and assigned to each soil association.
- C: Cropping management factors for each land use are based on the SCS Field Office Technical Guide, and are listed in Table 13.

Table 13. C Factors for Various Land Uses

Land Use	C Factor
Agriculture - Cultivated	0.22
Agriculture - Noncultivated	0.02
Residential - Low Density	0.03
Residential - High Density	0.04
Conservation Reserve Program (CRP)	0.005
Forest	0.003
Transportation	0.01

Several sources were consulted to determine the C factor for Agriculture-Cultivated (Cropland). C factors from the 1992 NRI data for points within the watershed were compiled. The Codington County ASCS 1992 Compliance Report was consulted which indicates total acreages of all crops planted in the county. This report showed approximately 35% small grain, 28% corn, 27% soybeans, and 10% alfalfa in rotation. The Conservation Technology Information Center (CTIC) 1992 Conservation Tillage Survey for Codington County was also consulted for relative percentages of conservation tillage types. (Data for the other counties in the watershed would not be significantly different than the data for Codington County.) With these percentages of crops grown, C factors in the SCS Field Office Technical Guide were selected, using locally accepted rotations and conservation practices. Based on the information from these references, an average C factor of 0.22 was determined for Agriculture - Cultivated.

P: The erosion control practice factor accounts for structural conservation practices such as terracing or contour stripcropping. There is no significant amount of these practices in the watershed due to flatter slopes or uneven terrain. The P factor was determined to be 1.0, which has no effect on the USLE equation, and therefore was not included in the soil loss tables.

Delivery ratios (column labeled DR in Appendix A) used for the subwatersheds within the Lake Kampeska watershed were partially based on drainage area, taken from Table C1-4 on page C-10 of the Clean Lakes Program Guidance Manual (EPA, 1980). Delivery ratios, however, are primarily for suspended solids. Based on information from the Area SCS Office at Brookings, SD, an additional 5% was added to the delivery ratios to account for streambed loads in the watershed tributaries that are also contributing to sediment accumulations in Lake Kampeska.

The soil loss estimates for the various land uses in Appendix A were completed by subwatershed for each soil association within each county. A soil association is a landscape that has a distinctive proportional pattern of soils. For a very large watershed area, such as the Lake Kampeska watershed, this method provides comparisons using average values for USLE factors within each soil association. Minor acreages of some soil associations were combined with major acreages of similar soil types. The subwatershed boundaries were drawn on the general soil map of each county. These areas were then measured with a digital planimeter to arrive at the relative percentage of each soil association within each subwatershed. These percentages were then multiplied by the known land area of each county within a given subwatershed to derive the estimated acreage of each soil association. See the table below for an explanation of the soil associations and codes used in the soil loss estimate tables.

Table 14. Soil Associations and Codes Used in Each County

Soil Association	Code
Codington County	
1 Poinsett-Waubay-Oldham	Cod1PWO
2 Poinsett-Buse-Parnell	Cod2PBP
3 Brookings-Kranzburg-Vienna	Cod3BKV
6 Estelline-Fordville-Renshaw	Cod6EFR
7 Lamoure-Rauville	Cod7LR
Grant County	
5 Vienna-Lismore	Gra5VL
6 Renshaw-Fordville-Divide	Gra6RFD
7 LaDelle-Dovray-Playmoor	Gra7LDP
Roberts County	
8 Renshaw-Fordville	Rob8RF
9 Vienna	Rob9V
Day County	
5 Forman-Buse-Parnell	Day5FBP
6 Buse-Barnes	Day6BB
10 Vienna	Day10V

To arrive at the acreages used in the soil loss estimate tables, the acreage of each soil association within each subwatershed was multiplied by the percentages of the land uses within a particular subwatershed. It is recognized that all land uses are not divided according to the same percentage within each soil association. However, for this large-scale study, these estimates are adequate to yield data for comparisons.

The Still Lake subwatershed was not included in the soil loss estimate tables due to its small size and the fact that Still Lake itself acts as a sediment sink. Therefore, this subwatershed does not contribute significant sediment loadings to the Lake Kampeska watershed. Mud Creek is included in the tables, but it should be noted that it only contributes flow and loadings to Lake Kampeska when it overflows the dike in the old inlet channel.

The following table summarizes the results of the soil loss estimate tables by subwatershed, from largest to smallest loadings of solids.

Summary of Soil Loss Estimates by Subwatershed

Subwatershed		Solids (Kg/Yr)
Upper Sioux		16,312,859
Mud Creek		14,274,028
Middle Sioux		10,299,343
Soo Creek		10,035,353
Indian River		8,868,288
Mahoney Creek		7,198,192
Immediate Kampeska		7,189,548
Lower Sioux		6,588,036
	Total	80,765,647

The summary results for soil loss estimates as shown in the previous table help to prioritize the subwatershed areas for restoration efforts which would be carried out in a Phase II Implementation Project. Even though the Mud Creek subwatershed ranks quite high in terms of estimated soil losses, it is not recommended as a top priority subwatershed because the loadings from this drainage basin do not reach Lake Kampeska under normal flow conditions. Even though loadings from Mud Creek can reach the lake during periods of flooding, this is a relatively rare occurrence.

Likewise, the Upper Sioux subwatershed is not recommended as a top priority watershed for restoration efforts, in spite of the very high estimates for soil losses. The reason for this is the long distance of this subwatershed from the lake. Much of the solids loadings will be retained in the watershed, and associated organic matter will have a greater opportunity for decomposition before reaching the lake. Based on the relative loadings as shown in the previous table, and taking into account other factors such as watershed size, amount of cropland, evidence of streambank erosion, and relative number of livestock feeding areas, the recommended priority ranking for the subwatersheds for Phase II restoration efforts would be as follows*:

	Subwatershed	% of Solids Loadings
1)	Middle Sioux	12.7%
2)	Mahoney Creek	8.9%
3)	Lower Sioux	8.2%
4)	Soo Creek	12.4%
5)	Upper Sioux	20.2%
6)	Indian River	11.0%
7)	Immediate Kampeska	8.9%
8)	Mud Creek	17.7%
		100.0%

*The Still Lake subwatershed is not ranked because it is primarily a closed basin with very little flow to the Lake Kampeska watershed.

Feedlots

An aerial survey of the Lake Kampeska watershed was conducted in March, 1993, to determine the location of feedlots in the Lake Kampeska watershed. Approximately 75 livestock feeding areas were observed during the course of the aerial survey. These livestock feeding areas were found to be rather evenly distributed throughout the watershed area.

In June, 1993, an onsite inventory was conducted in the Codington County portion of the Big Sioux River watershed to gather more detailed information and to verify locations of feeding areas determined in the aerial survey. The severity of feedlot runoff problems was found to vary greatly, ranging from cattle being fed on the bank of the Big Sioux River, to a few cattle fed several miles away from the tributaries with healthy grass buffer strips downstream.

Livestock operations included dairy, beef, hogs, sheep, and horses, with the majority being dairy and beef cattle. The numbers of the livestock varied from approximately 10 head to approximately 500 head. The areas that were surveyed included winter feeding areas, and feedlots, or concentrated feeding areas, with vegetation varying from denuded (bare) to partially grassed.

Survey results and preliminary rankings are on file in the Codington Conservation District office. Table 15 is a summary of the survey:

Table 15. Feeding Area Survey by Subwatershed

Subwatershed	Number of feeding areas
1) Middle Sioux	14
2) Mahoney Creek	11
3) Soo Creek	4
4) Lower Sioux	3

The Mud Creek and Still Lake subwatersheds were not surveyed due to their lower priority status; and Grant, Day, and Roberts county portions of the watershed were not surveyed on the ground. However, it is known that several livestock operations exist in these areas, varying in severity of runoff problems and treatment needs.

The Soil Conservation Service is working with the owners of two of the feedlots to contain runoff. One of these feedlots is located in the Mahoney Creek subwatershed, and the other one is located in the Soo Creek subwatershed. Design work has begun for construction of an animal waste management system at one of the feedlots. However, construction will not begin until later in 1994.

The results of the tributary monitoring program indicate that high levels of fecal coliform bacteria and nutrient loadings are being derived from the feedlots located in the Middle Sioux, Mahoney Creek, Soo Creek, and Indian River subwatersheds. The construction of animal waste management systems and implementation of other best management practices to control feedlot runoff should be high priorities for these subwatersheds during a Phase II restoration project.

Shoreline Erosion Survey

A survey of the Lake Kampeska shoreline was conducted on October 2, 1992. A pontoon was used to survey the entire shoreline around the lake. Areas of erosion were documented by photography and videotape. In addition, the areas of erosion were recorded on a map of Lake Kampeska provided by the City of Watertown Engineer's Office. For each area of erosion, an estimate was made of the height, length, and severity. The subjective categories for severity of erosion were as follows:

* Minor
* Moderate
* Moderate/Severe
* Severe

A total of 1,927 feet (587 m) of the shoreline was found to have some degree of erosion. All of the areas in the Moderate, Moderate/Severe, and Severe erosion categories (1,541 feet or 469 m) represent potential loadings of sediment to Lake Kampeska, and should be corrected as soon as possible.

A summary of the length (L) and height (H), in feet, within each erosion category is found in Table 16, Lake Kampeska Shoreline Erosion Survey.

Table 16. Lake Kampeska Shoreline Erosion Survey, ** October 2, 1992

	Minor	Moderate	Moderate/Severe	Severe
	H / L	H / L	H / L	H / L
	2 / 100	10 / 50	5 / 30	20 / 20
	3 / 50	12 / 10	12 / 70	15 / 100
	4 / 20	9 / 100	15 / 30	
	10 / 10	5 / 35	5 / 10	
	3 / 50	7 / 40	15 / 80	
	10 / 10	2 / 50	20 / 400	
	12 / 25	2 / 100	12 / 20	
	5 / 15	2 / 75	15 / 15	
	2 / 20	10 / 10	5 / 60	
	2 / 55	20 / 15		
	5 / 10	6 / 6		
	6 / 6	6 / 20		
	5 / 15	15 / 30		
		5 / 50		
		6 / 10		
		5 / 5		
		5 / 100		
Ave. Height	5.3	7.5	11.6	17.5
Total Length	386	706	715	120
% of Total Shoreline (71,280 feet)	0.5%	1.0%	1.0%	0.2%

Figure 8, Lake Kampeska Shoreline Erosion, on the following page illustrates the areas of Moderate, Moderate/Severe, and Severe erosion around the lake.

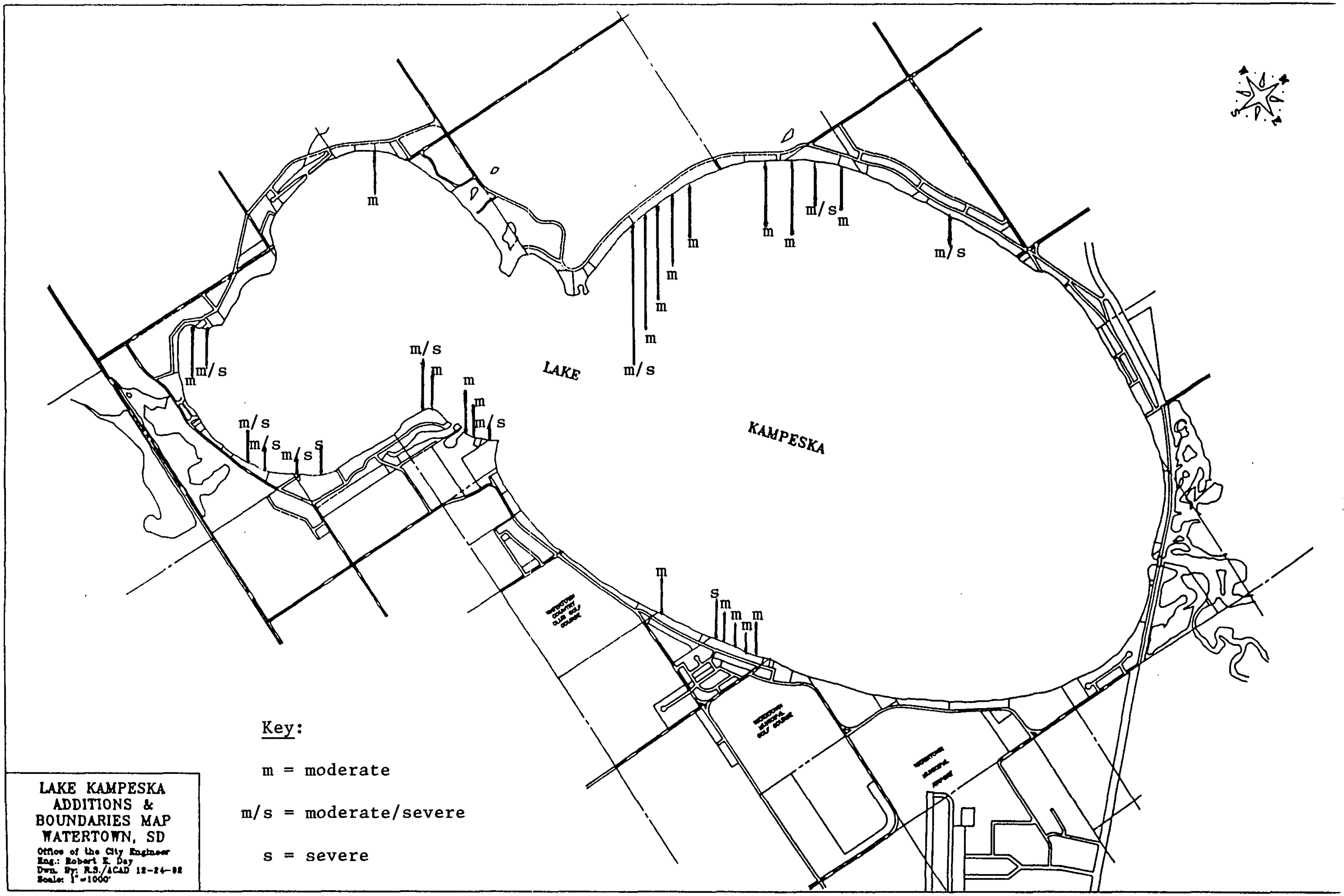


Figure 8. Lake Kampeska Shoreline Erosion

WATER QUALITY MONITORING

The Lake Kampeska study was designed to accomplish the following objectives:

1. To assess the current water quality of Lake Kampeska and its tributaries.

2. To identify, monitor, and evaluate sources of pollutants to the lake from the watershed.

3. To calculate a nutrient and sediment budget for Lake Kampeska.

4. To develop recommendations for restoration alternatives.

To insure the quality of monitoring data, water sampling was conducted under strictly controlled conditions. Samples were collected by a local staff person from the Department of Environment and Natural Resources, with assistance from volunteer members of the Kampeska Chapter of the Izaak Walton League (IWL). Water quality analysis was conducted by the EPA-approved State Health Laboratory in Pierre, South Dakota. Data analysis was accomplished through the use of computer modeling and statistical analysis.

Tributary Water Quality Data

The purpose of the tributary monitoring program was to collect the water quality and flow data required to develop both nutrient and hydraulic budgets for the lake. These budgets were then used to determine the total loadings from the various tributary sources in order to target restoration efforts to critical loading areas in the watershed.

The Big Sioux River inlet/outlet and six tributary sites were selected as monitoring locations for the Lake Kampeska watershed (Figure 6, Tributary Monitoring Sites, Page 34). Descriptions of the tributary sites are as follows:

Site 1. Marina Bay inlet located at the southwest end of the lake. This site was used to monitor flow from a small, unnamed tributary. This site is located in the SE1/4, NE1/4, NW1/4, SE1/4 of Section 25, T117N, R54W; latitude 44° 54′ 39″, longitude 97° 15′ 16″.

Site 2. Memorial Park inlet located at the northwest part of the lake. This site was intended to be used to quantify loads from a small unnamed tributary. This site is located in the NE1/4, SE1/4, NW1/4, NW1/4 of Section 30, T117N, R53W; latitude 44° 55′ 02″, longitude 97° 14′ 36″.

Site 3. An inlet located at the northeast part of the lake next to Kampeska Lodge. This site was intended to measure loads from a small unnamed tributary. The location of this site is the NW1/4, NW1/4, NW1/4, NW1/4 of Section 16, T117N, R53W; latitude 44° 56′ 58", longitude 97° 10′ 22".

Site 4. The Big Sioux River inlet/outlet located at the northeast end of the lake. This site serves as both the Big Sioux River inlet, and the only outlet of the lake. The monitoring data from this site has provided information on both the loads into the lake from the Sioux River, and the loads out of the lake to the Big Sioux River. This site is located in the NW1/4, NE1/4, SW1/4, NE 1/4 of Section 15, T117N, R53W; latitude 44° 56′ 39", longitude 97° 10′, 31".

Site 5. The Mud Creek tributary site is located approximately 3 1/2 miles northeast of the lake. This site was used to provide loading information for Mud Creek. The location of this site is the NE1/4, NE1/4, NW1/4, NW1/4 of Section 6, T117N, R52W; latitude 44° 57′, 48", longitude 97° 07′ 20".

Site 6. This site on the Big Sioux River is approximately 4 miles north of Lake Kampeska. The data from this site has provided loadings from the Big Sioux River for a portion of the watershed upstream of the lake. This site has a U. S. Geological Survey gaging station, and is located in the NE1/4, NE1/4, NE1/4 of Section 16, T118N, R52W; latitude 45° 00′ 22", longitude 97° 09′ 53".

Site 7. The location of this site on the Big Sioux River is approximately 16 miles north of Lake Kampeska. This site also has a U. S. Geological Survey gaging station, and has provided loading information for the upper portion of the Big Sioux River watershed. The location of this site is in the NE1/4, NE1/4, NE1/4 of Section 17, T120N, R52W; latitude 45° 10′ 51", longitude 97° 11′ 09".

Stevens water level recorders were used to collect stage height records at Sites 1, 4, and 5. A stage recorder was not installed at Site 2, as there was no flow at this site during the study period. The flows at Sites 1 and 3 were extremely limited. A stage recorder was not installed at Site 3. The very intermittent flow at this site was measured with a flow meter.

Discharge data was obtained by two methods:

1) By using a flow meter to take point velocities on cross sections of the tributaries and calculating cubic feet per second.

2) For USGS gaging stations (Sites 6 and 7) flow data was obtained from the USGS.

The following water sample collection schedule was followed whenever possible. All sites were sampled twice weekly during the first week of snowmelt runoff, and once a week thereafter until runoff stopped. During storm events, samples were collected daily for the duration of storm runoff. Base flow measurements were taken periodically between storm events. Samples were taken at Site 4 for Quality Assurance.

The laboratory parameters that were analyzed to characterize the lake inflow and outflow, and to develop a nutrient and sediment budget, were as follows:

Fecal Coliform	Ammonia
Total Alkalinity	Nitrate + Nitrite
Total Solids	Total Volatile Suspended Solids
TKN	Total Fixed Suspended Solids
Total Phosphorus	Total Dissolved Solids
Total Dissolved Phosphorus	

The tributary samples for the above parameters were placed in four separate bottles with appropriate preservatives. The bottles were packed in ice for shipment to the State Health Laboratory at Pierre.

Field parameters that were collected and analyzed by sample collection personnel were the following:

Water Temperature	Dissolved Oxygen
Air Temperature	Field pH

Visual observations by sample collection personnel included, but were not limited to, these in the following table:

Precipitation	Dead Fish
Wind	Surface Film on Water
Odor	Turbidity
Septic Conditions	Water Color

The Lake Kampeska watershed sampling sites were established to monitor the areas with greatest potential for sediment and nutrient loadings. Summaries of concentration data for the tributary sites are shown in Appendices B-1 to B-5, Tributary Concentration Tables. The minimum, maximum, and mean values of the data are included at the bottom for each site.

The values for Site 4, the lake inlet/outlet, have been split into two sections to account for the days when water flowed out of the lake. This division is indicated throughout the report as Site KAM4 Inlet, and Site KAM4 Outlet. The values for Site KAM4 Outlet were determined by comparing the upstream and in-lake concentrations. In addition, the water gradient and wind speed and direction across the lake were taken into account to determine flows into or out of the lake.

The loadings summaries for each site can be found in APPENDIX C, 1992 Tributary Loading Tables. It should be noted that Site 5, Mud Creek, did not flow into Lake Kampeska during the 1992 season. However, during the 1993 spring runoff, this tributary flowed over the dike which has been constructed to divert the water from Mud Creek into the Big Sioux River below Lake Kampeska. Consequently, Mud Creek did contribute loadings into Lake Kampeska during the 1993 spring runoff.

For most of the sample results, the concentrations of nutrients and solids increased between Sites 7 and 6. Between Site 6 and Site 4 the concentrations decreased. This can be attributed partially to more stable streambanks and increased use of best management practices between Site 6 and Site 4.

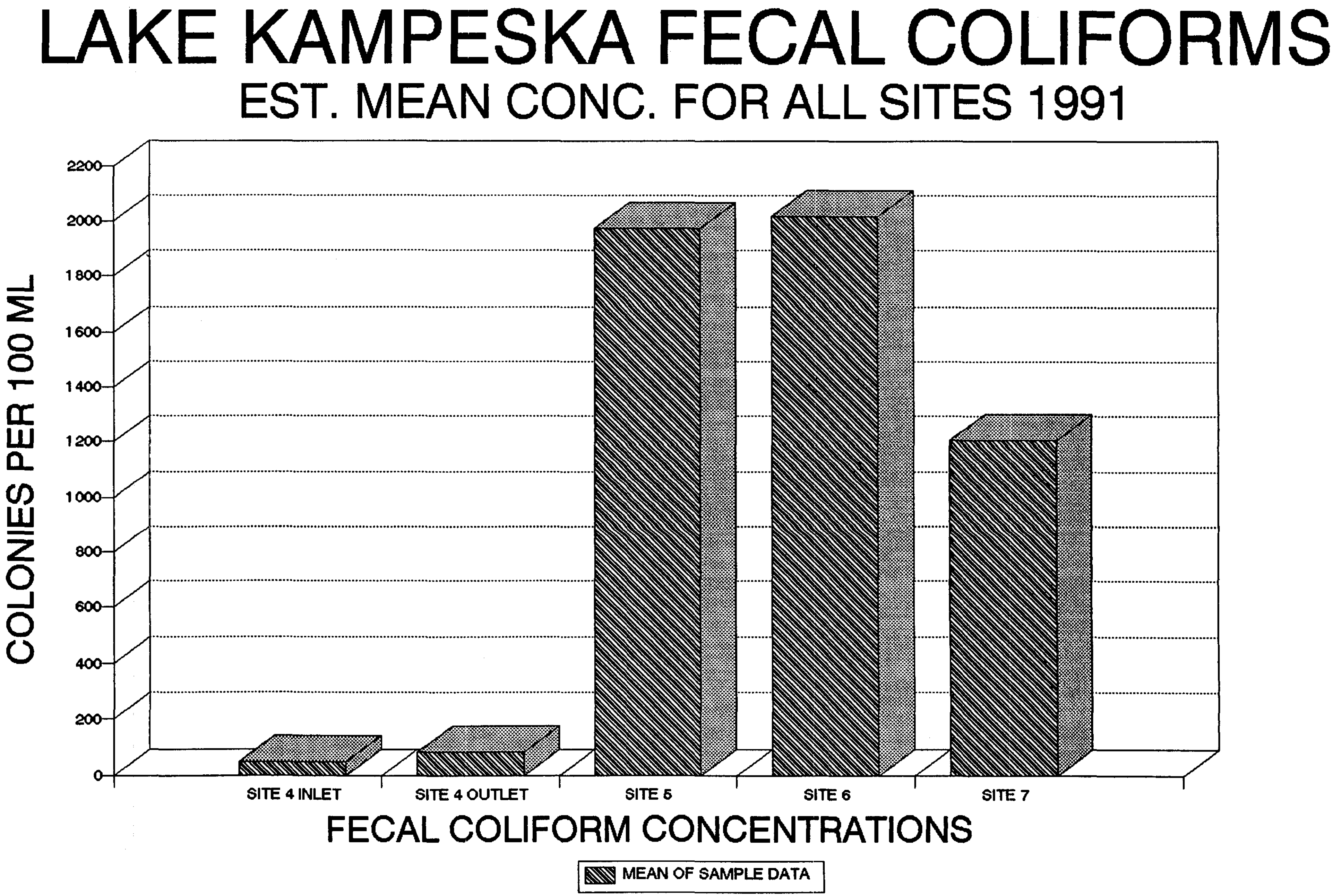
Fecal Coliform Bacteria

Fecal coliform bacteria are indicator organisms of animal and/or human waste. Sources include runoff from livestock feedlots, and failing septic systems. The water quality standard for fecal coliform bacteria in the Big Sioux River is a count of 1,000 organisms per 100 milliliters (1,000/100 mL). See Appendices B-1 to B-5 and Figure 9 for comparisons of fecal coliform results at the tributary monitoring sites.

Fecal coliform results for the Site 4 inlet/outlet did not exceed the standard during the sampling period. Site 6 and Site 7 both exceeded the standard during the sampling period. The fecal coliform standard was exceeded six consecutive times at Site 6 during spring storm events. The fecal coliform standard at Site 7 was exceeded three times. The first occurrence at both sites was on June 17, 1992, during a storm runoff event. The next two occurrences were on July 1 and 2, 1992, again following a storm runoff event. Taking into account the results at Sites 5, 6, and 7, the fecal coliform standard was exceeded on every sample date from June 17 to September 3, 1992. The last samples on November 3, 1992, for Sites 5, 6, and 7, arrived too late at the State Health Laboratory to be tested for bacteria. [It should also be noted that the water in Mud Creek, which was monitored at Site 5, did not flow into Lake Kampeska during 1992.]

The increase in fecal coliform concentrations between Site 6 and Site 7 can be attributed to the many livestock feeding operations in this area (Table 15, Feeding Area Survey by Subwatershed, Page 44). The lack of these operations in the area between Site 6 and Site 4 can partially

Figure 9. Lake Kampeska Fecal Coliforms Conc.



explain the drop in the concentrations entering the lake.

The problem of high fecal coliform results needs to be addressed, particularly in the subwatersheds between Sites 6 and 7 where the livestock operations are the most prevalent.

Solids

The mean concentrations of total, suspended, and dissolved solids for the sampling sites in the Big Sioux River Watershed are shown in Figures 10 and 11, Graphs of Tributary Solids Concentrations. Higher concentrations of total, suspended, and dissolved solids were found at Site 6 as compared to Site 7. This can be explained by the extensive field runoff and streambank erosion between these sites, as verified during a canoe trip down the Big Sioux River in May, 1993. Inflow from the Indian River, Soo Creek, and Mahoney Creek into the Big Sioux River below Site 7 also accounts for some of the increase in solids concentrations between these sites. Figures 12 and 13, Tributary Solids Loading Graphs, depict the loading relationships between the different monitoring sites in the watershed. The greatest total suspended solids loadings occurred at Site 6, with the next greatest loadings occurring at Site KAM4 Inlet (Figure 13). The loading of total suspended solids into the lake is approximately 945 thousand pounds (429 thousand kilograms) per year (Figure 14, Lake Kampeska Inlet vs. Outlet Solids Loads). This compares to the loading out of the lake at Site KAM 4 Outlet of 16 thousand pounds (7,500 kilograms) per year (Figure 14). The largest portion of the suspended solids loading flows into the lake during flood stages of the river.

The most stringent suspended solids standard for the Big Sioux River is 90 mg/L. This standard was exceeded at two sites (5 and 6) during the sample period. As can be seen from Appendix B-3, the standard was exceeded on two sample dates at Site 5, and on one occasion at Site 6 (Appendix B-4). For the yearly average, the sample results are well within the standard (Figure 11, Lake Kampeska Tributary Solids Concentration Graph).

Figure 10. Total Solids, and Dissolved Solids Conc. Tributary sites

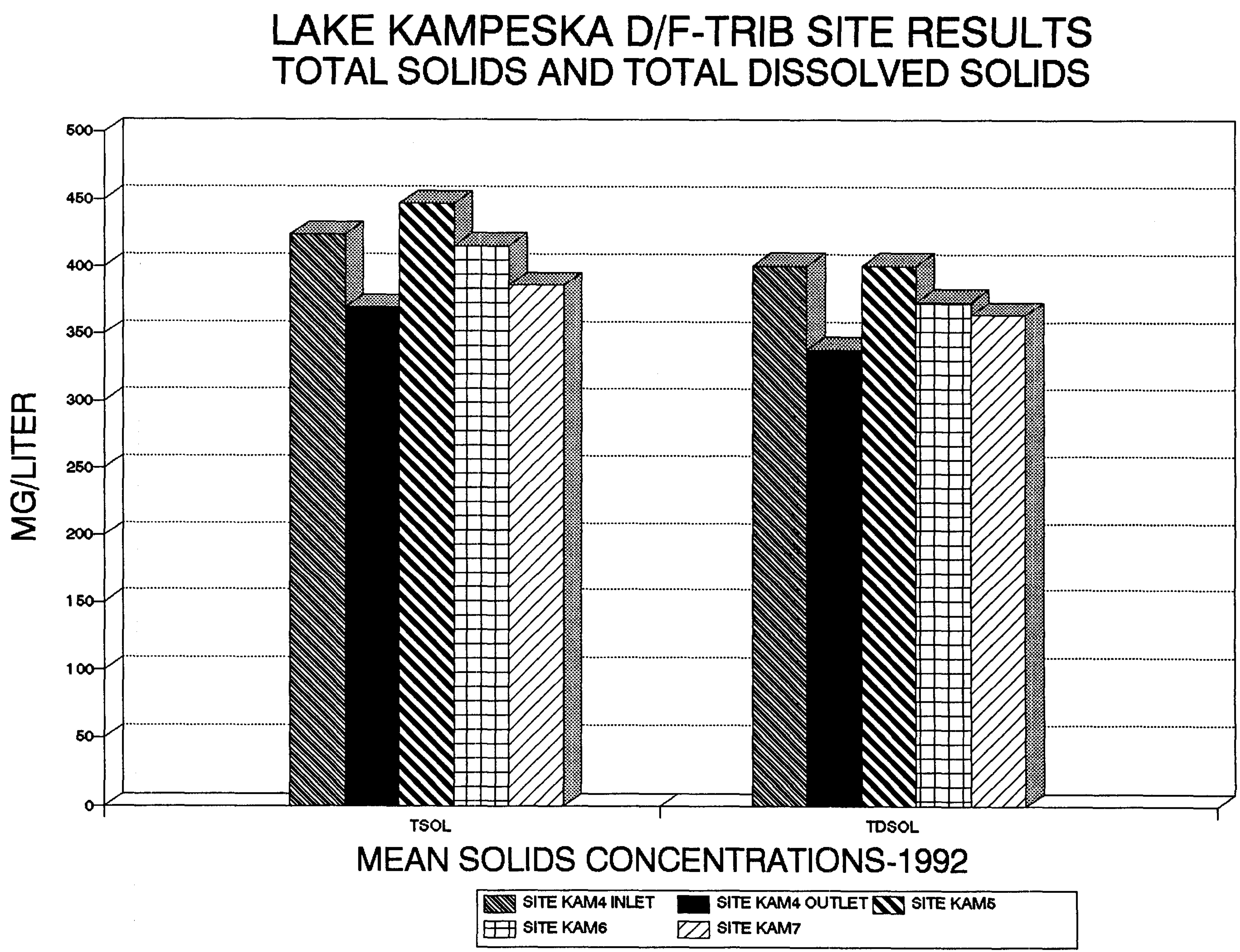


Figure 11. Suspended, Fixed, and Volatile Solids Conc. Tributary Sites

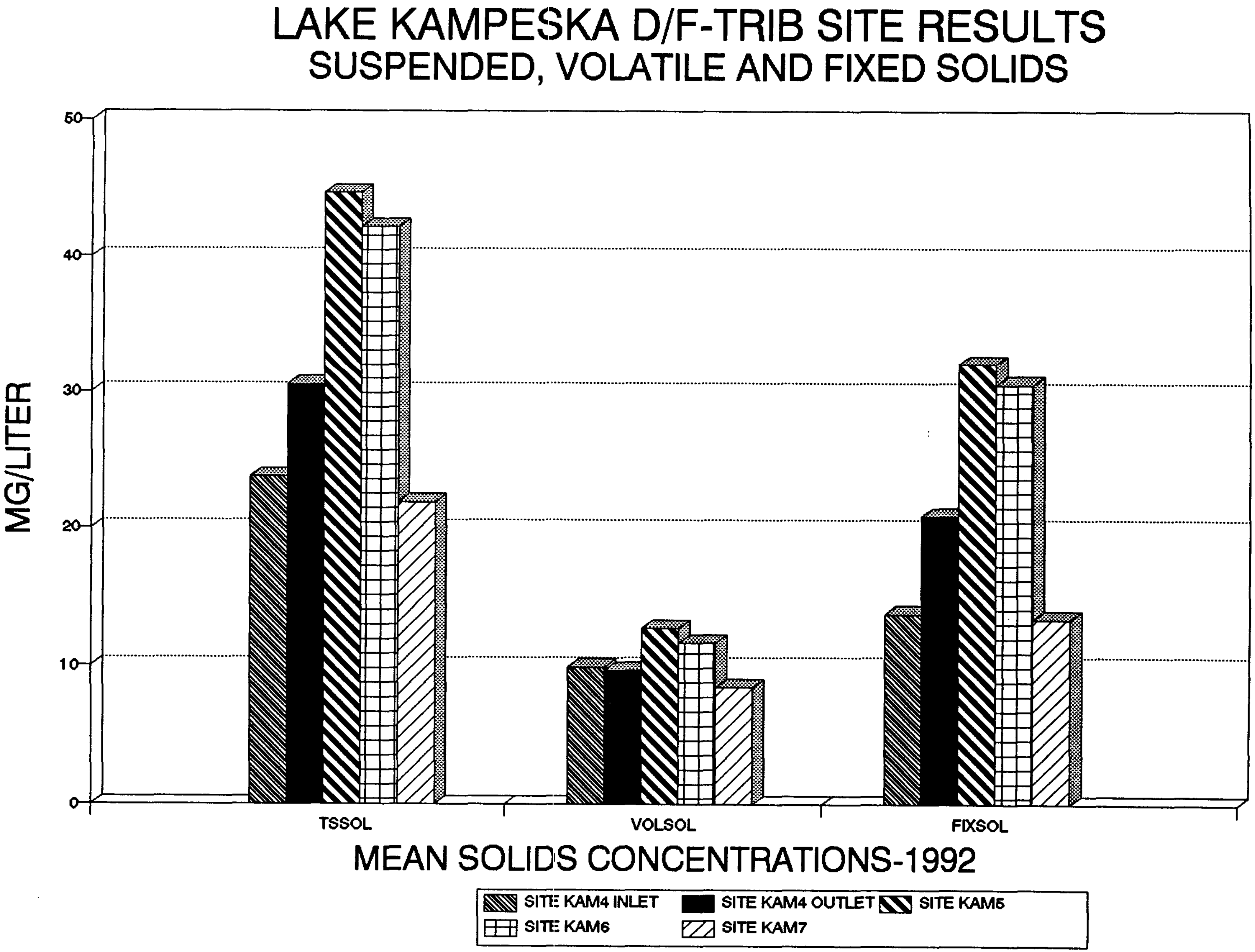


Figure 12. Total Solids and Dissolved Solids Loadings Tributary Sites

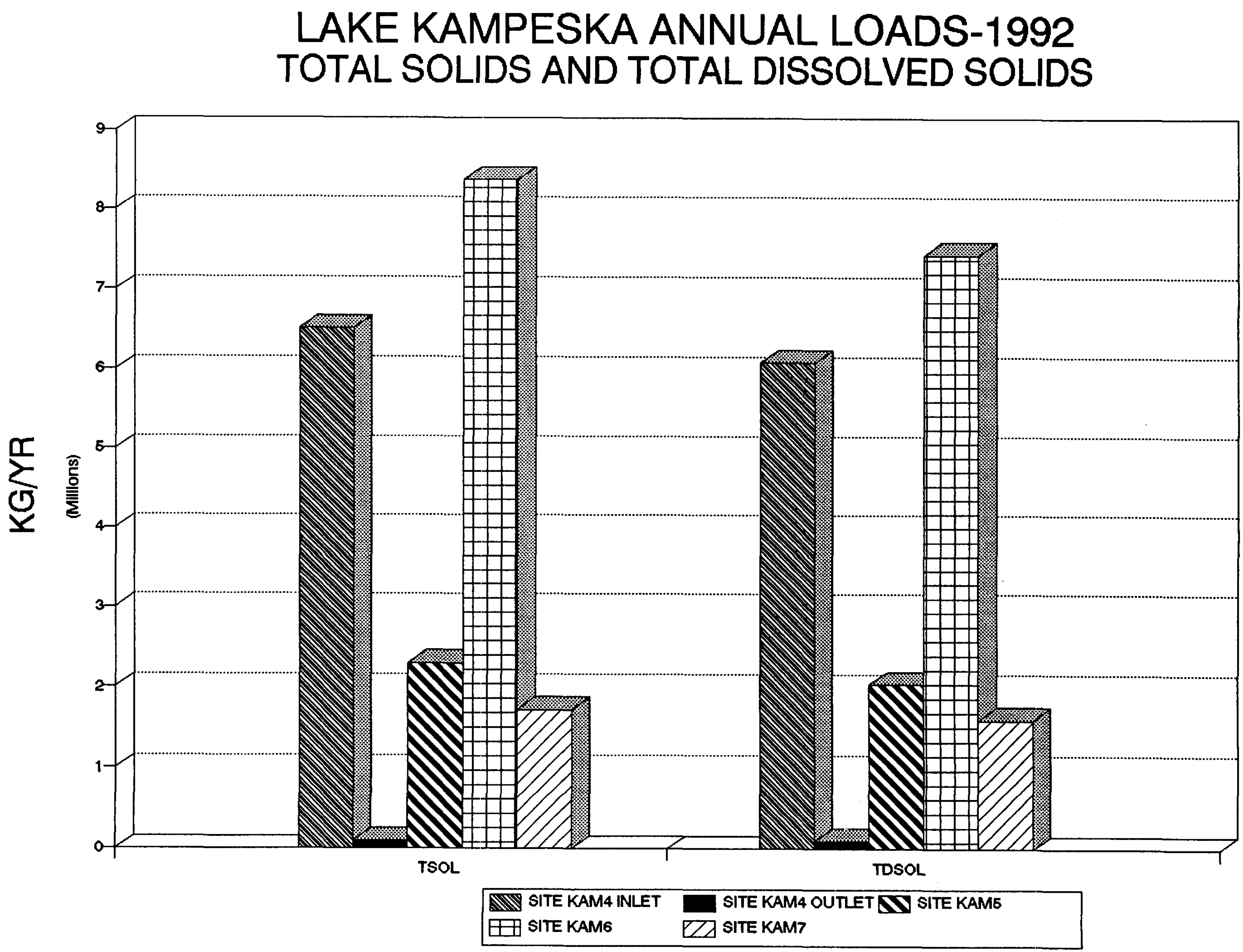


Figure 13. Suspended, Fixed, and Volitile Solids Loadings Tributary Sites

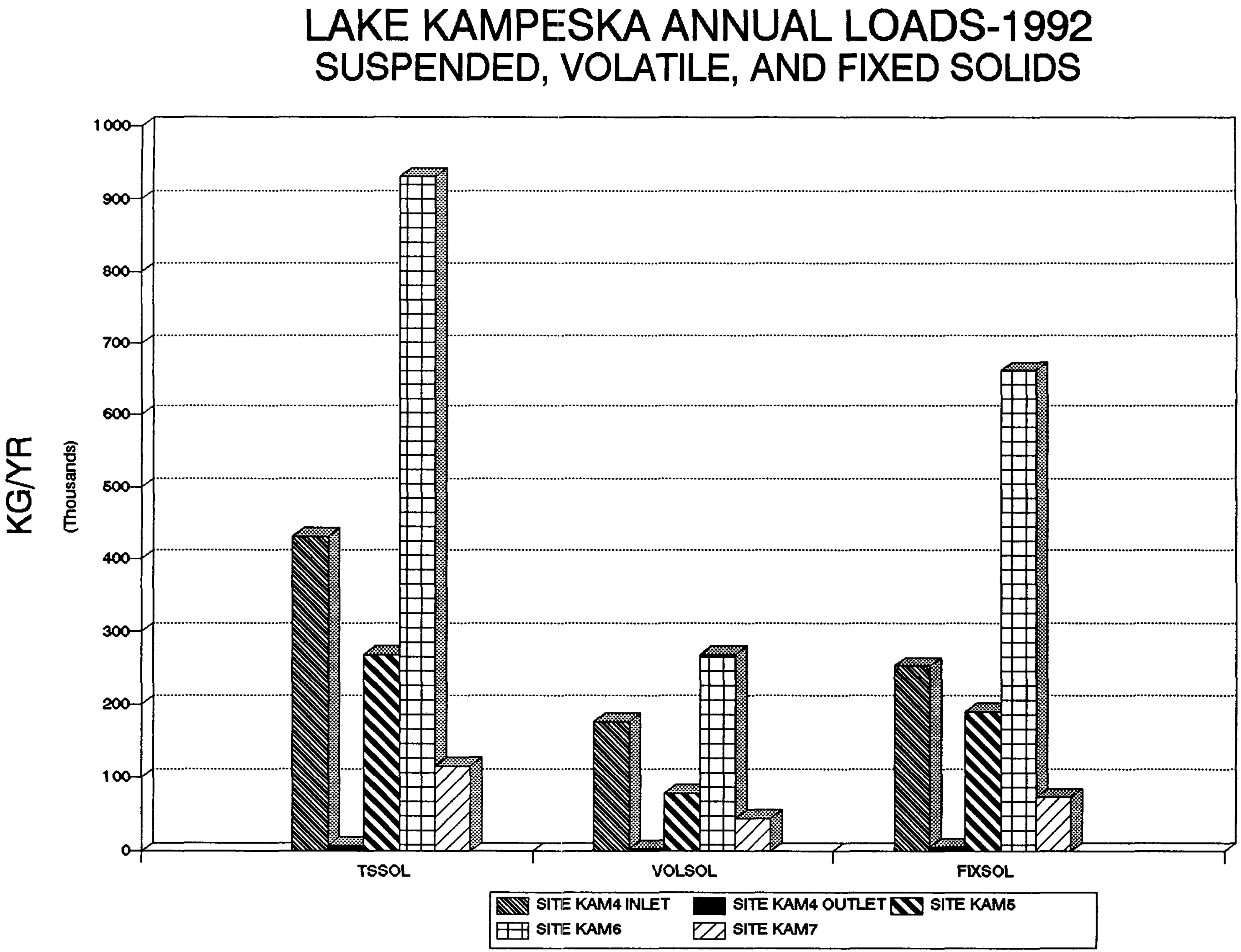
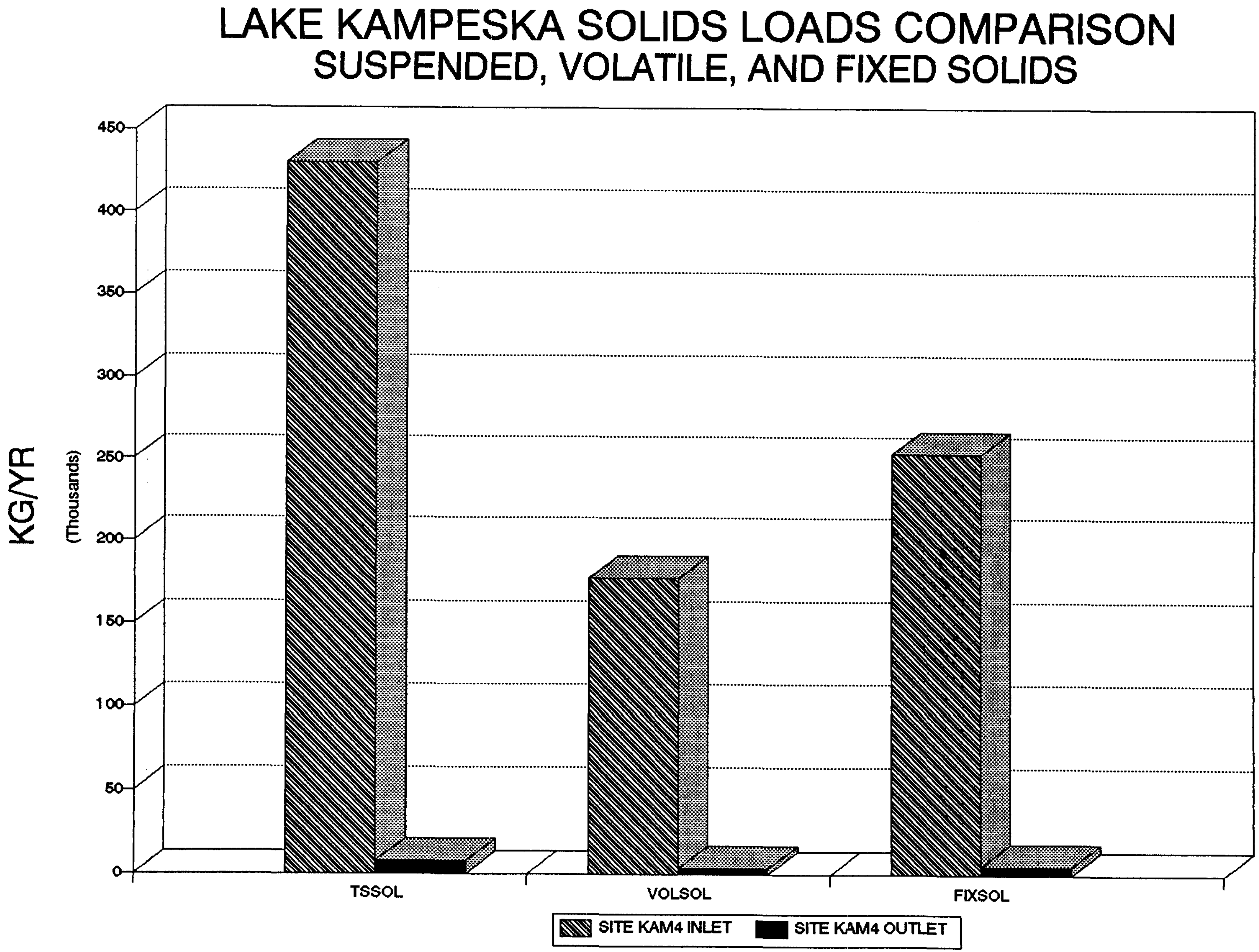


Figure 14. Suspended, Fixed, and Volatile Solids Loads Inlet vs. Outlet



Nitrogen

The highest mean nutrient concentrations for nitrate/nitrite nitrogen and TKN occurred at Site 7 (Figure 15, Lake Kampeska D/F Tributary Site Results, Mean Nutrient Concentrations). The highest nitrogen loads, however, were found at Site 6 due to greater water flows (Figure 16, Lake Kampeska Estimated Mean Nutrient Loads, 1992). The loading of nitrate/nitrite nitrogen at Site KAM4 Inlet versus Site KAM4 Outlet showed a difference of 5,373 pounds (2,440 kilograms) per year. This is the total loading of nitrate/nitrite nitrogen into the lake for the year (Figure 17, Lake Kampeska Inlet vs. Outlet Nutrient Loadings Graph).

The majority of the higher concentrations for nitrogen at the tributary monitoring sites in 1992 were found during the spring runoff. Sources of this nitrogen include animal waste, domestic waste from septic systems, or runoff from nutrient-rich agricultural land. Since much of the land is cropped, fertilizer runoff from recently planted crops was the most probable source.

The water quality standard for nitrates in the Big Sioux River is 50 mg/L. This level was never reached during the sampling period. The highest concentration recorded was 2.4 mg/L at Site 7 on November 3, 1992 (Appendix B-5, Tributary Concentration Summaries).

Phosphorus

Other than the lake outlet, the highest mean concentration of total phosphorus, 0.238 mg/L, occurred at Site 7 (Figure 15, Lake Kampeska D/F Tributary Site Results, Mean Nutrient Concentrations). This can be attributed to the extent of cultivated agricultural land in the upper Sioux subwatershed. Site KAM4 Outlet had the highest mean concentration of total phosphorus at 0.247 mg/L (Figure 15). This can be attributed to the fact that most of the water flowed out of the lake when wind action was the greatest. The wind action stirred up the bottom sediments in depths less than 12.5 feet (3.8 m), thus re-suspending the sediment-bound phosphorus. The amount of phosphorus entering the lake is much greater than that going out. The loading of total phosphorus into the lake, Site KAM4 Inlet, during the 1992 sampling period was 7,141 pounds (3,242 kilograms) (Figure 17). This compares to a loading out of the lake at Site KAM4 Outlet of 146 pounds (66.5 kilograms) (Figure 17, Lake Kampeska Inlet vs. Outlet Nutrient Loadings Graph). It can be seen that flows into the lake from the Big Sioux River are adding large loadings of total phosphorus. The phosphorus at the water/sediment interface in the lake is re-suspended by wind action, boat motors, and bottom-feeding fish. This occurs because stratification is limited to depths greater than 12.5 feet (3.8 m). The depth of the lake immediately around the inlet/outlet is primarily less than 12.5 feet. This allows the sediment most available to the outflowing waters to be re-suspended and discharged.

Figure 15. Mean Nutrient Concentrations Tributary Sites

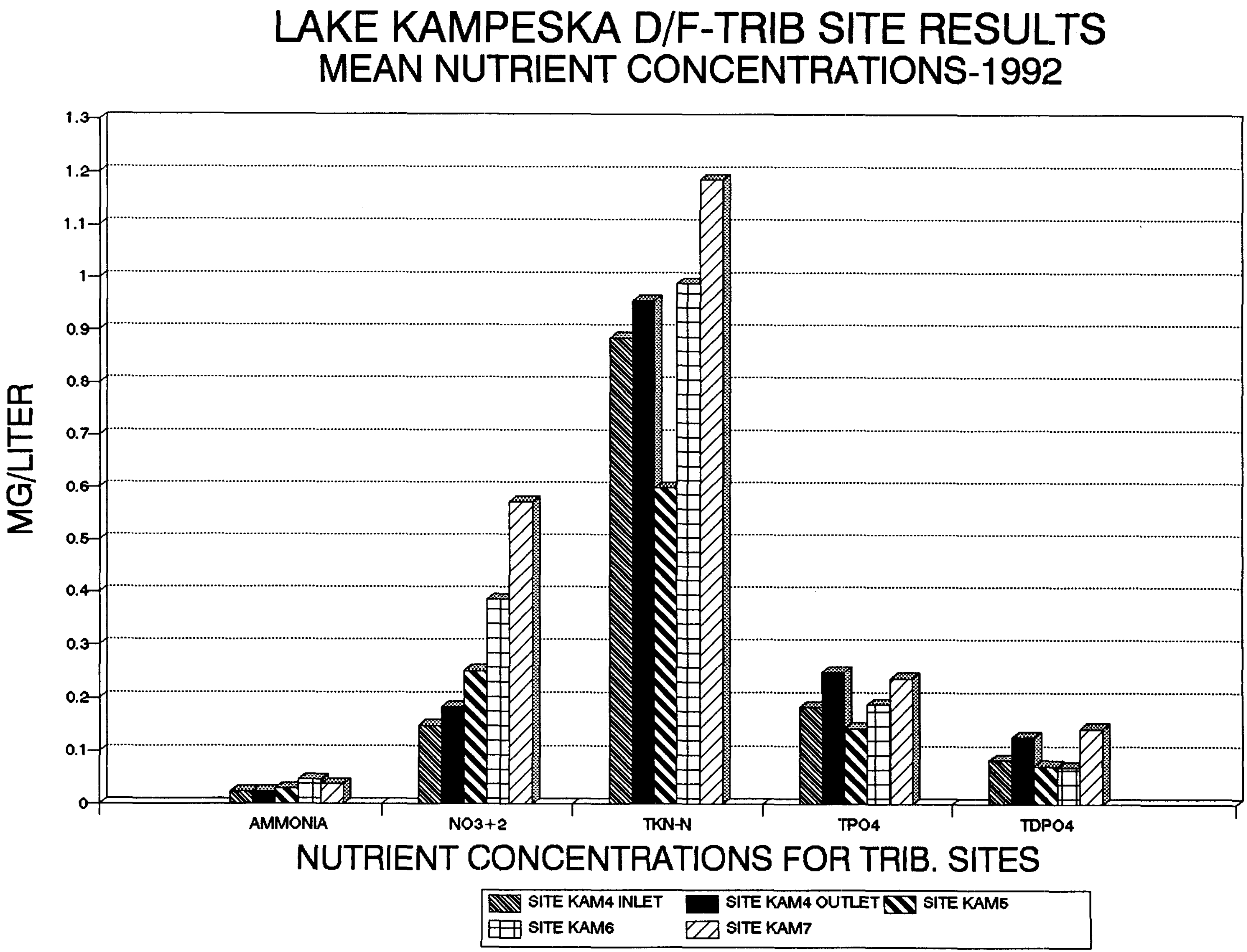


Figure 16. Annual Nutrient Loads Tributary Sites

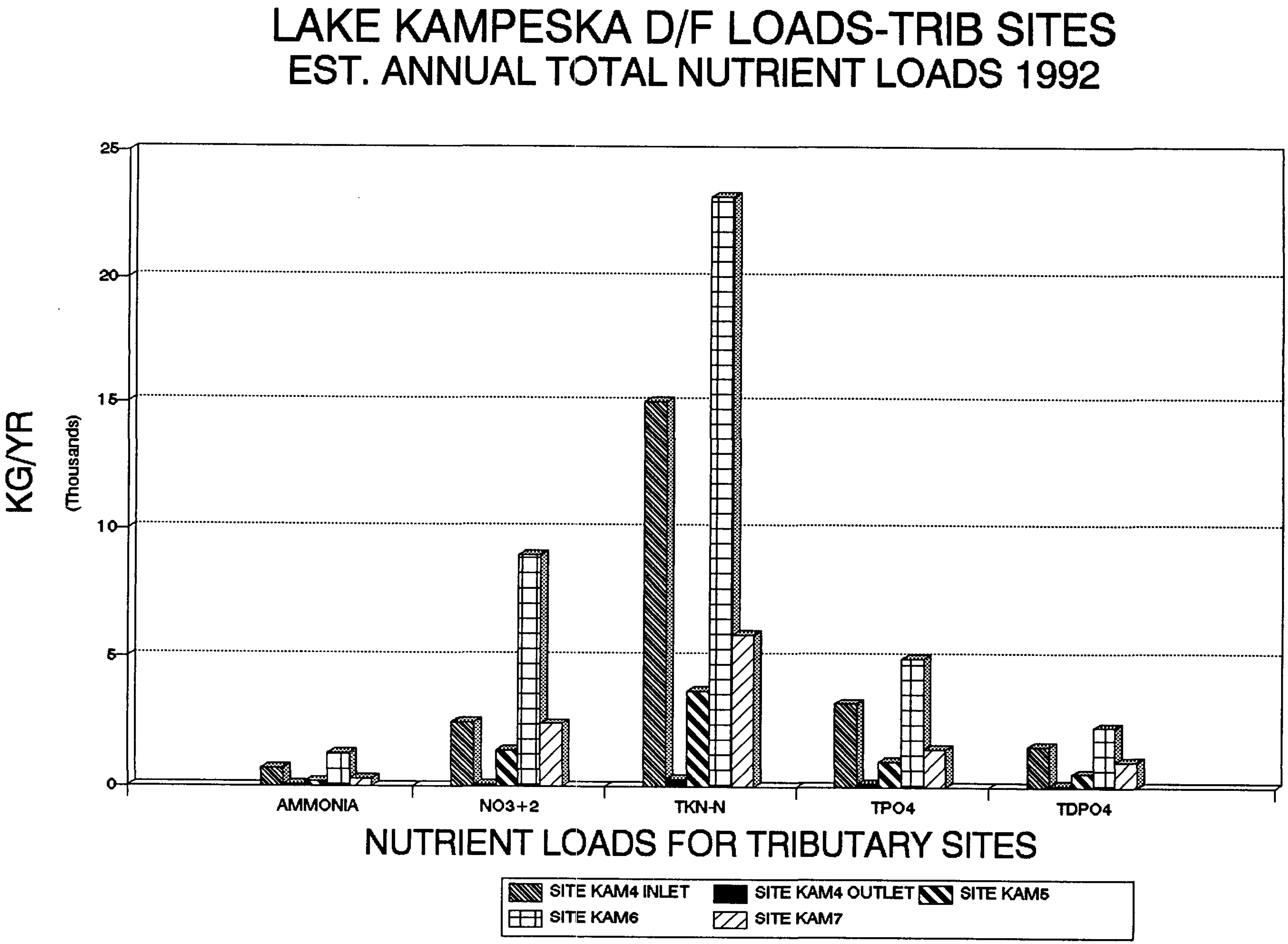
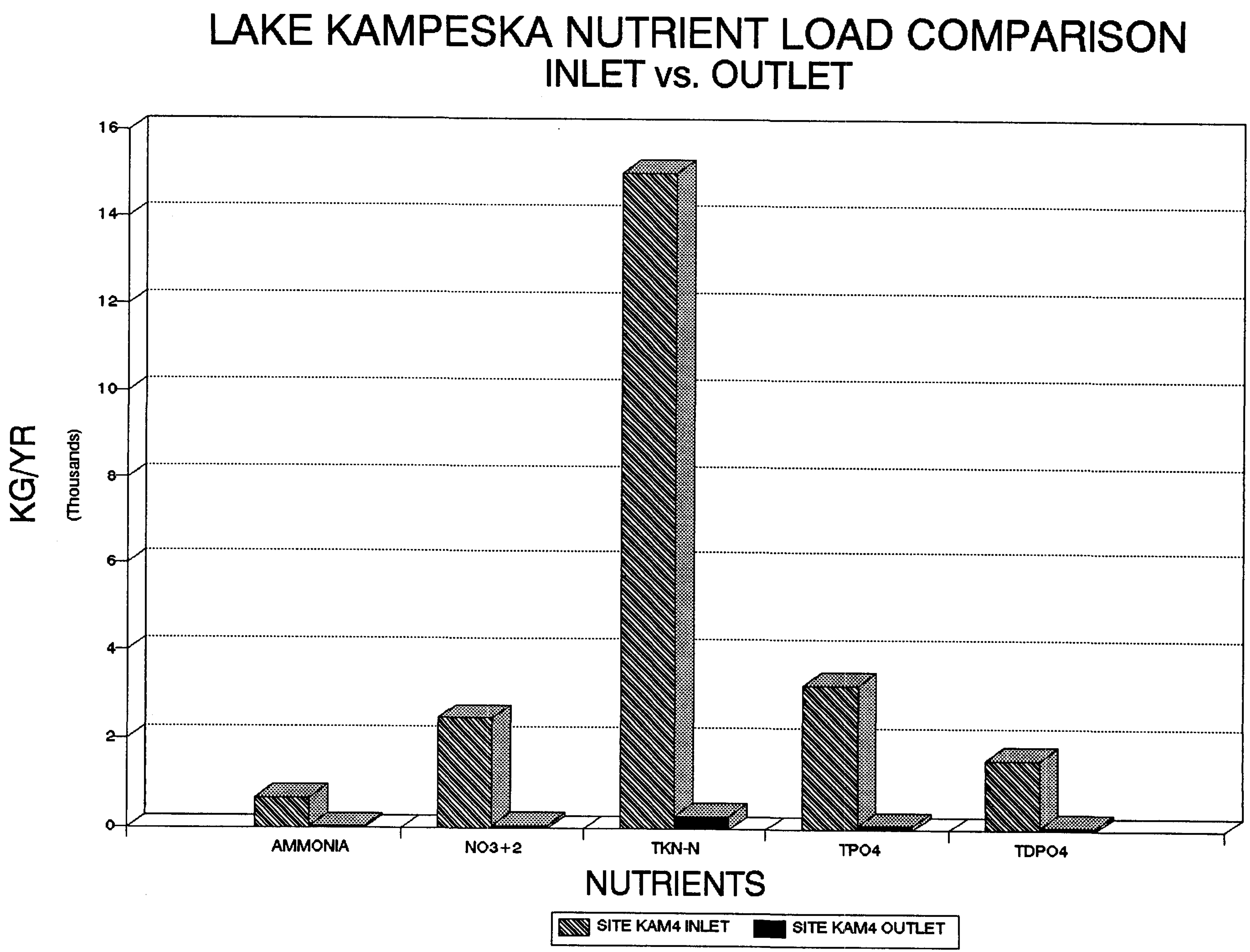


Figure 17. Nutrient Loads Comparison Inlet vs. Outlet



The high loadings of suspended solids entering the lake (Figure 14) contribute to the particulate and bound portion of the phosphorus. Sources of phosphorus in the watershed include animal waste, failing septic systems, and cropland runoff.

pH

Water quality standards for the Big Sioux River indicate that pH should be greater than 6.5 units and less than 9.0 units. Only one sample result was slightly outside this range, as the pH at Site 7 on April 2, 1992, was 9.1 (Appendix B-5, Tributary Concentrations Summary).

Tributary Data Spring 1992/1993 Comparison

It is difficult to directly compare the data for spring, 1992, with the data for spring, 1993, because of differences in runoff events. In 1992, the Big Sioux River/Lake Kampeska watershed experienced slight snow runoff and then had large runoff events in early June and again in early July, both caused by large rainstorms. Also, snowmelt in 1992 began in early February due to unseasonably warm temperatures, whereas in 1993 the snowmelt and runoff event didn't begin until March 28 (Appendix C and Appendices D-1 to D-5). The 1993 snowmelt runoff was much greater due to a larger snowpack which accumulated in the watershed over the winter. As a result, the loadings for the spring of 1993 are much greater than those for the spring of 1992 (prior to May 10). The data for spring, 1993, if compared to the flood data for June/July, 1992, are similar, if it is kept in mind that planting of crops had already occurred in 1992. Although the data show some differences due to time of runoff events, they also indicate that the major loadings occur during large runoff events.

In-Lake Water Quality Data

Three in-lake sampling sites were selected for Lake Kampeska (Figure 18, Lake Kampeska In-lake Sampling Sites). Descriptions of the sampling sites are as follows:

Site 9. Site 9 is located in the middle of the southwest end of the lake, approximately 1 mile north of the Sandy Shores State Park; latitude 44° 54′ 30″, longitude 97° 14′ 40″.

Site 10. This site is located approximately 1 1/4 mile northwest of the Watertown Country Club golf course; latitude 44° 55′ 30″, longitude 97° 12′ 00″.

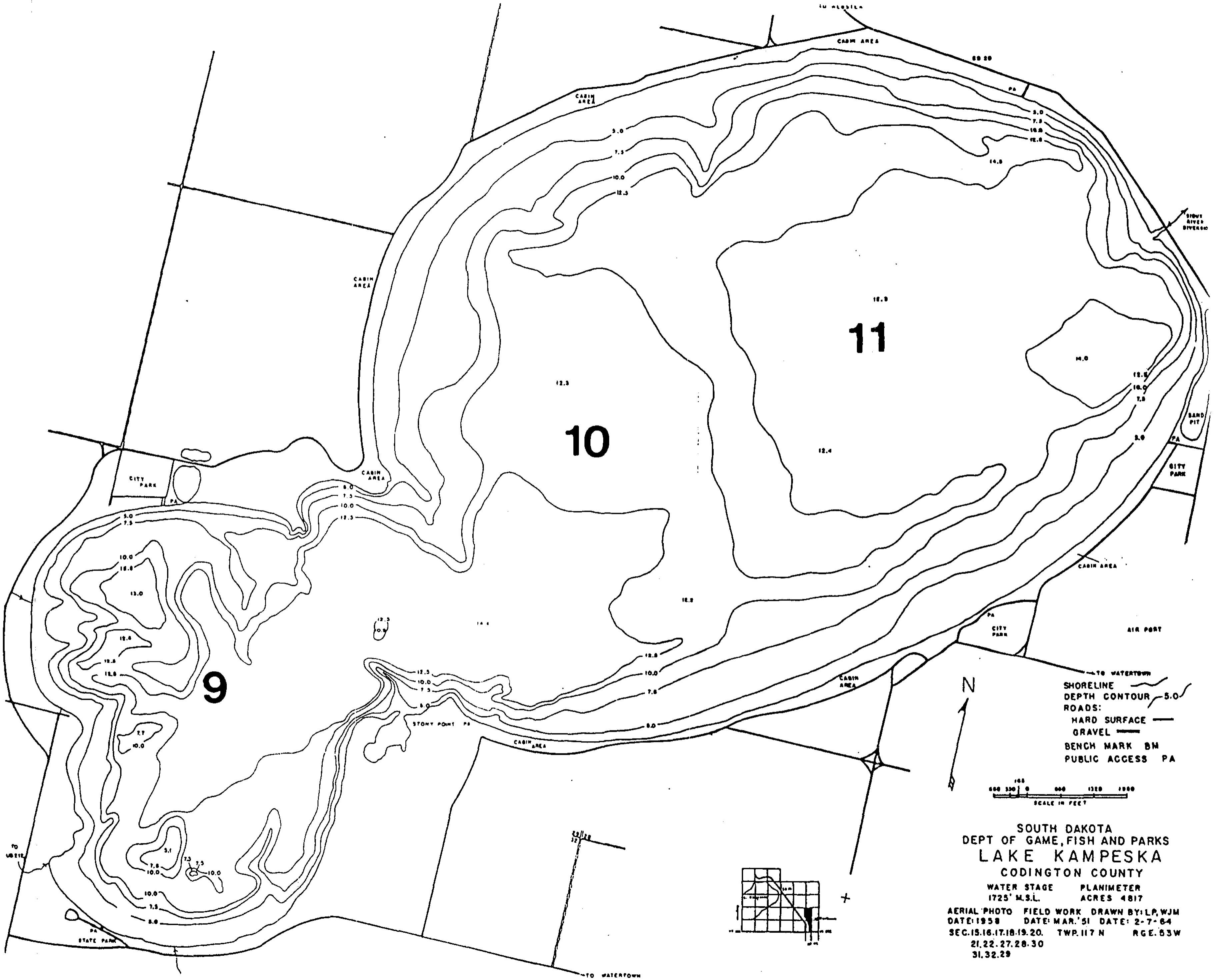


Figure 18. In-Lake Sampling Sites

Site 11. Site 11 is located approximately 1 mile southwest of the Big Sioux River inlet/outlet (Site 4); latitude 44° 56′ 00″, longitude 97° 10′ 26″.

Each in-lake site was sampled monthly from October through March, and twice a month from April to September. There were times during the winter months when sampling could not be conducted because of unsafe ice conditions. At those times, sampling was postponed until ice conditions were safe. On each sampling date, samples were collected from both the surface and near the bottom of the lake. Additional samples for Quality Assurance/Quality Control (QA/QC) were collected at Site 11. Bottom sample water at Site 11 was used for the QA/QC sampling.

The physical and chemical parameters analyzed for the in-lake samples were the same as the tributary samples, with the addition of chlorophyll a analysis. Samples for the chlorophyll a analysis were filtered and frozen for examination at a later date.

The in-lake parameters analyzed by sample collection personnel included:

Water Temperature	Air Temperature
Dissolved Oxygen	pH
Water Depth	Secchi Disk Depth

Dissolved oxygen and water temperature were measured with a YSI meter calibrated according to elevation. The water temperature and dissolved oxygen were measured at the surface of the lake, then at two-foot (0.6 m) intervals to 10 feet (3.1 m) of depth, and then at one-foot (0.3 m) intervals to the bottom.

Visual observations noted by field sampling personnel included, but were not limited to, the following:

Wind	Odor
Precipitation	Septic Conditions
Dead Fish	Surface Film on Water
Turbidity	Water Color
Algal Blooms	Lake Elevation

Hydrologic Budget

Because of water flowing both directions at Site KAM4 Inlet/Outlet, an accurate hydrologic and particulate budget could not be calculated by the usual means. Calculating the outflow involved comparisons of lake gradients between Sites 1 and 4, tributary velocities upstream, precipitation records, and wind direction and speed across the lake.

The lake volume increased dramatically with runoff events in both 1992 and 1993, and then gradually returned to normal levels. This extended hydraulic retention time allows particulate matter in the water to settle out, thus contributing to sedimentation of the lake.

Dissolved Oxygen

The dissolved oxygen levels in Lake Kampeska have historically been very good, with no recorded fish kills. No anoxic conditions were documented during the course of the study. Figures 19 and 20 show dissolved oxygen and temperature profiles for the Phase I sampling period.

The average results for the three surface water sample sites never dropped below the water quality standard of 5 mg/L during the sampling period (Figure 21, Dissolved Oxygen Surface Graph). The average dissolved oxygen results for the bottom samples dropped below the 5 mg/L standard on only one date, February 19, 1992 (Figure 22). The average bottom oxygen reading of 4 mg/L occurred during ice cover on the lake. The low oxygen level was probably caused by the decay of organic material in the bottom sediments, and a lack of penetration by sunlight through the snow cover on the ice. Decreased light penetration would decrease photosynthesis by algae and aquatic plants, thus leading to lower oxygen levels.

In-lake dissolved oxygen and temperature isopleths (Figures 19 and 20) were compiled using data collected during 1992. The data used was the average temperature and dissolved oxygen readings from three separate sites in the lake. The depths of these sites varied from thirteen feet to fifteen feet. The displayed isopleths were limited to depths of thirteen feet. Depths greater than this were not used so as to alleviate differences between sites.

In-lake temperature stratification patterns were seen during the winter months between November and March. These dates coincided with the formation of ice in November and the spring thaw and increased inflow from the Big Sioux River which occurred in late March and April. A very limited stratification period occurred in late July to early August. This only occurred in depths greater than 12.5 feet and only differentiated by three degrees Celsius. The periods from March to July and August to October were periods when the lake was mixed from top to bottom allowing free chemical movement throughout the lake.

In-lake dissolved oxygen stratification was more sporadic and occurred primarily in depths greater than eleven feet. Warm weather stratification was usually dependent upon periods of increased algal growth and turbidity. The surface stratification which occurred during May, 1992, corresponded with decreased Secchi depth readings. This indicated an increase in turbidity. The Secchi depth readings increased in June and dissolved oxygen levels dropped at eleven feet during July. This indicates the organic matter settled to the bottom and bacteriological decomposition was using an increased amount of the dissolved oxygen. This cycle of surface and bottom stratification occurred again in August and September. The dissolved oxygen stratification occurred to a limited degree during the winter months and coincided with the thermal stratification.

Lake Kampeska Dissolved Oxygen Isopleths

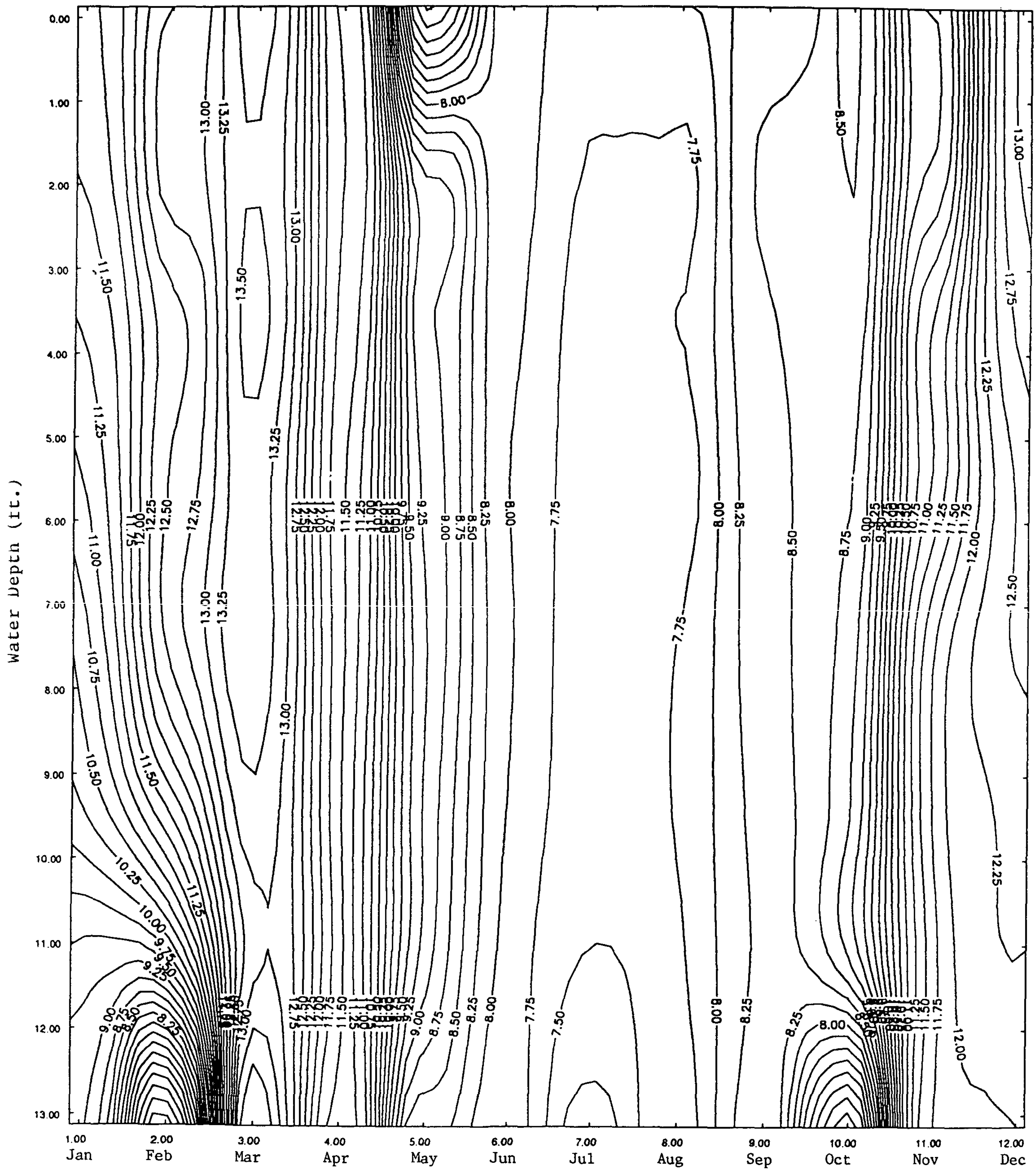


Fig 19. Lake Kampeska Composite Dissolved Oxygen Profile (mg/L), 1991-1993.

Lake Kampeska Temperature Isopleths

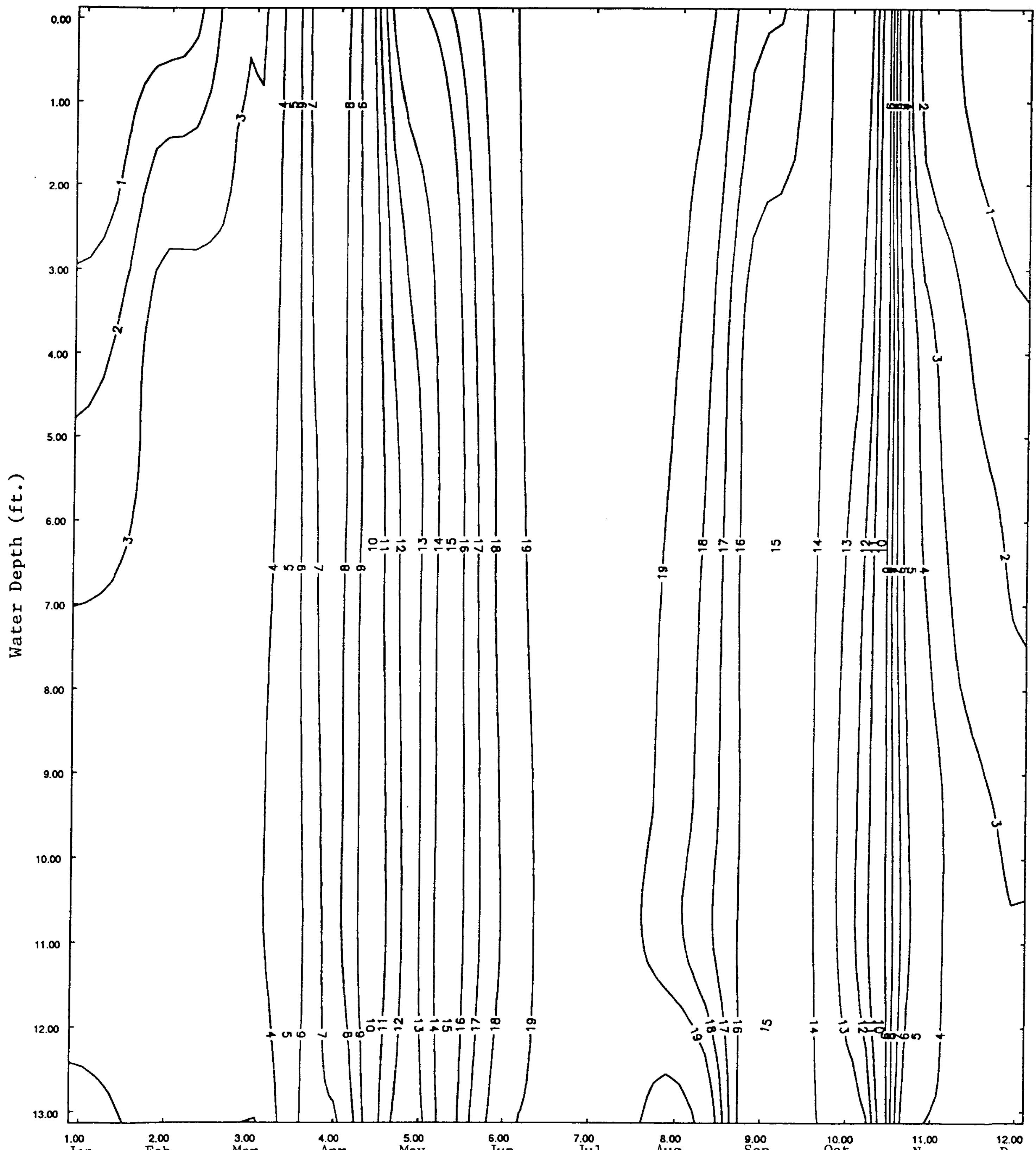


Fig 20. Lake Kampeska Composite Temperature Profile (C^{o}), 1991-1993.

Figure 21. Dissolved Oxygen Mean Values Surface Samples

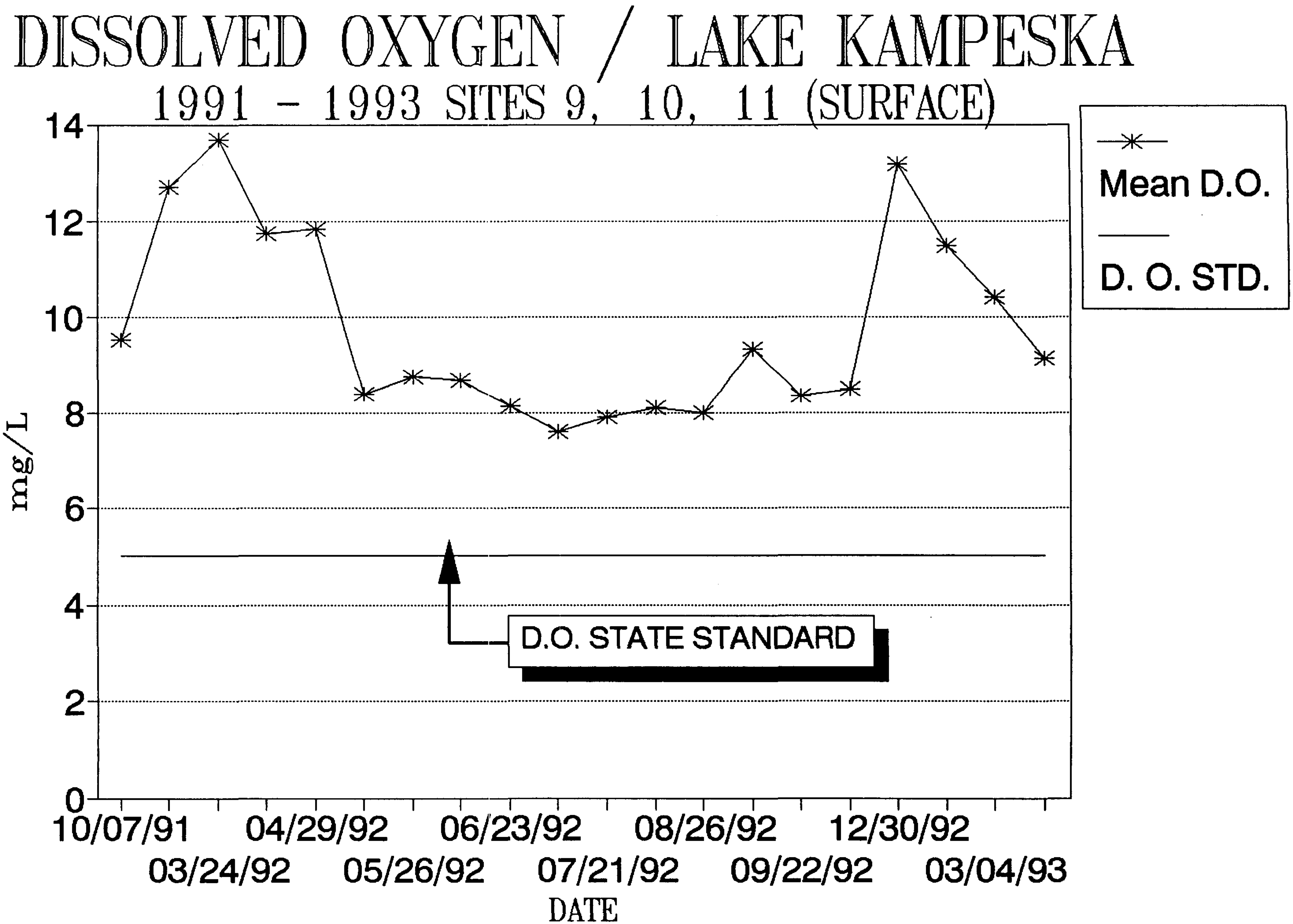
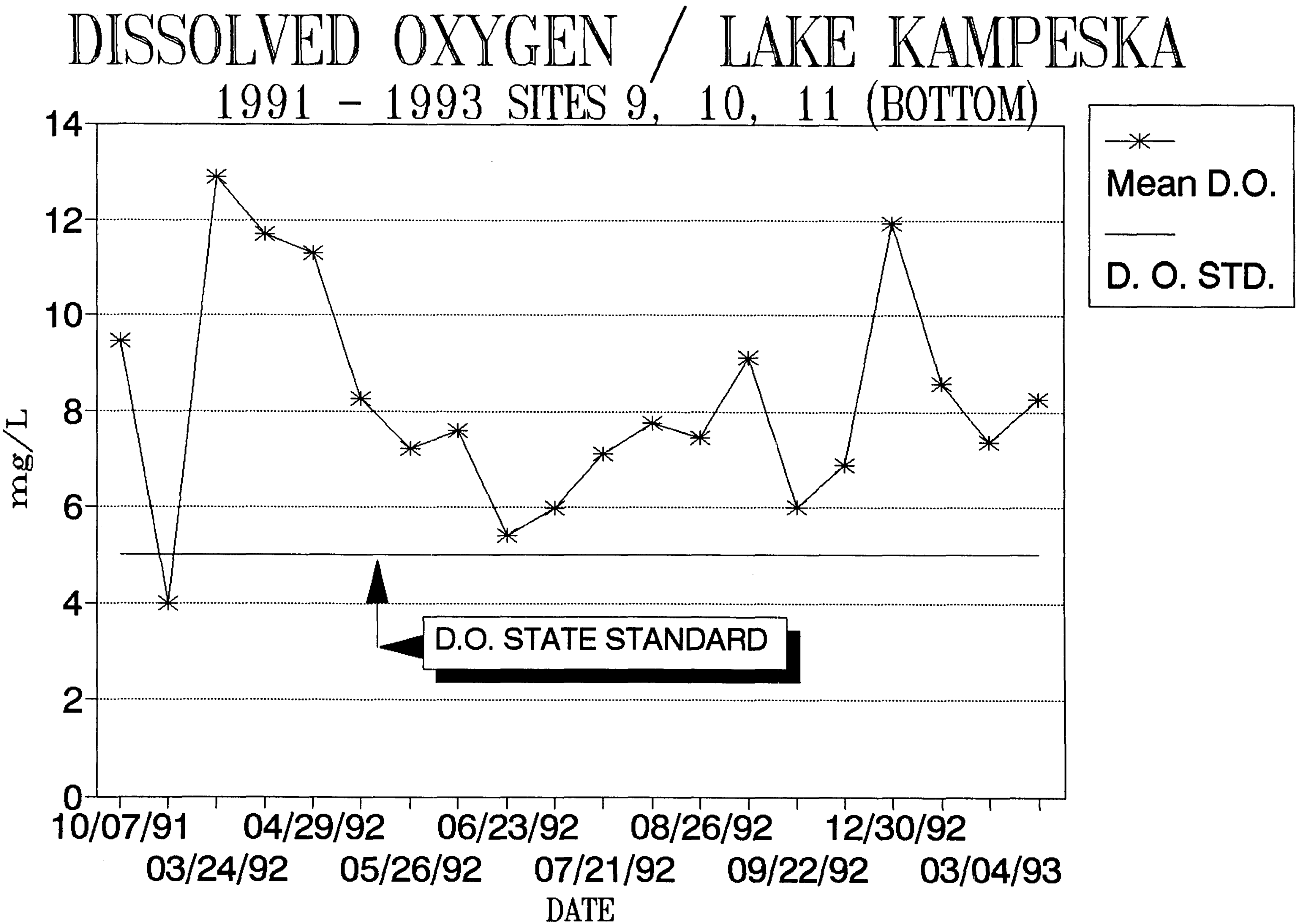


Figure 22. Dissolved Oxygen Mean Bottom Samples



Fecal Coliform

One of the designated uses for Lake Kampeska is immersion recreation, such as swimming. The results of fecal coliform bacteria monitoring during the study did not indicate a concern for public health. In-lake fecal coliform concentrations were negligible during the sample period, in spite of the high concentrations found in some of the tributary samples. The low in-lake results may be attributed to the increased volume (dilution) of the lake.

In-lake sample results for fecal coliform bacteria never exceeded 160 MPN (most probable number of organisms) per 100 mL. The water quality standard for Lake Kampeska is 200 MPN per 100 mL (Appendices E3 to E6).

pH

The pH water quality standard for Lake Kampeska is the range between 6.5 and 9.0 units. The results for surface and bottom samples obtained during the assessment period were between these standards at all times (Figures 23 and 24, Field pH Graphs, Surface and Bottom). The median value was approximately 8.3. This can be attributed to the carbonate levels in the soils of the watershed being high enough to buffer the lake. Field pH differentiates primarily in the late winter months as in February, 1992 and January, 1993. Field pH dropped lower at these times than during representative warm and cold water months.

Figure 23. Field pH Surface Mean.

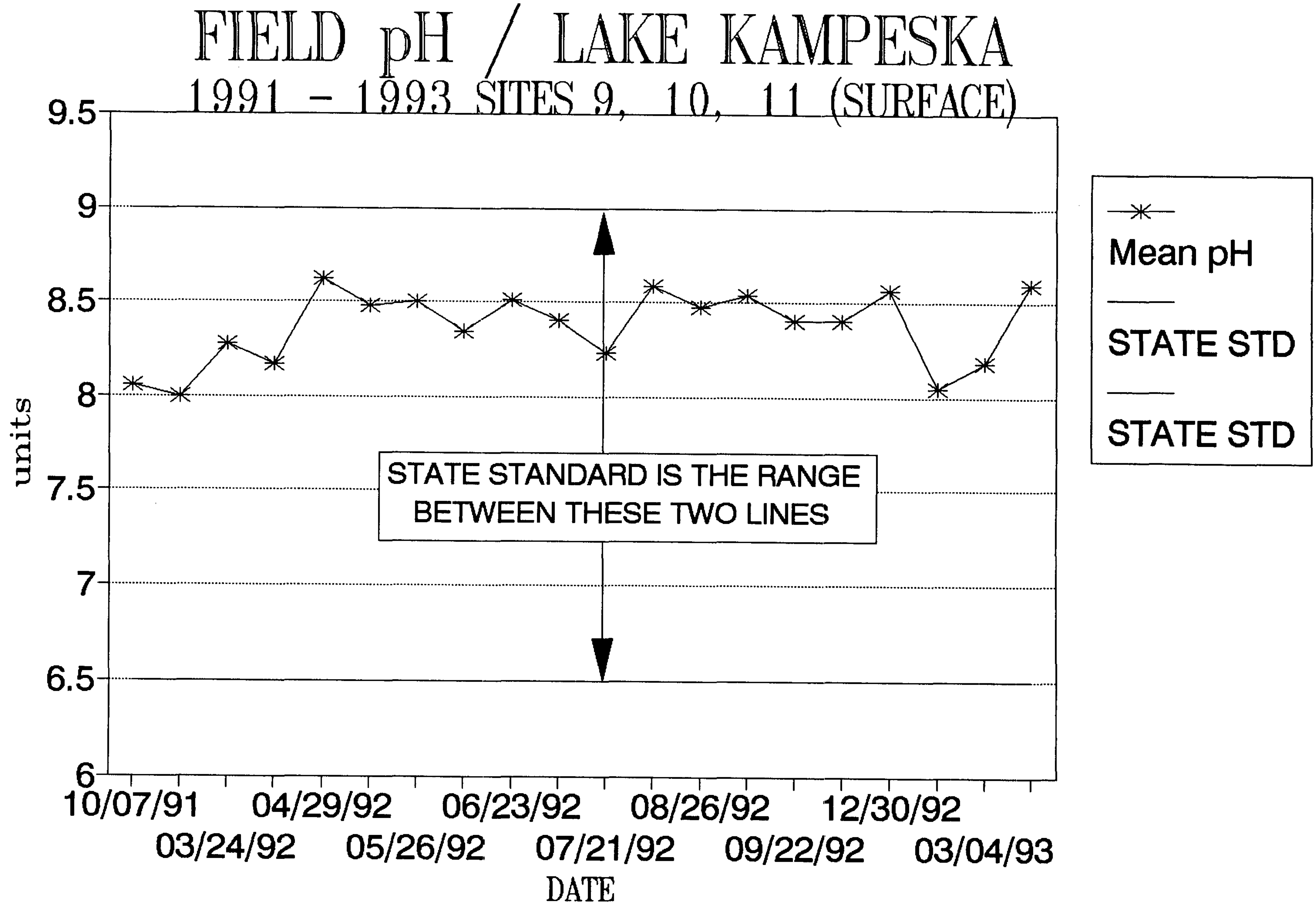
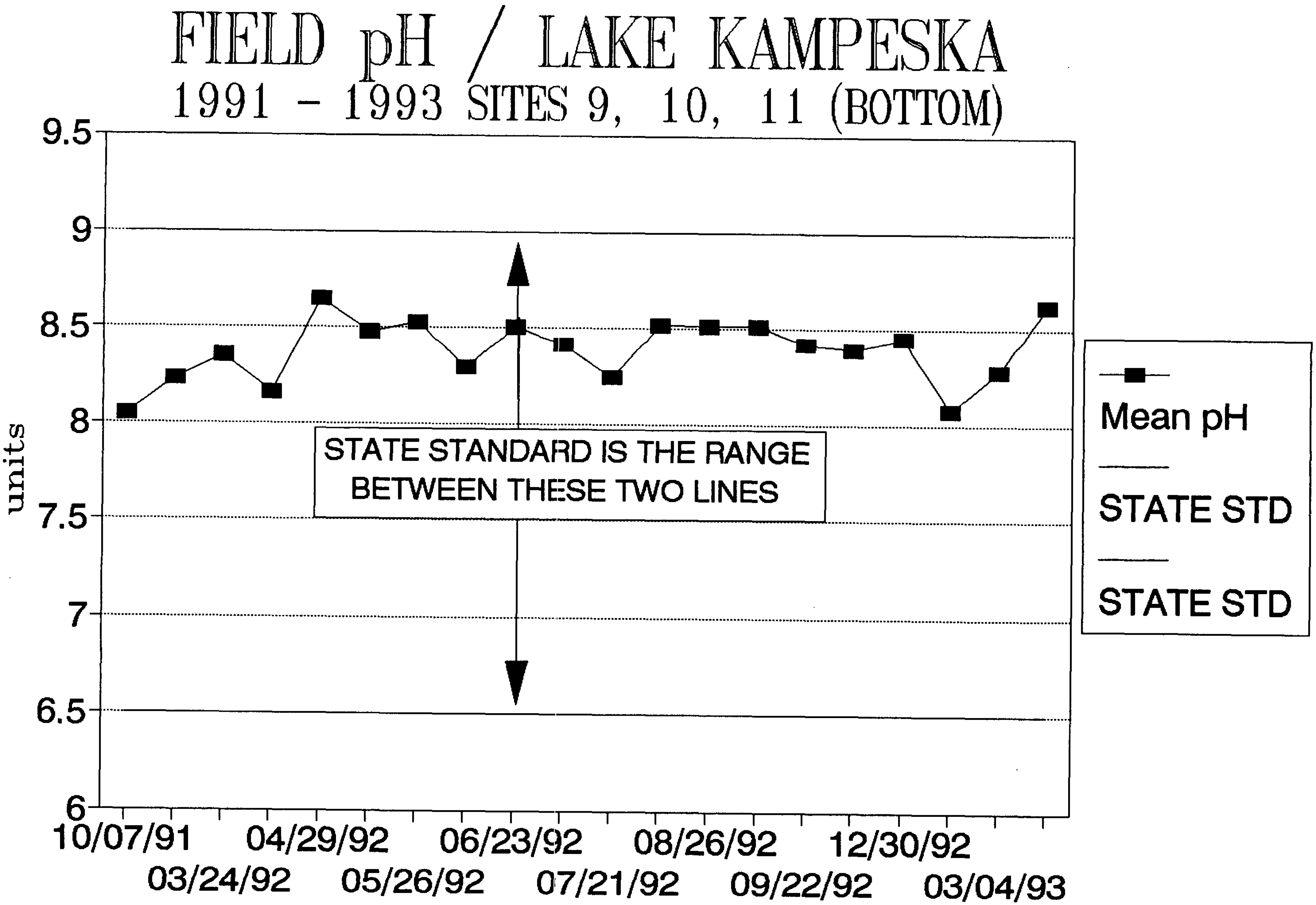


Figure 24. In-Lake Field pH Mean.



Total Suspended Solids

Suspended solids impair water clarity and aesthetic appearance. As can be seen from a comparison of Figures 25, 26, and 27, the total suspended solids levels reflect Secchi disk measurements. Higher suspended solids concentrations result in decreased depths for Secchi disk measurements. It was found that high suspended solids and decreased clarity generally followed periods of sustained wind. Increased Secchi depths during winter months are partially the result of ice cover, which negates the effect of the wind.

The levels of suspended solids also fluctuated with periods of lake mixing in the spring and fall, and with periods of stratification in depths greater than 12.5 feet (3.8 m), which occur in winter and summer. Suspended solids concentrations fluctuated the most at the surface (Figure 25). However, even the higher concentrations pose little direct threat to fish populations in the lake. Fish can be impaired by concentrations greater than 90 mg/L. The relatively low suspended solids concentrations in the lake seem to suggest that sediment loads into the lake settle out of the water column quickly, trapping nutrients in the bottom sediment until physical re-suspension.

Seasonal trends are apparent for total suspended solids only in the differentiation of winter versus warm water months. During the winter months suspended solids concentrations drop, and during warm water months the concentrations fluctuate, but stay consistently higher than the cold water months of November to February.

Figure 25. Total Suspended Solids Mean Surface Values.

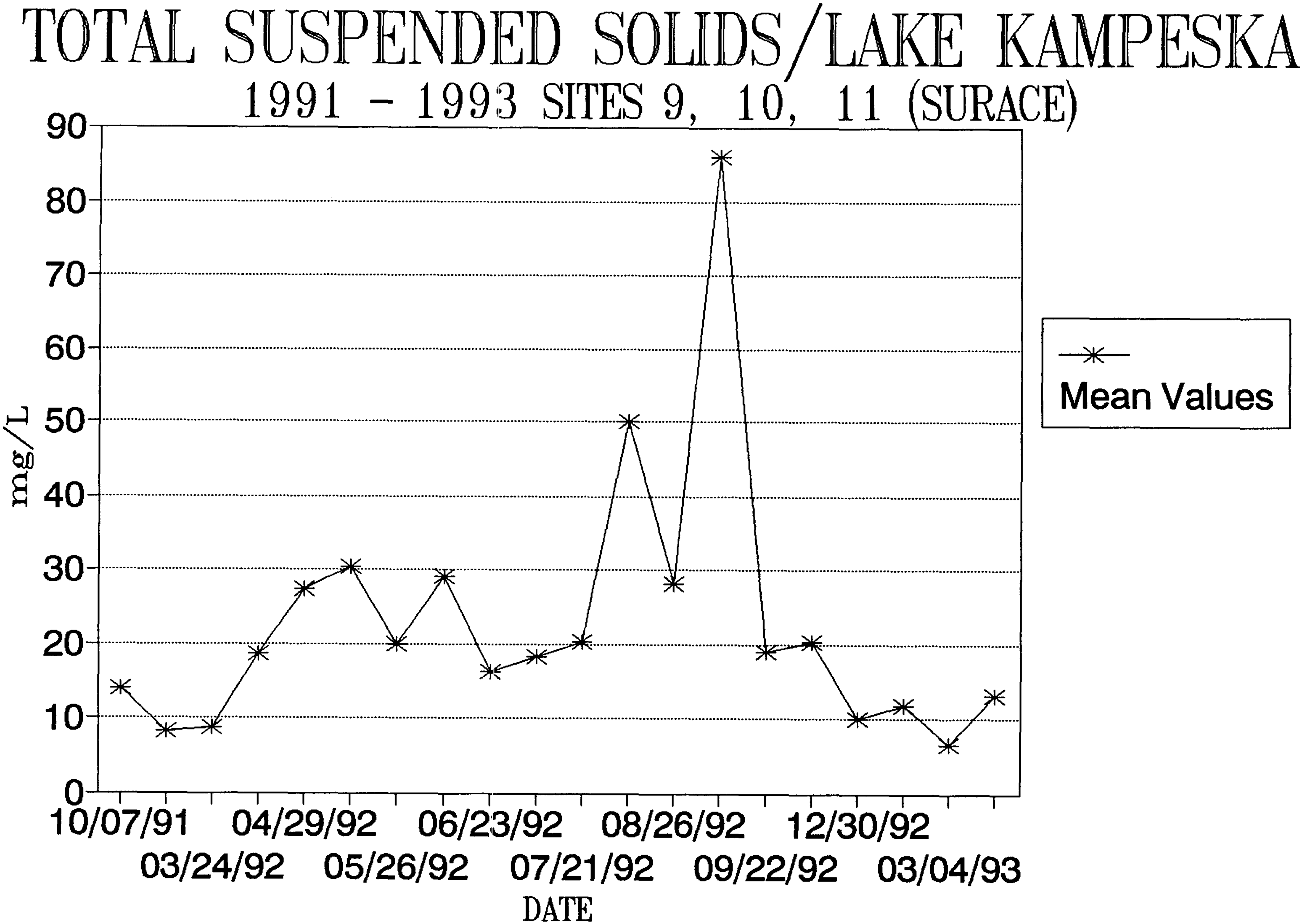


Figure 26. Suspended Solids Mean Bottom Samples.

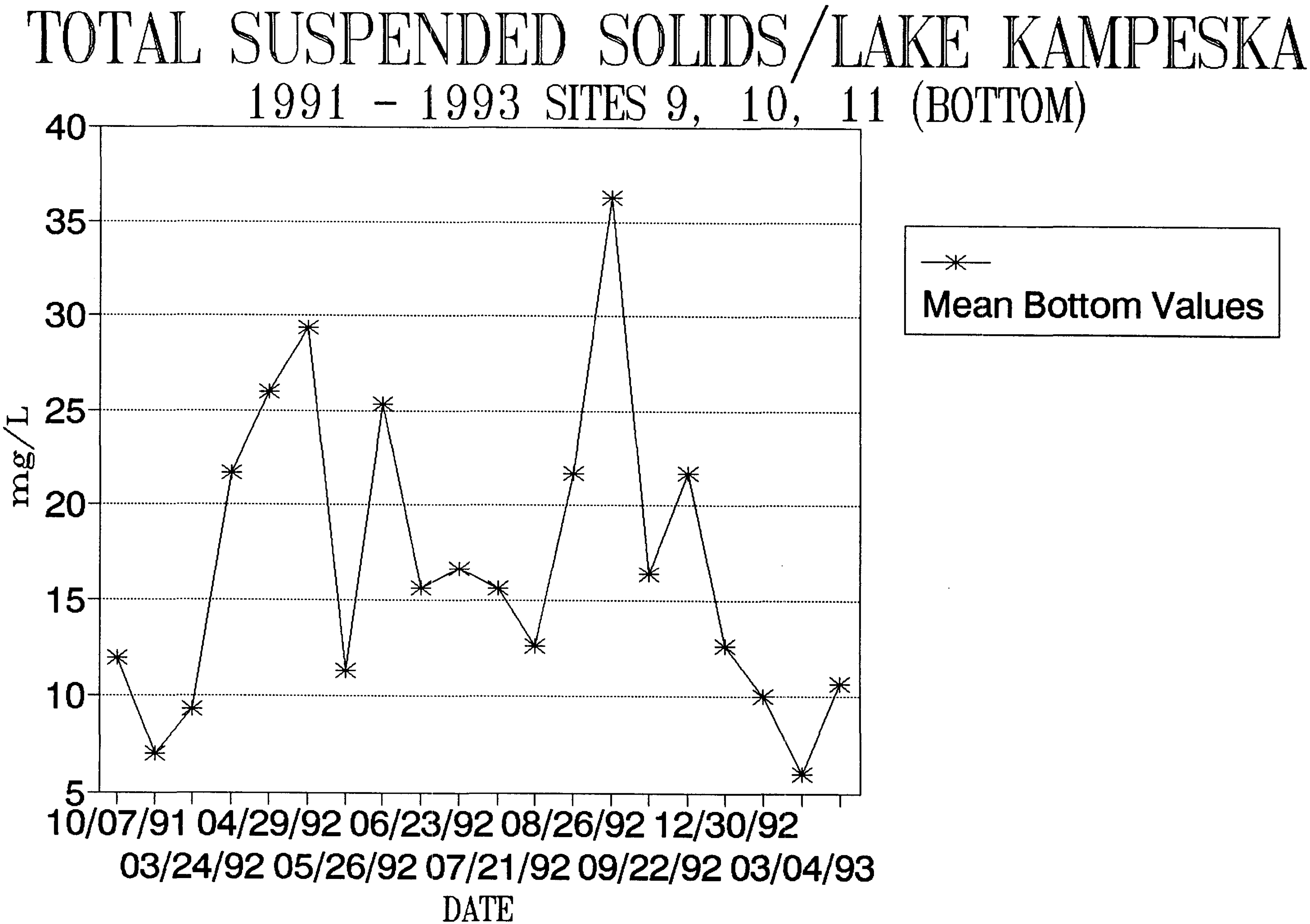
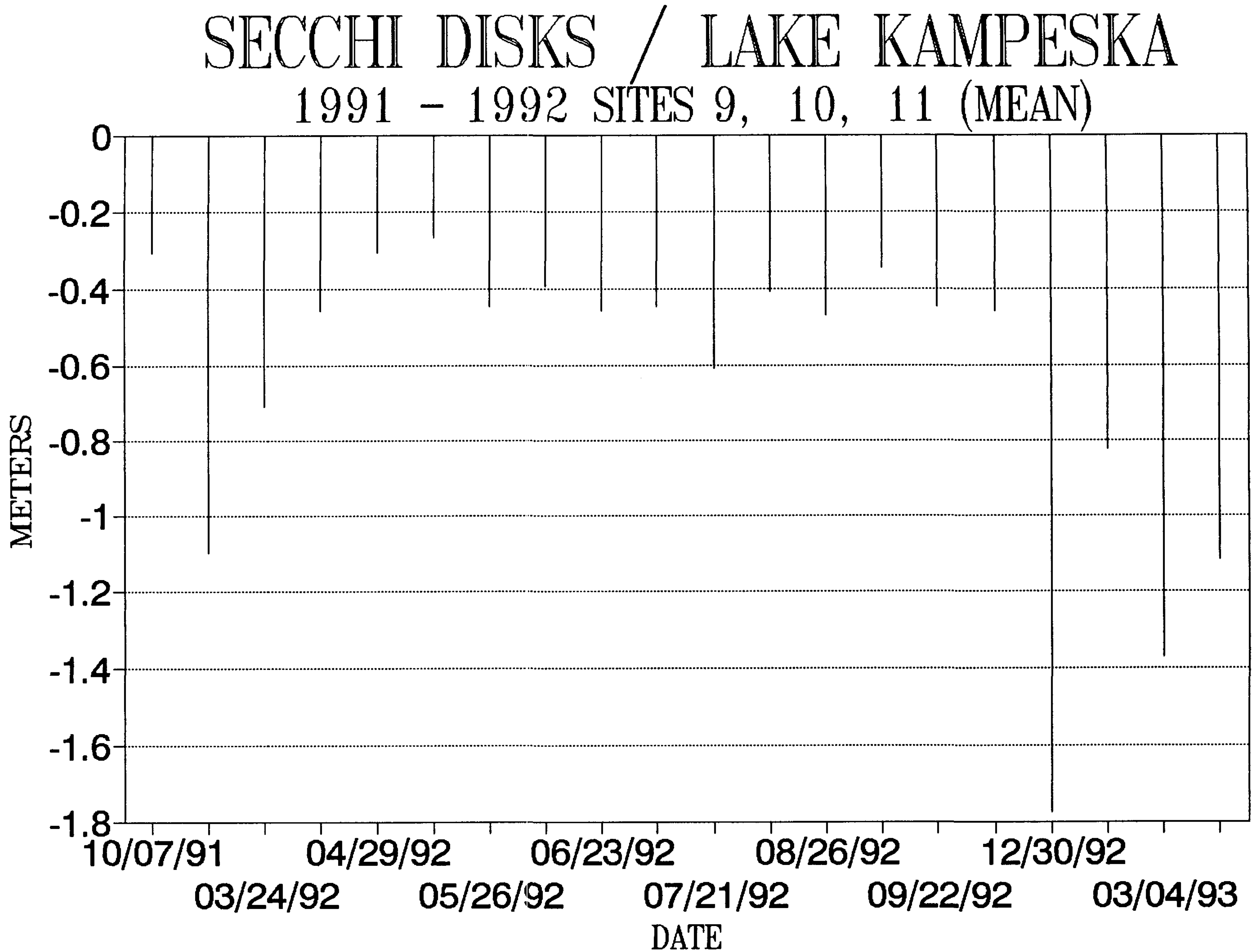


Figure 27. Secchi Depth Comparison.



Total Kjeldahl Nitrogen

Total Kjeldahl Nitrogen (TKN) is used to measure organic nitrogen, which is total organic nitrogen plus ammonia. TKN levels were not significantly different for the three sampling sites, although bottom sample results were higher later in the year (Tables E2, E4, and E6, Appendix E). These higher levels may be the result of organic nitrogen being released from large quantities of decaying organic matter.

Total Phosphorus

Phosphorus is a nutrient that is required for the growth and maintenance of living things. In lakes, excessive levels of phosphorus can cause nuisance algal blooms which interfere with recreational activities and drinking water treatment processes. Extensive algal blooms decrease the aesthetic appeal of lakes.

The phosphorus levels in Lake Kampeska were on a steady rise during the sample period from October, 1991, to March, 1993. However, the last sample results in May, 1993, showed a distinct downward trend (Figure 28, Phosphorus Graph, Surface and Bottom). The parallel trends and concentration similarities between the surface and bottom samples indicate a uniform distribution of phosphorus throughout the water column. This allows easy assimilation by the biota of the lake, and is an indication that the lake is nitrogen limited (nitrogen is the "critical" nutrient which is in short supply for sustained plant growth). The nitrogen to phosphorus ratio also shows that the lake may be nitrogen limited (Table 17, Carlson Index and N to P Ratio Summary, Page 81). Nitrogen/phosphorus ratios of less than 10.0 generally indicate that a lake is nitrogen limited.

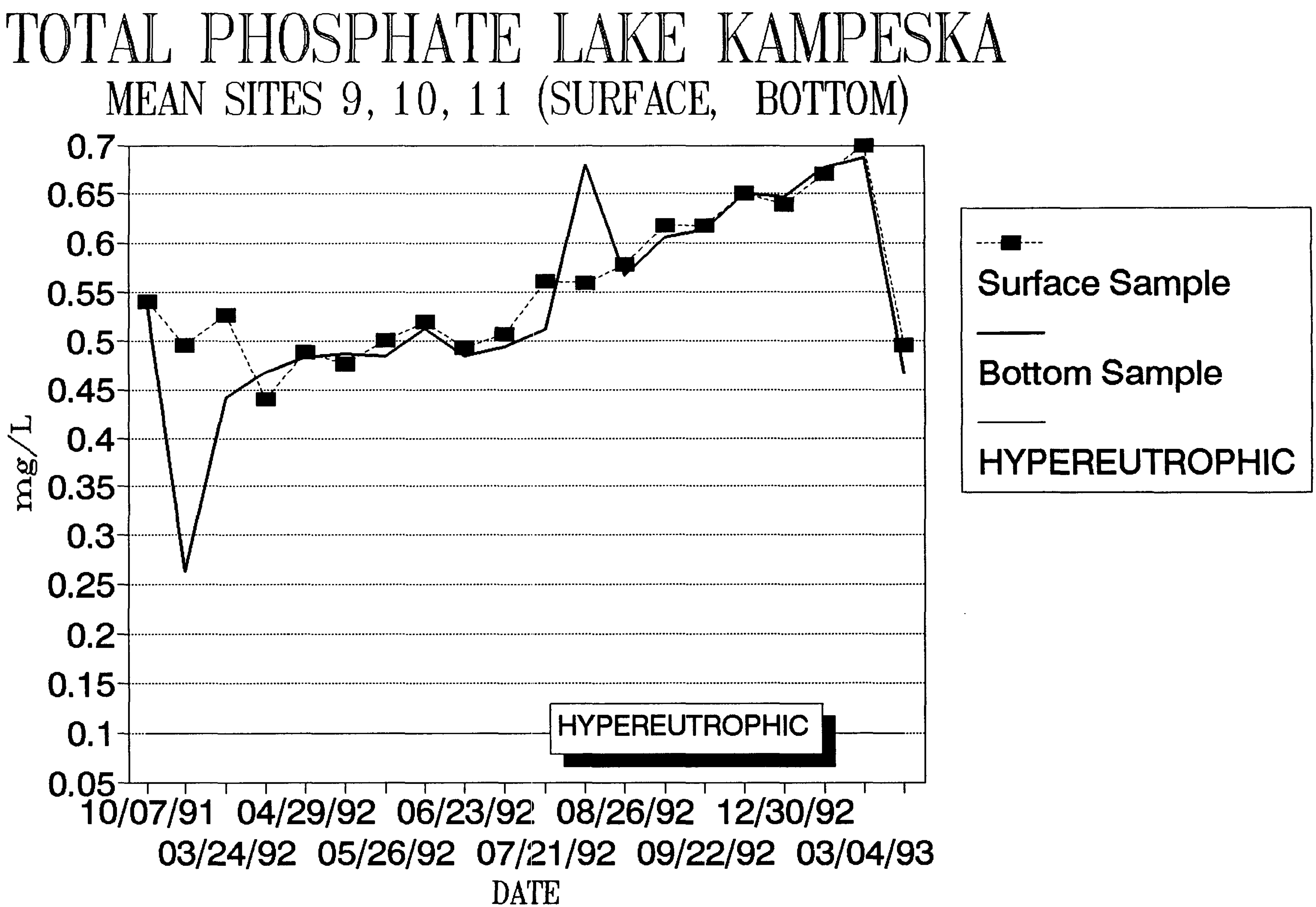
In-lake levels of phosphorus greater than 0.02 mg/L can stimulate the growth of most types of green and blue-green algae (Wetzel, 1983). The total phosphorus sample results generally ranged between 0.4 mg/L and 0.7 mg/L, which greatly exceeds the 0.02 mg/L level. Hypereutrophic levels of phosphorus lead to frequent and extensive algal blooms, which result in lowered water clarity and decreased aesthetic appeal. The City of Watertown's lake drinking water treatment plant is often closed for several weeks during the year due to algal blooms in late summer.

Total phosphate levels do not appear to have seasonal trends based upon examination of data collected between October, 1991 and April, 1993. The in-lake trend appeared to be a steady rise during the sample period except for a drop occurring in the last samples taken (May, 1993). No further samples were taken to support these results.

Total Dissolved Phosphorus

The minimum in-lake level for total dissolved phosphorus, or potentially available phosphorus, was 0.272 mg/L for the bottom sample at Site 9 on April 15, 1992. Samples taken from October, 1992, to March, 1993,

Figure 28. Total Phosphate Surface & Bottom



showed total dissolved phosphorus concentrations ranging from 0.564 mg/L to 0.797 mg/L (Appendix E). These levels of phosphorus are 28 to 40 times the amount required for optimum growth of many algal species (Wetzel, 1983). The percentage of available phosphorus compared to total phosphorus at the in-lake sites generally ranged from 80% to 90%. This indicates that the phosphorus in the lake is readily available for uptake by algae and other aquatic plants.

The percentage of available phosphorus compared to total phosphorus for the tributary monitoring site results generally ranged from 40% to 60%. Therefore, the percentage of available phosphorus is greater in the lake than in the tributaries. This may indicate that phosphorus is being released from the sediment. The comparative results of available phosphorus between the tributaries (40% to 60%) and the lake (80% to 90%) seem to indicate that much of the phosphorus entering the lake is sorbed onto sediment particles. The sediment particles settle to the bottom of the lake, where phosphorus is released by re-suspension or low oxygen levels. Although low oxygen levels were not found at the lake bottom on a consistent basis, this may have been a result of the dissolved oxygen probe not always being directly in the water/sediment interface. All of these factors account for the higher available (dissolved) phosphorus levels in the lake, and the subsequent problem of extensive algal blooms.

Trophic State Index

Carlson's Trophic State Index (TSI) is an indicator which can be used to measure relative trophic state of a given body of water (EPA, 1990). The Carlson Index was used to determine the trophic status of Lake Kampeska using both Secchi disk measurements and phosphorus concentrations (Figure 29 and Table 17). The Carlson Index uses TSI levels of 65 and over to denote hypereutrophic bodies of water. Lake Kampeska exceeded the hypereutrophic level on 70 of 100 samples using the Secchi disk index, and on 100 of 100 samples using the phosphorus index. The low TSI results for Secchi disk measurements occurred during the late winter and early spring (December, 1992 to March, 1993), with only the May 3, 1993, reading occurring without ice cover. The low Secchi disk TSI for May, 1993, also parallels a drop in the phosphorus TSI for that date. However, the phosphorus index level only drops from 99 to 94. These fluctuations coincide with improved water quality in Lake Kampeska during the late winter and early spring, before ice out (Table 17, TSI Summary).

Figure 29. Phosphorus and Secchi TSI Values

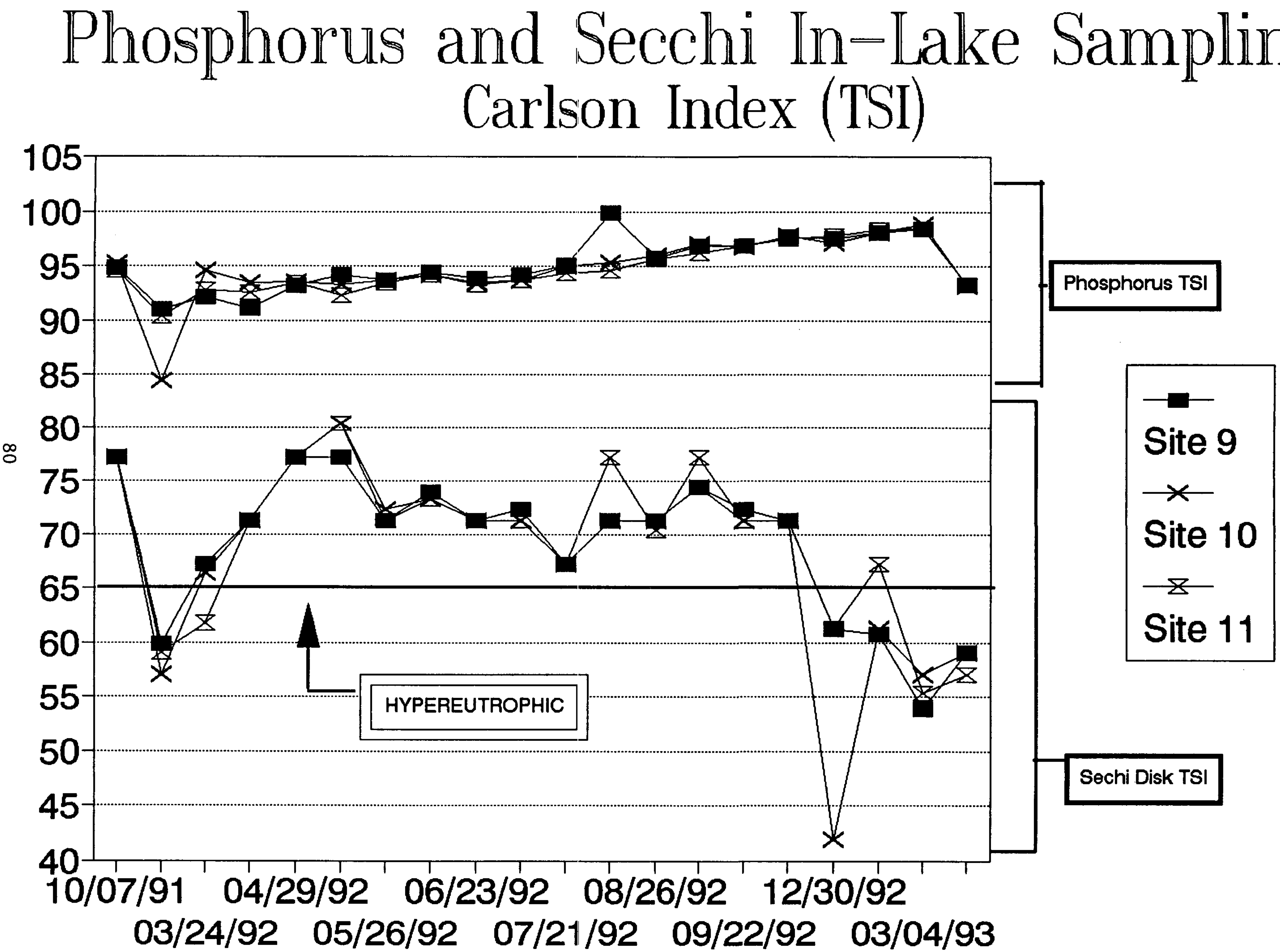


Table 17. Carlson Index (TSI) and Nitrogen/Phosphorus Ratio Summaries

SITE 9 (SOUTHWEST) SURACE

DATE	TIME	SITE	SDISK TSI	TPO4 TSI	NITR. PHOS. RATIO
10/07/91	900	9	77	95	1.1
02/19/92	1200	9	60	88	1.8
03/24/92	1200	9	67	92	1.3
04/15/92	1100	9	71	92	1.1
04/29/92	1000	9	77	93	0.5
05/12/92	1000	9	77	94	1.7
05/26/92	1215	9	71	93	1.2
06/09/92	1130	9	74	94	1.0
06/23/92	800	9	71	94	1.3
07/09/92	830	9	72	94	1.2
07/21/92	1245	9	67	94	2.1
08/04/92	1145	9	71	103	1.1
08/26/92	1115	9	71	96	1.2
09/10/92	1030	9	75	97	1.2
09/22/92	1315	9	72	97	0.5
10/06/92	830	9	71	98	1.4
12/30/92	1000	9	61	97	1.1
01/14/93	1100	9	61	98	1.6
03/04/93	1400	9	54	96	1.2
05/03/93	1630	9	59	93	1.9

SITE 9 (SOUTHW BOTTOM)

DATE	TIME	SITE	SDISK TSI	TPO4 TSI	NITR. PHOS. RATIO
10/07/91	900	9	77	95	1.1
02/19/92	1200	9	60	94	1.3
03/24/92	1200	9	67	93	1.3
04/15/92	1100	9	71	90	1.3
04/29/92	1000	9	77	93	0.8
05/12/92	1000	9	77	94	1.3
05/26/92	1215	9	71	94	1.3
06/09/92	1130	9	74	95	0.9
06/23/92	800	9	71	94	1.1
07/09/92	830	9	72	94	1.0
07/21/92	1245	9	67	96	1.3
08/04/92	1145	9	71	96	1.1
08/26/92	1115	9	71	96	1.7
09/10/92	1030	9	75	97	1.0
09/22/92	1315	9	72	97	1.2
10/06/92	830	9	71	98	0.8
12/30/92	1011	9	61	98	0.8
01/14/93	1100	9	61	98	1.1
03/04/93	1400	9	54	99	1.1
05/03/93	1630	9	59	94	2.0

LAKE KAMPESKA IN-LAKE SAMPLE DATA, 1991-1993

SITE 10 (MIDDLE) SURFACE

DATE	TIME	SITE	SDISK TSI	TPO4 TSI	NITR. PHOS. RATIO
10/07/91	1030	10	77	95	1.4
02/19/92	1100	10	57	75	5.2
03/24/92	1300	10	66	91	2.0
04/15/92	1145	10	71	93	0.9
04/29/92	1045	10	77	94	0.9
05/12/92	1045	10	80	94	1.1
05/26/92	1245	10	72	93	1.3
06/09/92	1230	10	73	94	1.1
06/23/92	830	10	71	93	1.2
07/09/92	900	10	71	94	1.2
07/21/92	1315	10	67	94	1.3
08/04/92	1110	10	71	95	1.4
08/26/92	1215	10	71	96	1.2
09/10/92	1100	10	75	97	1.0
09/22/92	1345	10	71	97	0.5
10/06/92	900	10	71	98	0.2
12/30/92	110	10	42	97	0.9
01/14/93	1300	10	61	96	1.3
03/04/93	1430	10	57	99	1.7
05/03/93	1545	10	59	93	1.9

SITE 10 (MIDDLE) BOTTOM

DATE	TIME	SITE	SDISK TSI	TPO4 TSI	NITR. PHOS. RATIO
10/07/91	1030	10	77	95	1.3
02/19/92	1100	10	57	94	1.2
03/24/92	1300	10	66	98	0.9
04/15/92	1145	10	71	94	1.2
04/29/92	1045	10	77	93	0.7
05/12/92	1045	10	80	93	1.6
05/26/92	1245	10	72	94	2.1
06/09/92	1230	10	73	94	1.8
06/23/92	830	10	71	93	1.2
07/09/92	930	10	71	94	1.0
07/21/92	1315	10	67	96	1.3
08/04/92	1110	10	71	96	1.3
08/26/92	1215	10	71	96	1.0
09/10/92	1100	10	75	97	1.2
09/22/92	1345	10	71	97	0.6
10/06/92	900	10	71	98	1.4
12/30/92	1100	10	42	97	0.9
01/14/93	1300	10	61	98	1.1
03/04/93	1430	10	57	99	1.3
05/03/93	1545	10	59	94	1.8

SITE 11 (NORTHEAST) SURFACE

DATE	TIME	SITE	SDISK TSI	TPO4 TSI	NITR. PHOS. RATIO
10/07/91	1030	11	77	95	1.0
02/19/92	1000	11	59	87	2.7
03/24/92	1400	11	62	93	1.1
04/15/92	1215	11	71	93	1.1
04/29/92	1115	11	77	93	0.5
05/12/92	1115	11	80	92	1.4
05/26/92	1315	11	71	93	1.3
06/09/92	1330	11	73	94	1.3
06/23/92	900	11	71	93	1.6
07/09/92	930	11	71	93	1.5
07/21/92	1330	11	67	95	1.2
08/04/92	1035	11	77	95	1.6
08/26/92	1215	11	70	95	0.9
09/10/92	1120	11	77	96	1.4
09/22/92	1415	11	71	97	0.4
10/06/92	930	11	71	97	1.6
12/30/92	12	11	61	98	0.9
01/14/93	1400	11	67	98	1.3
03/04/93	1530	11	55	98	1.7
05/03/93	1445	11	57	93	2.1

SITE 11 (NORTH BOTTOM)

DATE	TIME	SITE	SDISK TSI	TPO4 TSI	NITR. PHOS. RATIO
10/07/91	1100	11	77	95	1.3
02/19/92	1000	11	59	94	1.5
03/24/92	1400	11	62	93	1.0
04/15/92	1215	11	71	92	1.2
04/29/92	1115	11	77	94	0.6
05/12/92	1115	11	80	92	1.3
05/26/92	1315	11	71	94	1.3
06/09/92	1330	11	73	94	1.0
06/23/92	900	11	71	93	1.5
07/09/92	930	11	71	94	1.0
07/21/92	1330	11	67	94	1.6
08/04/92	1035	11	77	94	2.0
08/26/92	1245	11	70	96	1.2
09/10/92	1120	11	77	97	0.9
09/22/92	1415	11	71	97	1.4
10/06/92	1200	11	71	98	0.8
12/30/92	1230	11	61	98	0.8
01/14/93	1400	11	67	98	1.1
03/04/93	1530	11	55	99	1.4
05/03/93	1445	11	57	94	2.3

Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) monitoring was conducted in accordance with methods set forth in "Standard Operating Procedures For Field Samplers" (SD DENR, Clean Lakes Program, 1992). Three different samples were to be taken: 1) field duplicate, 2) blank (distilled water), and 3) phosphorus spike. These samples were submitted to the South Dakota State Health Laboratory for analysis, together with the routine samples.

Blank samples were obtained from commercial distilled water sources. The results obtained for the blank samples (Table 18) basically represent the detection limits of the laboratory equipment. Smaller detection limits could be obtained for some parameters such as nitrate nitrogen, but this would increase the time for analysis, and increase the cost for test results.

The overall accuracy for field duplicate samples was 92%. This is a very high rate of accuracy, and indicates good quality assurance procedures for field sampling and laboratory procedures. These results indicate no need for changes in sampling or analysis techniques.

The differences in the phosphorus spike results may have resulted from the inaccuracy of available field measurement equipment. These differences do not correlate to the overall accuracy of 92% for the duplicate samples. Similar inaccuracies were found for phosphorus spike results in other projects. For this reason, the phosphorus spike analyses were discontinued in this and other projects.

QA/QC sample results in Table 18 that are underlined exceeded EPA holding time requirements. Recommended holding times were exceeded for only two parameters (TKN-N and TPO4) on one set of duplicate samples (10/7/91). This minor exception indicates excellent compliance with holding time requirements, and no need for changes in either sample shipping or laboratory handling procedures.

TABLE 18. QUALITY ASSURANCE/QUALITY CONTROL FOR LAKE KAMPESKA

-BLANK-

DATE	TIME	SITE	SAMP	DEPTH	W. TEMP	A. TEMP	FPH	FECAL COLIFOR /100ML	TALKAL mg/l	TSOL mg/l	TDSO mg/l	TSSO mg/l	VOLSO mg/l	FIXSOL mg/l	AMMON mg/l	UNIONIZED AMMON mg/l	NO3+2 mg/l	TKN-N mg/l	TPO4 mg/l	TDPO mg/l
02/19/92		KAM11-B	GRAB	BOTTOM	4	-4	7.9	2	2	11	7	4	4	0	0.02	0.000173	0.1	0.1	0.005	0.007
03/24/92		KAM11-B	GRAB	BOTTOM	3	4.5	8.2	2	2.2	20	18	2			0.02	0.000346	0.1	0.1	0.005	0.005
04/23/92		KAM4-B	GRAB	SURFACE	4.7	3.5	8.4	10	1.8	14	8	6	6	0	0.02	0.000532	0.1	0.1	0.005	0.005
06/18/93		KAM4-B	GRAB	SURFACE	20.2	25.1	8.3	10	2	8	4	4	3	1	0.03	0.00233	0.1	0.1	0.005	0.005
09/22/92		KAM11-B	GRAB	BOTTOM	15	14	8.4	10	2.8	0	0	5	1	4	0.02	0.001344	0.1	0.1	0.005	0.005
03/30/93		KAM4-B	GRAB	SURFACE	3	4.1	7.2	10	3.2	0	0	2			0.02	3.44E-05	0.1	0.1	0.01	0.01
05/09/93		KAM4-B	GRAB	SURFACE	16.3	16	7.9	10	4.4	18	16	2			0.02	0.000438	0.1	0.11	0.013	0.005

-FIELD DUPLICATE-

DATE	TIME	SITE	SAMP	DEPTH	W. TEMP	A. TEMP	FPH	FECAL COLIFOR /100ML	TALKAL mg/l	TSOL mg/l	TDSO mg/l	TSSO mg/l	VOLSO mg/l	FIXSOL mg/l	AMMON mg/l	UNIONIZED AMMON mg/l	NO3+2 mg/l	TKN-N mg/l	TPO4 mg/l	TDPO mg/l
10/07/91		kAM11-R	GRAB	SURFACE	9.4	8	8.1	50	7.4	377	363	14			0.02	0.00021	0.1	0.33	0.471	0.447
10/07/91		KAM 11	GRAB	SURFACE	9.4	8	8.1	10	7	360	348	12			0.02	0.00021	0.1	0.41	0.529	0.441
02/19/92		KAM11-R	GRAB	BOTTOM	4	-4	7.9	2	238	403	395	8	7	1	0.02	0.00017	0.1	0.47	0.468	0.428
02/19/92		KAM11	GRAB	BOTTOM	4	-4	7.9	2	236	409	402	7	7	0	0.02	0.00017	0.1	0.65	0.491	0.395
03/24/92		KAM11-R	GRAB	BOTTOM	3	4.5	8.2	2	208	354	344	10			0.02	0.00035	0.1	0.41	0.448	0.405
03/24/92		KAM11	GRAB	BOTTOM	3	4.5	8.2	2	209	354	344	10			0.02	0.00035	0.1	0.36	0.458	0.402
04/23/92		KAM4-R	GRAB	SURFACE	4.7	3.5	8.4	10	289	492	477	15	9	6	0.02	0.00053	0.1	0.89	0.113	0.027
04/23/92		KAM4	GRAB	SURFACE	4.7	3.5	8.4	10	292	490	476	14	10	4	0.02	0.00053	0.1	0.79	0.093	0.027
06/18/93		KAM4-R	GRAB	SURFACE	20.2	25.1	8.3	2300	155	387	325	62	24	38	0.15	0.01165	0.15	0.3	0.339	0.156
06/18/93		KAM4	GRAB	SURFACE	20.2	25.1	8.3		156	388	325	63	18	45	0.15	0.01165	0.3	1.28	0.352	0.166
09/22/92		KAM11-R	GRAB	BOTTOM	15	14	8.4	100	218	390	369	21	5	16	0.02	0.00129	0.1	0.17	0.627	0.554
09/22/92		KAM11	GRAB	BOTTOM	15	14	8.4	160	214	397	378	19	3	16	0.02	0.00132	0.1	0.8	0.621	0.568
03/30/93		KAM4-R	GRAB	SURFACE	3	4.1	7.2	60	100	202	186	16			0.07	0.00012	1.2	2.15	0.305	0.196
03/30/93		KAM4	GRAB	SURFACE	3	4.1	7.2	80	101	202	182	20			0.08	0.00014	1.1	2.18	0.302	0.199
05/09/93		KAM4-R	GRAB	SURFACE	16.3	16	7.9	20	267	479	471	8			0.02	0.00044	0.1	1.1	0.166	0.116
05/09/93		KAM4	GRAB	SURFACE	16.3	16	7.9	20	270	473	469	4			0.02	0.00044	0.1	1.13	0.159	0.12

-PHOSPHORUS SPIKE-

DATE	TIME	SITE	SAMP	DEPTH	TPO4P mg/l	DIFFERENCE mg/l
02/19/92		KAM11-S	GRAB	BOTTOM	0.199	0.292
02/19/92		KAM11	GRAB	BOTTOM	0.491	
03/24/92		KAM11-S	GRAB	BOTTOM	0.634	0.274
03/24/92		KAM11	GRAB	BOTTOM	0.36	
04/23/92		KAM4-S	GRAB	SURFACE	0.279	0.186
04/23/92		KAM4	GRAB	SURFACE	0.093	
06/18/93		KAM4-S	GRAB	SURFACE	0.531	0.179
06/18/93		KAM4	GRAB	SURFACE	0.352	

Underlined concentrations have exceeded the EPA holding time.

SEDIMENT SURVEY AND SAMPLING

Sediment Survey

During the winters of 1989-1990 and 1990-1991 the Kampeska Chapter of the Izaak Walton League organized a labor intensive study to determine the build-up of sediment in Lake Kampeska. Over the two-winter period, the project entailed the efforts of 70 individuals and included over 1400 hours of labor and equipment.

A grid system of sample sites every 300 feet was surveyed and measured on the entire lake. A total of 2,214 holes were drilled through the ice. The water and sediment depths were measured and recorded at each hole.

Due to limitations in measuring equipment, the combined depth measurement of water and sediment did not exceed 25 feet. Consequently, the bottom of the sediment could not be reached in 1504, or 68%, of the measurements. A summary of all the measurements is shown below:

	Water Depths in Feet												
	4	5	6	7	8	9	10	11	12	13	14	15	16
No. of measurements	2	20	84	70	117	124	91	96	99	620	647	222	22
Ave. sedt. depths(ft.)	0	0	0	0	0	.5	.2	.6	2.5	11.2	9.1	9.1	5.1

From this summary, it can be seen that the majority of the sediment is in the deeper portions of the lake, beginning at about 12 feet. Based on this information, Lake Kampeska was apparently a much deeper lake.

Other conclusions drawn from the sediment survey include the following:

1) 36% of the lake volume that could be measured with the available equipment is currently filled with sediment
2) 82% of the lake contains measurable sediment deposits
3) 64% of the lake has sediment deposits in excess of 9 feet deep

Based on an average sediment depth of 6.9 feet (1.98 m) in the 2,214 sample sites, it has been calculated that the total sediment volume that could be measured was 50,922,000 cubic yards. It is presumed that the actual total volume of sediment in the lake is much greater than this amount. Maps showing the elevations of water depths and sediment depths are included in APPENDIX F, Lake Kampeska Sediment Survey Maps.

Sediment Sampling

Sediment and water samples were collected from Lake Kampeska at two sites (Site 9, Southwest and Site 11, Northeast) on September 30, 1991. The samples were submitted to the U. S. Army Corps of Engineers Laboratory in Omaha, Nebraska, for analysis. The analyses were conducted on the sediment sample, the lake water sample (receiving water), and the water sample resulting from mixing of the sediment and lake water (elutriate water). The purpose of running these tests was to determine if removal of sediment from the lake might cause detrimental effects in the receiving water or in areas of sediment disposal. All of the samples were analyzed for metals, pesticides, and other toxic substances. In addition, the receiving water and elutriate water were tested for hardness, nutrients, chemical oxygen demand, total cyanide, and oil and grease. The sample results are shown in Table 19, Lake Kampeska Elutriate Sample Data--Site 9, Southwest; and Table 20, Lake Kampeska Elutriate Sample Data--Site 10, Northeast.

Although the sediment samples were not analyzed for nutrients, some assumptions can be made about nutrients in the sediment by comparing concentrations in the lake water (receiving water) with concentrations in the elutriate water (lake water mixed with sediment). The sediment appears to release ammonia nitrogen from bacteria decomposing organic material, and Kjeldahl nitrogen which could be organic material not yet decomposed. No definite assumptions can be made about nitrate-nitrite nitrogen as there are only very small differences between the receiving water and the elutriate water. The total phosphorus concentrations are smaller in the elutriate water than in the receiving water. This would tend to indicate that phosphorus is not being retained in the sediment, but rather is being used by algae and other aquatic plants.

The main purpose of analyzing the sediment, lake water, and elutriate water was to determine concentrations of metals, pesticides, and other toxic substances. The results showed that the sediment, lake water, and elutriate water did not appear to contain high concentrations of contaminated material. The results are similar to results for other South Dakota lakes, and indicate that adverse effects from any potential future dredging projects should be minimal.

Table19. Lake Kampeska Elutriate Sample Data--Site 9, Southwest

DEPARTMENT OF THE ARMY
Missouri River Division, Corps of Engineers
Division Laboratory
Omaha, Nebraska

Project: Section 22 PAS Project for South Dakota
Date Sample Taken: 30 Sep 91
Date Sample Received: 01 Oct 91
Sample Description: Water and Sediment
Time Sample Taken: 0900
Customer Sample Id: Lake Kampeska 9(SW)
Lab Sample No: 911003-W001, W002, & W003
Sample Container: 1-1 gal wide mouth glass (sed)
3-1 gal amber glass (water)

Analysis	Sediment Result	Units	Receiving Water Result	Units	Elutriate Water Result	Units
Ca and Mg Hardness			266	mg/L	265	mg/L
Ammonia Nitrogen			0.04	mg/L	0.20	mg/L
Chemical Oxygen Demand			14	mg/L	22	mg/L
Total Cyanide			<0.02	mg/L	<0.02	mg/L
Nitrate-Nitrite Nitrogen			0.09	mg/L	0.07	mg/L
Total Phosphorus			0.48	mg/L	0.16	mg/L
Total Kjeldahl Nitrogen			0.74	mg/L	1.2	mg/L
Oil and Grease			<5	mg/L	<5	mg/L
Antimony	<0.5	mg/kg	<1	µg/L	<1	µg/L
Arsenic	5.3	mg/kg	6	µg/L	2	µg/L
Barium	430	mg/kg	180	µg/L	220	µg/L
Beryllium	<0.1	mg/kg	<1.0	µg/L	<1.0	µg/L
Cadmium	<0.5	mg/kg	<0.1	µg/L	<0.1	µg/L
Chromium	56	mg/kg	6	µg/L	1	µg/L
Copper	28	mg/kg	<10	µg/L	<10	µg/L
Iron	31000	mg/kg	80	µg/L	60	µg/L
Lead	33	mg/kg	<1.0	µg/L	1.0	µg/L
Magnesium	20000	mg/kg	33	mg/L	34	mg/L
Manganese	3600	mg/kg	<5	µg/L	1900	µg/L
Mercury	<0.1	mg/kg	<0.2	µg/L	<0.2	µg/L
Selenium	<1	mg/kg	1.1	µg/L	4.1	µg/L
Zinc	120	mg/kg	<10	µg/L	<10	µg/L
Nickel	28	mg/kg	4	µg/L	3	µg/L
Aluminum	33000	mg/kg	80	µg/L	<50	µg/L
Calcium	63000	mg/kg	52	mg/L	50	mg/L
Sodium	200	mg/kg	14	mg/L	12	mg/L
Potassium	3100	mg/kg	8.1	mg/L	11	mg/L
Silver	<1.0	mg/kg	<10	µg/L	<10	µg/L
Simazine (Princep)	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Metribuzin (Lexone)	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Atrazine (Aatrex)	<100	µg/kg	0.11	µg/L	0.14	µg/L
Aldrin	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
alpha-BHC	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
beta-BHC	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
gamma-BHC (Lindane)	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Mirex	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Chlordane	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
P'P"DDD	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
P'P"DDE	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
P'P"DDT	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Dieldrin	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Endosulfan I	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Propachlor (Ramrod)	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Metolachlor (Dual)	<100	µg/kg	0.16	µg/L	0.14	µg/L
Alachlor (Lasso)	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Diazinon	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Endrin	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Heptachlor	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Heptachlor epoxide	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Methoxychlor	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Toxaphene	<500	µg/kg	<0.50	µg/L	<0.50	µg/L
PCB-1016	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1221	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1232	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1242	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1248	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1254	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1260	<100	µg/kg	<0.10	µg/L	<0.01	µg/L

Table 20. Lake Kampeska Elutriate Sample Data--Site 10, Northeast

DEPARTMENT OF THE ARMY
Missouri River Division, Corps of Engineers
Division Laboratory
Omaha, Nebraska

Project: Section 22 PAS Project for South Dakota
Date Sample Taken: 30 Sep 91
Date Sample Received: 01 Oct 91
Sample Description: Water and sediment
Time Sample Taken: 0900

Customer Sample Id: Lake Kampeska 10(NE)
Lab Sample No: 911003-W004, W005, & W006
Sample Container: 1-1 gal wide mouth glass
3-1 gal amber glass (water)

Analysis	Sediment Result	Units	Receiving Water Result	Units	Elutriate Water Result	Units
Ca and Mg Hardness			280	mg/L	286	mg/L
Ammonia Nitrogen			0.04	mg/L	0.25	mg/L
Chemical Oxygen Demand			19	mg/L	26	mg/L
Total Cyanide			<0.02	mg/L	<0.02	mg/L
Nitrate-Nitrite Nitrogen			0.09	mg/L	0.12	mg/L
Total Phosphorus			0.48	mg/L	0.32	mg/L
Total Kjeldahl Nitrogen			0.85	mg/L	1.4	mg/L
Oil and Grease			<5	mg/L	<5	mg/L
Antimony	1.2	mg/kg	3.5	µg/L	1.7	µg/L
Arsenic	5.1	mg/kg	5	µg/L	2	µg/L
Barium	450	mg/kg	170	µg/L	260	µg/L
Beryllium	<0.1	mg/kg	<1.0	µg/L	<1.0	µg/L
Cadmium	<0.5	mg/kg	0.2	µg/L	0.1	µg/L
Chromium	58	mg/kg	2	µg/L	<1	µg/L
Copper	29	mg/kg	<10	µg/L	<10	µg/L
Iron	30000	mg/kg	2700	µg/L	1900	µg/L
Lead	26	mg/kg	<1.0	µg/L	<1.0	µg/L
Magnesium	20000	mg/kg	34	mg/L	36	mg/L
Manganese	3300	mg/kg	<5	µg/L	2300	µg/L
Mercury	<0.1	mg/kg	<0.2	µg/L	<0.2	µg/L
Selenium	<1	mg/kg	1.5	µg/L	1.1	µg/L
Zinc	120	mg/kg	10	µg/L	<10	µg/L
Nickel	28	mg/kg	2	µg/L	3	µg/L
Aluminum	33000	mg/kg	<50	µg/L	<50	µg/L
Calcium	66000	mg/kg	56	mg/L	55	mg/L
Sodium	250	mg/kg	11	mg/L	12	mg/L
Potassium	3100	mg/kg	8.0	mg/L	11	mg/L
Silver	<1.0	mg/kg	<10	µg/L	10	µg/L
Simazine (Princep)	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Metribuzin (Lexone)	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Atrazine (Aatrex)	<100	µg/kg	0.11	µg/L	0.11	µg/L
Aldrin	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
alpha-BHC	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
beta-BHC	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
gamma-BHC (Lindane)	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Mirex	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Chlordane	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
P'P"DDD	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
P'P"DDE	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
P'P"DDT	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Dieldrin	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Endosulfan I	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Propachlor (Ramrod)	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Metolachlor (Dual)	<100	µg/kg	0.16	µg/L	0.16	µg/L
Alachlor (Lasso)	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Diazinon	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
Endrin	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Heptachlor	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Heptachlor epoxide	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Methoxychlor	<10	µg/kg	<0.01	µg/L	<0.01	µg/L
Toxaphene	<500	µg/kg	<0.50	µg/L	<0.50	µg/L
PCB-1016	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1221	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1232	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1242	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1248	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1254	<100	µg/kg	<0.10	µg/L	<0.10	µg/L
PCB-1260	<100	µg/kg	<0.10	µg/L	<0.10	µg/L

BIOLOGICAL RESOURCES AND ECOLOGICAL RELATIONSHIPS

Plants

Lake Kampeska is located in the Coteau des Prairies division of the Central Lowlands physiographic province. The flora of the region is characterized as Eastern Deciduous and Tall Grass Prairie. Although substantial amounts of grassland still occur west of the Missouri River, the Tall Grass Prairie in the eastern part of South Dakota has largely been plowed and its potholes drained so that very few remnants remain. The prairie remnants that remain are either heavily overgrazed or so disturbed that only indicator species can be found (Van Bruggen, 1976).

Trees, shrubs, and aquatic plants considered typical of the Eastern Deciduous Region are listed in Table 21, Representative Listing of Trees, Shrubs, and Aquatic Plants Characteristic of the Eastern Deciduous Region. In addition to these typical vegetative types, several relatively rare plants are found in the Lake Kampeska area. A listing of these rare plants is included in Table 22, List of Rare Plants in the Lake Kampeska Region.

Several State and Federal endangered or threatened species are present in the Lake Kampeska region. These species are listed in Table 23, State and Federal Endangered or Threatened Species in the Lake Kampeska Region.

Table 21. Representative listing of trees, shrubs, and aquatic plants characteristic of the Eastern Deciduous region.

<u>Acer saccharum</u> Sugar Maple	<u>Prunus americana</u> American plum
<u>Amelanchler sanguinea</u> serviceberry	<u>Quercus macrocarpa</u> Bur Oak
<u>Celtis occidentals</u> Hackberry	<u>Rhamnus lanceolata</u> Buck thorn
<u>Corylus americana</u> American Hazelnut	<u>Ribes cynosbatl</u> Prickly Gooseberry
<u>Euonymous atropurpurea</u> Burning - bush	<u>Tilia americana</u> Basswood
<u>Gymnocladus dioca</u> Kentucky coffee tree	<u>Ulmus thomasil</u> Rock Elm
<u>Juglans nigra</u> Black Walnut	<u>Viburnum lentago</u> Sweet Viburnum
<u>Ostrya virginiana</u> Ironwood	<u>Viburnum rafinesqulanum</u> Downy Arrow-wood
<u>Anemone quinquefolia</u> Wood Anemone	<u>Prenanthes alba</u> White Rattlesnake Root
<u>Arabis canadensis</u> Rockcress	<u>Solidago flexicaulis</u> Goldenrod
<u>Asarum canadense</u> Wild Ginger	<u>Trillium cernum</u> Nodding Trillium
<u>Caulophyllum thalictroldes</u> Blue Conosh	<u>Trillium nixale</u> Snow Trillium
<u>Cystopteris bulbifera</u> Bulblet Bladder Fern	<u>Uvularla grandiflora</u> Small-Flowered Bellwort
<u>Erythronium albidum</u> Glacier Lily	<u>Geranium maculatum</u> Geranium
<u>Hystrix patula</u> Bottlebrush Grass	

Table 21 continued

AQUATIC PLANTS

Alisma plantago-aquatica Water Plantain	Potamogeton pectinatus Sago Pondweed
Cicuta maculata Water Hemlock	Sagittaria cuneata Arrowhead
Cyperus ferruginescens Galingale	Scirpus validus Bullrush
Eleocharis macrostachya Spike Rush	Sparganium eurycarpum Bur Reed
Equisetum hyemale Horsetail	Typha angustifolia Cattail
Juncus dudleyi Rush	Typha latifolia Cattail
Lemna minor Duckweed	Utricularia vulgaris Bladderwort
Potemogeton nodosus Pondweed	

Van Bruggen, 1976

Table 22. List of Rare Plants in the Lake Kampeska Region.

Acer saccharum
Sugar Maple

Acorus americanus
Sweetflag

Anemone quinquefolia
Wood anemone

Aralia racemosa
Spikenard

Asarum canadense
Wild Ginger

Aster borealis
Rush Aster

Aster umbellatus
Flattop Aster

Cacalla plantaginea
Indian Plantain

Carex capillaris
Hair Sedge

Carex lacustris
Lake Sedge

Carex pedunculata
Peduncled Sedge

Caulophyllum thalictroides
Blue Cohosh

Corallorhiza trifida
Pale Coral-root

Cypripedium candidum
White Lady-slipper

Dentaria laciniata
Toothwart

Gentiana puberulenta
Downy Gentian

Gentianopsis procera
Small Fringed Gentian

Geranium maculatum
Wild Cranesbill

Hystrix patula
Bottlebrush Grass

Juncus articulatus
Jointed Rush

Lactula floridana
Florida Lettuce

Leersia virginica
Virginia Cutgrass

Najas marina
Water Nymph

Populus balsamifera
Balsam Poplar

Potamogeton amplifolius
Largeleaf Pondweed

Prenanthes alba
White Rattlesnake Root

Salix humills
Prairie Willow

Sparganium chlorocarpum
Green-fruited Bur Reed

Spiraea alba
Meadow Sweet

Spiranthes magnicamporum
Nodding Ladies Tresses

Trillium cernuum
Nodding Trillium

Trillium flexipes
Declining Trillium

Uvularia grandiflora
Large-flowered Bellwort

Zizania aquatica
Wild Rice

Table 23. State and Federal Endangered or Threatened Species in the Lake Kampeska Region.

NAME	STATUS
Plantanthera leucophaea Prairie Fringed Orchid	Federal Candidate Species
Hesperia dacotae Dakota Skipper Butterfly	Federal Candidate Species
Falco peregrinus Peregrine Falcon	Federal, State Endangered
Grus americana Whooping Crane	Federal, State Endangered
Hallaeetus leucocephalus Bald Eagle	Federal, State Endangered
Umbra limi Central Mudminnow	State Endangered
Percopsis omiscomaycus Troutperch	State Threatened
Storeria dekayl Texas Brown Snake	State Threatened
Storeria occipitomaculata Redbelly Snake	State Threatened

Houtcooper, et. al. 1985

Animals

The animal species of the Lake Kampeska region are quite diverse because of the intermixing of the Eastern Deciduous habitat with the Tall Grass Prairie habitat. Game animals and birds managed by the South Dakota Department of Game, Fish and Parks and their relative densities are listed in Table 24, Relative Densities of Game Species in the Lake Kampeska Region.

In addition to game species, the Lake Kampeska region supports many non-game and/or rare species. These species, which are sensitive to habitat changes or other disturbances, are listed in Table 25, Non-Game and Rare Species in the Lake Kampeska Region.

Table 26, Non-Game and Rare Species Potentially Occurring in the Lake Kampeska Region, lists other species that could potentially occur in the Lake Kampeska area, but have not been confirmed. In addition to the species listed previously, the habitat surrounding Lake Kampeska supports a large variety of other animals, plants, and birds common to both the Eastern Deciduous and Tall Grass Prairie biomes.

Table 24. Relative Densities of Game Species in the Lake Kampeska Region

SPECIES	RELATIVE DENSITY
White-tail deer	medium-high
Mule deer	very low
Antelope	very low
Wild turkey	very low
Sharp-tailed grouse	very low
Ring-necked pheasant	medium
Gray partridge	medium-high
Ducks (native)	medium
Geese (native Canada)	medium
Mourning dove	low
Cottontail rabbit	medium
Tree squirrel	high
Mink	high
Beaver	high
Muskrat	low
Skunks	low
Weasels	medium
Badger	low
Coyote	medium-low
Foxes	medium
Raccoon	high
Jackrabbits	medium

South Dakota Department of Game, Fish and Parks

Table 25. Non-Game and Rare Species in the Lake Kampeska Region.

Accipiter cooperi Cooper's Hawk	Opheodrys vernalis Western Smooth Green Snake
Culaea inconstans Brook Stickleback	Tamias striatus Eastern Chipmunk
Hyla versicolor Gray Treefrog	

Midwest Research Institute, 1974.

Table 26. Non-game and Rare Species Potentially Occurring in the Lake Kampeska Region.

Amia calva Bowfin	Nycticorax violaceus Yellow-Crowned Night Heron
Buteo platypterus Broad-Winged Hawk	Podiceps grisegena Horned Grebe
Butorides striatus Green-Backed Heron	Podiceps grisegena Red-Necked Grebe
Charadrius melodus Piping Plover	Rana sylvatica Wood Frog
Clethrionomys gapperi Gapper's Red-Backed Vole	Scolopax minor American Woodcock
Egretta caerula Little Blue Heron	Sialla sialis Eastern Bluebird
Hiodon tergisus Mooneye	Sorex arcticus Arctic Shrew
Larsus californicus California Gull	Sorex palustris Water Shrew
Lophodytes cucullatus Hooded Merganser	Sterna hirundo Common Tern
Microsorex hoyl Pygmy Shrew	Vireo flayltrons Yellow-Throated Vireo
Moxostoma erythrurum Golden Redhorse	Zapus princeps Western Jumping Mouse
Necturus maculosus Mudpuppy	

Midwest Research Institute, 1974

SUMMARY AND CONCLUSIONS

In summary, many factors are contributing to the degradation of water quality in Lake Kampeska. According to the watershed analysis, the Upper Big Sioux River subwatershed is contributing the greatest loads of suspended solids. However, because of its distance from the lake, it is not recommended as a top priority subwatershed for restoration efforts. The watershed analysis also indicated high loadings of suspended solids from the Mud Creek subwatershed. Nevertheless, the majority of the time these loadings do not enter Lake Kampeska. For this reason, the Mud Creek subwatershed is given very low priority for implementation of restoration measures. The subwatersheds recommended as highest priorities for a Phase II restoration project, based on the results of the watershed analysis are as follows:

1) Middle Sioux, 2) Soo Creek, 3) Indian River 4) Mahoney Creek, and 5) Upper Sioux.

The results of the water quality monitoring program support the findings of the watershed analysis. The Middle Sioux subwatershed, which included flows from Mahoney Creek, Soo Creek, and Indian River, was found to have the highest loadings of sediment and nutrients. The Mud Creek subwatershed was found to have the second highest loadings, but again is not considered a top priority because the majority of the time the flow from this creek does not reach Lake Kampeska. The Upper Sioux subwatershed was found to have the next highest loadings of sediment and nutrients. Therefore, based on the results of the water quality monitoring program, the subwatershed areas would be ranked as follows for restoration efforts:

1) Middle Sioux subwatershed (including Mahoney Creek, Soo Creek, and Indian River), and
2) Upper Sioux subwatershed.

The water sample results indicated that the total sediment loading to Lake Kampeska is contributing greatly to the sedimentation of the lake. The results of the sediment sampling survey bear witness to this fact.

The results of aerial and onsite surveys of the watershed indicated that there are numerous feedlots distributed throughout the watershed. These livestock feeding operations are contributing significant loadings of sediment and nutrients to Lake Kampeska.

A survey of the lake shoreline showed that in spite of past efforts, there are still numerous areas of moderate to severe erosion. These areas of erosion are directly contributing to siltation in the lake.

The in-lake monitoring program determined that Lake Kampeska is in a hypereutrophic condition. Continued high loadings of sediment and nutrients to the lake will contribute greatly to the ongoing eutrophication process.

RESTORATION PRACTICES

The following list contains practices for consideration in the restoration of Lake Kampeska and the Big Sioux River watershed:

1) Lake Shoreline Stabilization/Management

   This practice would focus on the Immediate Kampeska subwatershed. It would consist of rip-rapping and stabilization of the highly erodible shoreline areas. Emphasis would also be placed upon shoreline property owner education in the use and application of fertilizers and pesticides, as well as the proper management of construction site runoff and waste materials.

2) Construction of Small Ponds/Dams

   This practice would involve the installation of small dams on tributaries in the watershed. The resulting ponds (two- to three-acre impoundments) would help control flood waters, and decrease the sedimentation of the lake basin.

3) Grassed Waterways

   A practice to control erosion from cropland is the installation of waterways in cropland fields. These waterways would decrease sheet and rill erosion, and help to retain sediment.

4) Filter Strips/Grass Seedings

   The planting of permanent grass or grass/alfalfa mixtures in cropland areas adjacent to the Big Sioux River and its tributaries would reduce sediment loadings from the watershed. This best management practice would be implemented through programs available from the ASCS; SCS; South Dakota Game, Fish and Parks; and South Dakota Department of Agriculture, Division of Forestry.

5) Animal Waste Management Systems

   A best management practice to control the runoff from livestock feeding areas is the construction of animal waste management systems. Other alternatives may include diversions of clean water away from livestock feeding areas, or planting of vegetative buffer strips between feeding areas and receiving waters.

6) <u>Streambank Stabilization/Riparian Area Management</u>

Implementation of grazing management on pastureland and rangeland is a conservation practice that would stabilize streambanks and improve the management of riparian areas. This practice would include rotational grazing and offsite water development (dugouts or wells). Canoe trips down the Big Sioux River in May, 1993, revealed many areas that have severe streambank erosion. (See Figure 30 at the end of this section of the report.) Areas of extreme sheet and rill erosion were observed adjacent to the river.

7) <u>Information and Education Program to Promote Best Management Practices</u>

An information and education program should be started to promote best management practices in priority subwatersheds. This would involve promotion of practices such as Integrated Crop Management, which includes fertilizer and pesticide management, as well as crop residue management.

8) <u>Wetland Restoration/Creation</u>

Through the implementation of these practices, wetlands that have been partially drained and farmed would be restored. Other areas would be investigated in priority subwatersheds for the creation of new wetlands. These restored and newly created wetlands would act as sediment sinks and nutrient filters.

9) <u>Conservation Reserve Program (CRP)</u>

No CRP program signup was announced for 1993. If a signup is announced, it will be for 1994 contracts. The bidding system has changed to be competitive nationwide based on environmental benefits. The CRP program should be utilized to the fullest extent possible.

10) <u>Septic System Survey</u>

A survey of septic wastewater systems should be conducted in priority subwatersheds to determine their impact upon the trophic state of the lake. Also included would be landowner education in the proper location and maintenance of septic tanks and drainfields, as well as the modification of existing deficient systems to meet current state rules for the design and function of septic waste systems.

11) Construction of Flow Control Structure

The major problem of sediment deposition in Lake Kampeska occurs during periods of high flow, such as during flooding events. Construction of a structure to divert flows downstream would be of the greatest benefit in reducing loads of both sediment and nutrients to the lake.

12) Selective Dredging

The sediment survey determined that the sediment volume in the lake is in excess of 52 million cubic yards. Although total dredging of the lake is not feasible or economical, selective dredging in the areas of deepest sedimentation would improve the fisheries habitat of the lake, and could potentially reduce the release of nutrients from the bottom sediments.

13) Construction of Flood Control Facilities

The U.S. Army Corps of Engineers is currently conducting a feasibility study for the construction of a flood control dam on the Big Sioux River upstream of Lake Kampeska. Construction of this dam, or other smaller flood control structures, would reduce sediment loadings to Lake Kampeska.

14) Construction of a Lake Outlet

Lake Kampeska originally had a surface water outlet. However this outlet was blocked off during the construction of the Watertown Regional Airport in the 1940's. Construction of an outlet would decrease the hydraulic residence time in the lake, and in turn reduce deposition of suspended nutrients and sediment.

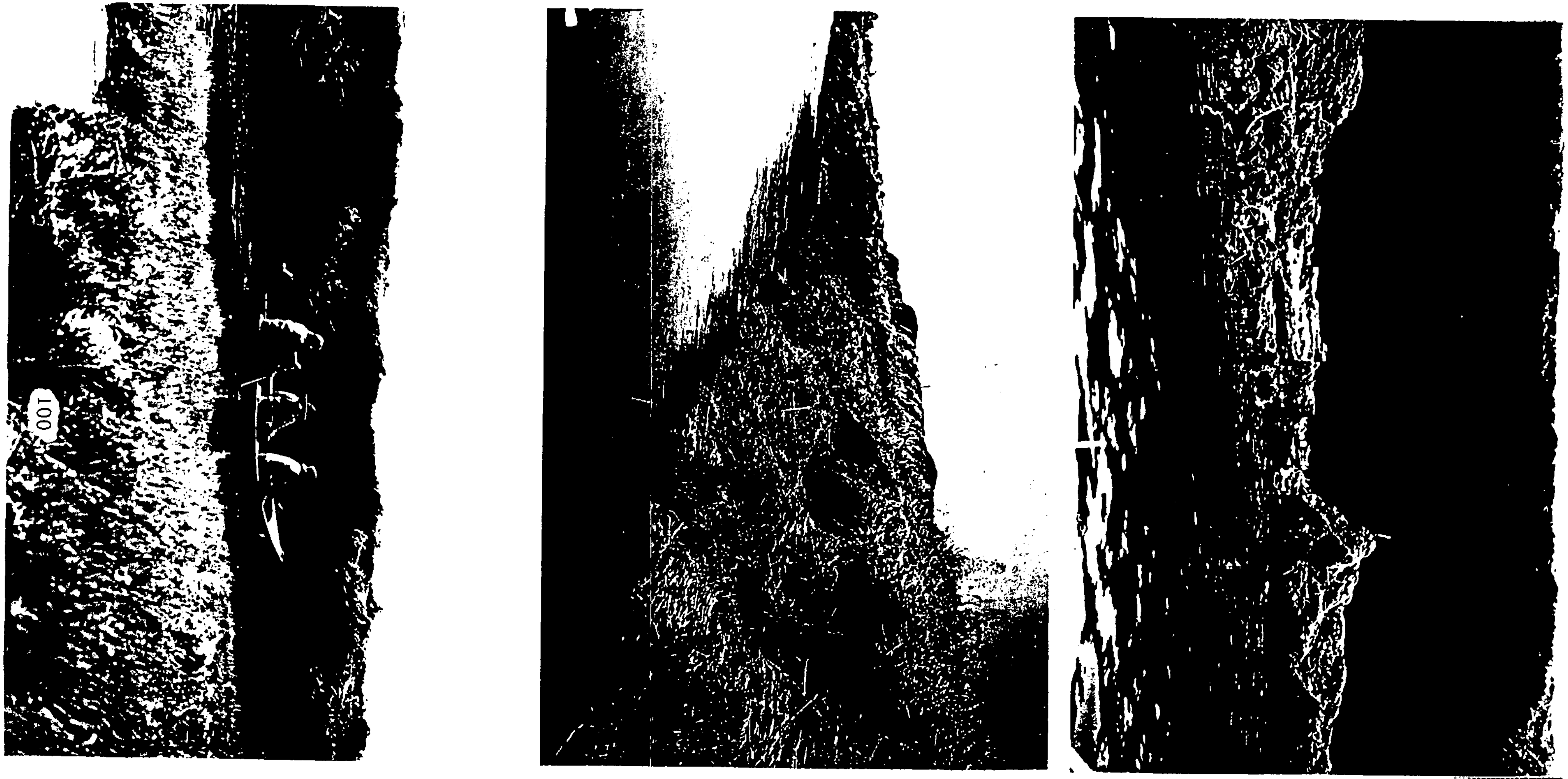


Figure 30. Photographs of Big Sioux River Streambank Erosion, May, 1993.

RECOMMENDATIONS

Based on the results of the Phase I Diagnostic/Feasibility Study, the following activities are recommended for the restoration of Lake Kampeska and the Big Sioux River watershed:

Primary Activities

The following primary restoration activities are recommended because they would have the most immediate impact on improvement of water quality in Lake Kampeska and the Big Sioux River watershed, and because of their economic feasibility.

1) Lake Shoreline Stabilization/Management

   It is recommended that 2,000 feet (609 m) of highly erodible shoreline be rip-rapped or stabilized by other methods. Implementation of this recommendation should begin in areas that have moderate, moderate/severe, and severe erosion. Implementation in areas of minor erosion should be undertaken as time and resources permit. The estimated cost of implementing this recommendation is $100,000 (2,000 feet of shoreline at $50 per linear foot).

   In addition to shoreline stabilization, a program of property owner education should be implemented for residents living around the lake. This education program would include information on the following topics:

   a) Fertilizer/pesticide application. Fertilizers without phosphorus should be applied to lawns, only as needed. Pesticides should be used for spot treatments, rather than for application to entire lawns. Neither fertilizers or pesticides should be applied before rain events. Commercial companies should be instructed to avoid the application of fertilizers and pesticides to sidewalks or driveways, to the greatest extent possible.

   b) Leaf/grass disposal. Composting of grass clippings and leaves should be promoted. Mulching of grass should be encouraged to leave grass clippings on lawns, which will act as natural fertilizer. Prevention of grass clippings, leaves, and other yard wastes from entering the lake will reduce nutrient loadings.

   c) Waste oil disposal. Lake residents should be informed of facilities that will accept and recycle waste oil.

d) Construction site erosion control. Property owners and/or contractors building new homes or other buildings and facilities around the lake should be advised of techniques to control erosion. The successful implementation of this recommendation may necessitate the strict enforcement of existing city ordinances which require erosion control around the lake.

2) Construction of Small Ponds/Dams

Approximately 75 small dams need to be constructed on tributaries in the watershed. The two- to five-acre impoundments created by these small dams will act as sediment sinks and water retention facilities. This can be accomplished through an existing cooperative grant program with the U. S. Fish and Wildlife Service and several other organizations under the local direction of the Codington, Grant, Day, and Roberts Conservation Districts. The cost for constructing these dams is estimated at $2,000 to $3,000 each. Therefore, the total cost of implementing this recommendation is $150,000 to $225,000.

3) Grassed Waterways

It is recommended that approximately 100,000 linear feet of grassed waterways be constructed in priority subwatersheds. At a cost of $1.50 per foot, the total cost to complete this recommendation would be $150,000.

4) Filter Strips/Grass Seedings

Under this recommendation, approximately 1,000 acres adjacent to the Big Sioux River and its tributaries would be planted to permanent vegetation. At a rate of $40 per acre, the total cost to complete this recommendation would be $40,000.

5) Animal Waste Management Systems

It is recommended that 50 animal waste management systems be constructed, with nutrient management systems and follow-up monitoring to ensure proper application of wastes. The amount of cropland required for the proper disposal of wastes would be approximately 15,000 acres. The average cost to construct an animal waste management system is $25,000 to $30,000. The total cost of implementing this recommendation is therefore $1,250,000 to $1,500,000.

6) Streambank Stabilization/Riparian Area Management

Grazing management systems should be implemented on 2,000 acres of pastureland and rangeland in priority subwatersheds. Critical area seedings should also be planted on severely degraded sideslopes. Livestock will need to be excluded from critical areas by fencing priority acreages that are likely to heal naturally. Innovative riparian area management techniques should be explored.

7) Information and Education Program to Promote Best Management Practices

The implementation of this recommendation would include the following:

a) Provide technical/financial assistance for Best Management Practices in priority subwatersheds.

b) Apply crop residue management on 10,000 acres, which is approximately 50% of the steeper cropland in the priority subwatersheds.

c) Apply Integrated Crop Management on 10,000 acres in priority subwatersheds.

8) Wetland Restoration/Creation

Through this recommendation, 100 acres of prior converted wetlands or farmed wetlands (wetlands partially drained and farmed, but still with wetland characteristics) would be restored. In addition, areas in priority subwatersheds would be investigated for the possibility of creating new wetlands. Programs of this type are currently provided by the South Dakota Department of Game, Fish and Parks, and Ducks Unlimited (MARSH program: Matching Aid to Restore State Habitats).

9) Conservation Reserve Program

If the Conservation Reserve Program (CRP) is continued through 1995, consideration should be given to designating the Lake Kampeska watershed as a Hydrologic Unit Priority Area. In addition, an incentive program should be developed to keep land under expiring CRP contracts in permanent grassed vegetation.

10) Septic System Survey

It is recommended that a survey be conducted in priority subwatersheds to determine the impact of failing or inadequate septic systems. (Septic systems around the lake have been eliminated by the construction of a sanitary sewer system.) If the survey in priority subwatersheds indicates significant problems, efforts should be undertaken to correct the problems. These would include landowner education on proper construction and maintenance of individual on-site wastewater systems. In addition, state rules would need to be enforced to ensure compliance with current requirements. Counties should be encouraged to develop and enforce ordinances in conformance with the state rules.

11) Construction of Flow Control Structure

An engineering study should be conducted to determine the feasibility of building a structure to divert water in the Big Sioux River downstream, away from Lake Kampeska, during periods of high flow. The study would need to take into account downstream effects, such as increased flooding in Watertown, at Pelican Lake, and other downstream areas. A cost/benefit analysis would need to be included in the study to compare benefits to Lake Kampeska versus the cost of mitigating adverse downstream effects.

Secondary Activities

The following activities are listed as secondary recommendations because of their high costs. Although these activities would result in improvements in Lake Kampeska and the Big Sioux River watershed, they should be undertaken only after major progress has been accomplished toward implementation of the primary recommendations listed above.

12) Selective Dredging

The following alternatives are recommended to accomplish selective removal of sediment, improvement of fisheries habitat, and a reduction in the release of nutrients from bottom sediments.

a) Dredging of the lake in areas of greatest sedimentation, and construction of islands positioned in the lake to act as windbreaks and park areas. Strategically located islands would allow for stabilization of lake shoreline.

b) Dredging of the lake to create a centralized channel, and construction of settling and retention ponds. This would facilitate the construction of an outlet by allowing flushing of the lake to occur down a centralized channel.

c) Purchase of a dredge by the City of Watertown and/or other local entities for use on the above dredging projects, as well as other possible correlated goals. Selective dredging in the lake would allow for increased stratification, which would decrease turbidity from wind action. Decreased turbidity would permit the establishment of increased macrophytic plant life on the lake bottom (less than 5% of the lake presently has submergent or emergent aquatic vegetation). Accomplishment of this goal would improve the fisheries habitat of the lake. In addition, decreased turbidity would enhance the aesthetic appeal of the lake for recreational activities.

13) Construction of Flood Control Facilities

It is estimated that construction of a major flood control facility on the Big Sioux River north of Lake Kampeska, such as the dam being studied by the Army Corps of Engineers, would retain 80% to 90% of the sediment loadings in the river. Construction of this proposed dam, or other smaller flood control structures, would contribute significantly to improvement of water quality in Lake Kampeska by preventing the deposition of solids and associated nutrients. The present schedule for completion of the Army Corps of Engineers' feasibility study for construction of a dam at the proposed Mahoney Creek site is June, 1994.

14) Construction of a Lake Outlet

It is recommended that the following alternatives be investigated for the construction of a new outlet on Lake Kampeska, after significant progress has been made toward implementation of the primary recommendations discussed previously.

a) Investigate construction of an outlet from the southwest portion of Lake Kampeska that would direct overflow water to Goose Lake, and eventually to Pelican Lake. The overflow water would maintain water levels in Goose Lake, and enhance its role as a waterfowl rookery and migratory flyway habitat. The flushing of water from the west end of Pelican Lake through the outlet at the east end would help to prevent deposition of solids from the Big Sioux River into Pelican Lake.

b) Investigate construction of an outlet from the southeast shoreline of Lake Kampeska. This outlet would connect Lake Kampeska with the Big Sioux River downstream of Watertown. The result would be decreased hydraulic residence time in Lake Kampeska, and thus decreased deposition of solids in the lake.

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APPENDIX A. USLE Soil Loss Estimates by Subwatershed

SOIL LOSS ESTIMATES FROM VARIOUS LANDUSES BY SOIL ASSOCIATION
SUB-WATERSHED: IMMEDIATE KAMPESKA

SOIL ASSOC.	LAND USE	AREA (Ac)	AREA (Ha)	R	K	LS	C	Tons/Ac/Yr	Total Tons	Total Kgs	DR	Delivered Sediments Kg/Yr
Cod1PWO	Ag-Cult	1695	678.0	95	0.28	0.53	0.22	3.10	5257.1	4,731,430	0.24	1,135,543
Cod2PBP	Ag-Cult	1877	750.8	95	0.28	2.0	0.22	11.70	21968.4	19,771,567	0.24	4,745,176
Cod6EFR	Ag-Cult	2482	992.8	95	0.24	0.27	0.22	1.35	3361.4	3,025,280	0.24	726,067
Cod1PWO	Ag-Noncult	944	377.6	95	0.28	0.53	0.02	0.28	266.2	239,553	0.24	57,493
Cod2PBP	Ag-Noncult	1045	418.0	95	0.28	2.0	0.02	1.06	1111.9	1,000,692	0.24	240,166
Cod6EFR	Ag-Noncult	1382	552.8	95	0.24	0.27	0.02	0.12	170.2	153,137	0.24	36,753
Cod1PWO	Res-LowDen	234	93.6	95	0.28	0.53	0.03	0.42	99.0	89,071	0.24	21,377
Cod2PBP	Res-LowDen	259	103.6	95	0.28	2.0	0.03	1.60	413.4	372,028	0.24	89,287
Cod6EFR	Res-LowDen	343	137.2	95	0.24	0.27	0.03	0.18	63.3	57,011	0.24	13,683
Cod1PWO	Res-HiDen	148	59.2	95	0.28	0.53	0.04	0.56	83.5	75,114	0.24	18,027
Cod2PBP	Res-HiDen	163	65.2	95	0.28	2.0	0.04	2.13	346.9	312,178	0.24	74,923
Cod6EFR	Res-HiDen	216	86.4	95	0.24	0.27	0.04	0.25	53.2	47,869	0.24	11,489
Cod1PWO	CRP	35	14.0	95	0.28	0.53	0.005	0.07	2.5	2,220	0.24	533
Cod2PBP	CRP	39	15.6	95	0.28	2.0	0.005	0.27	10.4	9,337	0.24	2,241
Cod6EFR	CRP	52	20.8	95	0.24	0.27	0.005	0.03	1.6	1,441	0.24	346
Cod1PWO	Forest	42	16.8	95	0.28	0.53	0.003	0.04	1.8	1,599	0.24	384
Cod2PBP	Forest	46	18.4	95	0.28	2.0	0.003	0.16	7.3	6,607	0.24	1,586
Cod6EFR	Forest	61	24.4	95	0.24	0.27	0.003	0.02	1.1	1,014	0.24	243
Cod1PWO	Transport	80	32.0	95	0.28	0.53	0.01	0.14	11.3	10,151	0.24	2,436
Cod2PBP	Transport	89	35.6	95	0.28	2.0	0.01	0.53	47.3	42,613	0.24	10,227
Cod6EFR	Transport	118	47.2	95	0.24	0.27	0.01	0.06	7.3	6,538	0.24	1,569
TOTALS:									33284.9	29,956,448		7,189,548

SOIL LOSS ESTIMATES FROM VARIOUS LANDUSES BY SOIL ASSOCIATION

SUB-WATERSHED: LOWER SIOUX

SOIL ASSOC.	LAND USE	AREA (Ac)	AREA (Ha)	R	K	LS	C	Tons/Ac/Yr	Total Tons	Total Kgs	DR	Delivered Sediments Kg/Yr
Cod3BKV	Ag-Cult	5853	2341.2	95	0.32	0.63	0.22	4.21	24661.3	22,195,138	0.23	5,104,882
Cod6EFR	Ag-Cult	2926	1170.4	95	0.24	0.27	0.22	1.35	3962.7	3,566,466	0.23	820,287
Cod7LR	Ag-Cult	2059	823.6	95	0.28	0.18	0.22	1.05	2168.9	1,951,981	0.23	448,956
Cod3BKV	Ag-Noncult	1728	691.2	95	0.32	0.63	0.02	0.38	661.9	595,704	0.23	137,012
Cod6EFR	Ag-Noncult	864	345.6	95	0.24	0.27	0.02	0.12	106.4	95,738	0.23	22,020
Cod7LR	Ag-Noncult	608	243.2	95	0.28	0.18	0.02	0.10	58.2	52,400	0.23	12,052
Cod3BKV	Res-LowDen	178	71.2	95	0.32	0.63	0.03	0.57	102.3	92,045	0.23	21,170
Cod6EFR	Res-LowDen	89	35.6	95	0.24	0.27	0.03	0.18	16.4	14,793	0.23	3,402
Cod7LR	Res-LowDen	63	25.2	95	0.28	0.18	0.03	0.14	9.0	8,144	0.23	1,873
Cod3BKV	Res-HiDen	17	6.8	95	0.32	0.63	0.04	0.77	13.0	11,721	0.23	2,696
Cod6EFR	Res-HiDen	9	3.6	95	0.24	0.27	0.04	0.25	2.2	1,995	0.23	459
Cod7LR	Res-HiDen	6	2.4	95	0.28	0.18	0.04	0.19	1.1	1,034	0.23	238
Cod3BKV	CRP	34	13.6	95	0.32	0.63	0.005	0.10	3.3	2,930	0.23	674
Cod6EFR	CRP	17	6.8	95	0.24	0.27	0.005	0.03	0.5	471	0.23	108
Cod7LR	CRP	12	4.8	95	0.28	0.18	0.005	0.02	0.3	259	0.23	59
Cod3BKV	Forest	85	34.0	95	0.32	0.63	0.003	0.06	4.9	4,395	0.23	1,011
Cod6EFR	Forest	42	16.8	95	0.24	0.27	0.003	0.02	0.8	698	0.23	161
Cod7LR	Forest	30	12.0	95	0.28	0.18	0.003	0.01	0.4	388	0.23	89
Cod3BKV	Transport	220	88.0	95	0.32	0.63	0.01	0.19	42.1	37,921	0.23	8,722
Cod6EFR	Transport	110	44.0	95	0.24	0.27	0.01	0.06	6.8	6,094	0.23	1,402
Cod7LR	Transport	77	30.8	95	0.28	0.18	0.01	0.05	3.7	3,318	0.23	763
TOTALS:									31826.3	28,643,633		6,588,036

SOIL LOSS ESTIMATES FROM VARIOUS LANDUSES BY SOIL ASSOCIATION
SUB-WATERSHED: MIDDLE SIOUX

SOIL ASSOC.	LAND USE	AREA (Ac)	AREA (Ha)	R	K	LS	C	Tons/Ac/Yr	Total Tons	Total Kgs	DR	Delivered Sediments Kg/Yr
Cod2PBP	Ag-Cult	901	360.4	95	0.28	2.0	0.22	11.70	10545.3	9,490,774	0.18	1,708,339
Cod3BKV	Ag-Cult	4170	1668.0	95	0.32	0.63	0.22	4.21	17570.0	15,813,040	0.18	2,846,347
Cod6EFR	Ag-Cult	3831	1532.4	95	0.24	0.27	0.22	1.35	5188.4	4,669,560	0.18	840,521
Cod7LR	Ag-Cult	2366	946.4	95	0.28	0.18	0.22	1.05	2492.2	2,243,025	0.18	403,744
Gra5VL	Ag-Cult	3427	1370.8	100	0.32	0.63	0.22	4.44	15199.4	13,679,487	0.18	2,462,308
Gra6RFD	Ag-Cult	1423	569.2	100	0.28	0.27	0.22	1.66	2366.7	2,130,060	0.18	383,411
Gra7LPD	Ag-Cult	422	168.8	100	0.28	0.18	0.22	1.11	467.9	421,122	0.18	75,802
Day5FPB	Ag-Cult	2473	989.2	90	0.28	0.40	0.22	2.22	5484.1	4,935,712	0.18	888,428
Day10V	Ag-Cult	967	386.8	90	0.32	0.32	0.22	2.03	1960.6	1,764,551	0.18	317,619
Cod2PBP	Ag-Noncult	316	126.4	95	0.28	2.0	0.02	1.06	336.2	302,602	0.18	54,468
Cod3BKV	Ag-Noncult	1462	584.8	95	0.32	0.63	0.02	0.38	560.0	504,004	0.18	90,721
Cod6EFR	Ag-Noncult	1343	537.2	95	0.24	0.27	0.02	0.12	165.4	148,815	0.18	26,787
Cod7LR	Ag-Noncult	830	332.0	95	0.28	0.18	0.02	0.10	79.5	71,533	0.18	12,876
Gra5VL	Ag-Noncult	1201	480.4	100	0.32	0.63	0.02	0.40	484.2	435,819	0.18	78,447
Gra6RFD	Ag-Noncult	499	199.6	100	0.28	0.27	0.02	0.15	75.4	67,904	0.18	12,223
Gra7LPD	Ag-Noncult	148	59.2	100	0.28	0.18	0.02	0.10	14.9	13,427	0.18	2,417
Day5FPB	Ag-Noncult	867	346.8	90	0.28	0.40	0.02	0.20	174.8	157,308	0.18	28,316
Day10V	Ag-Noncult	244	97.6	90	0.32	0.32	0.02	0.18	45.0	40,477	0.18	7,286
Cod2PBP	Res-LowDen	14	5.6	95	0.28	2.0	0.03	1.60	22.3	20,110	0.18	3,620
Cod3BKV	Res-LowDen	63	25.2	95	0.32	0.63	0.03	0.57	36.2	32,578	0.18	5,864
Cod6EFR	Res-LowDen	58	23.2	95	0.24	0.27	0.03	0.18	10.7	9,640	0.18	1,735
Cod7LR	Res-LowDen	36	14.4	95	0.28	0.18	0.03	0.14	5.2	4,654	0.18	838
Gra5VL	Res-LowDen	52	20.8	100	0.32	0.63	0.03	0.60	31.4	28,305	0.18	5,095
Gra6RFD	Res-LowDen	22	8.8	100	0.28	0.27	0.03	0.23	5.0	4,491	0.18	808
Gra7LPD	Res-LowDen	6	2.4	100	0.28	0.18	0.03	0.15	0.9	816	0.18	147
Day5FPB	Res-LowDen	38	15.2	90	0.28	0.40	0.03	0.30	11.5	10,342	0.18	1,862
Day10V	Res-LowDen	11	4.4	90	0.32	0.32	0.03	0.28	3.0	2,737	0.18	493
Cod2PBP	Res-HiDen	1	0.4	95	0.28	2.0	0.04	2.13	2.1	1,915	0.18	345
Cod3BKV	Res-HiDen	6	2.4	95	0.32	0.63	0.04	0.77	4.6	4,137	0.18	745
Cod6EFR	Res-HiDen	6	2.4	95	0.24	0.27	0.04	0.25	1.5	1,330	0.18	239

Cod7LR	Res-HiDen	3	1.2	95	0.28	0.18	0.04	0.19	0.6	517	0.18	93
Gra5VL	Res-HiDen	5	2.0	100	0.32	0.63	0.04	0.81	4.0	3,629	0.18	653
Gra6RFD	Res-HiDen	2	0.8	100	0.28	0.27	0.04	0.30	0.6	544	0.18	98
Gra7LPD	Res-HiDen	1	0.4	100	0.28	0.18	0.04	0.20	0.2	181	0.18	33
Day5FPB	Res-HiDen	4	1.6	90	0.28	0.40	0.04	0.40	1.6	1,452	0.18	261
Day10V	Res-HiDen	1	0.4	90	0.32	0.32	0.04	0.37	0.4	332	0.18	60
Cod2PBP	CRP	70	28.0	95	0.28	2.0	0.005	0.27	18.6	16,758	0.18	3,016
Cod3BKV	CRP	323	129.2	95	0.32	0.63	0.005	0.10	30.9	27,837	0.18	5,011
Cod6EFR	CRP	297	118.8	95	0.24	0.27	0.005	0.03	9.1	8,227	0.18	1,481
Cod7LR	CRP	183	73.2	95	0.28	0.18	0.005	0.02	4.4	3,943	0.18	710
Gra5VL	CRP	265	106.0	100	0.32	0.63	0.005	0.10	26.7	24,041	0.18	4,327
Gra6RFD	CRP	110	44.0	100	0.28	0.27	0.005	0.04	4.2	3,742	0.18	674
Gra7LPD	CRP	32	12.8	100	0.28	0.18	0.005	0.03	0.8	726	0.18	131
Day5FPB	CRP	191	76.4	90	0.28	0.40	0.005	0.05	9.6	8,664	0.18	1,559
Day10V	CRP	54	21.6	90	0.32	0.32	0.005	0.05	2.5	2,239	0.18	403
Cod2PBP	Forest	14	5.6	95	0.28	2.0	0.003	0.16	2.2	2,011	0.18	362
Cod3BKV	Forest	63	25.2	95	0.32	0.63	0.003	0.06	3.6	3,258	0.18	586
Cod6EFR	Forest	58	23.2	95	0.24	0.27	0.003	0.02	1.1	964	0.18	174
Cod7LR	Forest	36	14.4	95	0.28	0.18	0.003	0.01	0.5	465	0.18	84
Gra5VL	Forest	52	20.8	100	0.32	0.63	0.003	0.06	3.1	2,830	0.18	509
Gra6RFD	Forest	22	8.8	100	0.28	0.27	0.003	0.02	0.5	449	0.18	81
Gra7LPD	Forest	6	2.4	100	0.28	0.18	0.003	0.02	0.1	82	0.18	15
Day5FPB	Forest	38	15.2	90	0.28	0.40	0.003	0.03	1.1	1,034	0.18	186
Day10V	Forest	11	4.4	90	0.32	0.32	0.003	0.03	0.3	274	0.18	49
Cod2PBP	Transport	34	13.6	95	0.28	2.0	0.01	0.53	18.1	16,279	0.18	2,930
Cod3BKV	Transport	158	63.2	95	0.32	0.63	0.01	0.19	30.3	27,234	0.18	4,902
Cod6EFR	Transport	145	58.0	95	0.24	0.27	0.01	0.06	8.9	8,034	0.18	1,446
Cod7LR	Transport	90	36.0	95	0.28	0.18	0.01	0.05	4.3	3,878	0.18	698
Gra5VL	Transport	130	52.0	100	0.32	0.63	0.01	0.20	26.2	23,587	0.18	4,246
Gra6RFD	Transport	54	21.6	100	0.28	0.27	0.01	0.08	4.1	3,674	0.18	661
Gra7LPD	Transport	16	6.4	100	0.28	0.18	0.01	0.05	0.8	726	0.18	131
Day5FPB	Transport	94	37.6	90	0.28	0.40	0.01	0.10	9.5	8,528	0.18	1,535
Day10V	Transport	26	10.4	90	0.32	0.32	0.01	0.09	2.4	2,157	0.18	388
TOTALS:									63576.2	57,218,570		10,299,343

SOIL LOSS ESTIMATES FROM VARIOUS LANDUSES BY SOIL ASSOCIATION

SUB-WATERSHED: UPPER SIOUX

SOIL ASSOC.	LAND USE	AREA (Ac)	AREA (Ha)	R	K	LS	C	Tons/Ac/Yr	Total Tons	Total Kgs	DR	Delivered Sediments Kg/Yr
Gra5VL	Ag-Cult	8767	3506.8	100	0.32	0.63	0.22	4.44	38883.4	34,995,059	0.15	5,249,259
Gra6RFD	Ag-Cult	7444	2977.6	100	0.28	0.27	0.22	1.66	12380.9	11,142,775	0.15	1,671,416
Gra7LPD	Ag-Cult	331	132.4	100	0.28	0.18	0.22	1.11	367.0	330,312	0.15	49,547
Rob8RF	Ag-Cult	420	168.0	95	0.28	0.28	0.22	1.64	688.2	619,376	0.15	92,906
Rob9V	Ag-Cult	1490	596.0	95	0.32	0.62	0.22	4.15	6178.4	5,560,537	0.15	834,081
Day5FBP	Ag-Cult	2063	825.2	90	0.28	0.4	0.22	2.22	4574.9	4,117,418	0.15	617,613
Day6BB	Ag-Cult	3669	1467.6	90	0.28	2.5	0.22	13.86	50852.3	45,767,106	0.15	6,865,066
Gra5VL	Ag-Noncult	4818	1927.2	100	0.32	0.63	0.02	0.40	1942.6	1,748,356	0.15	262,253
Gra6RFD	Ag-Noncult	4091	1636.4	100	0.28	0.27	0.02	0.15	618.6	556,703	0.15	83,505
Gra7LPD	Ag-Noncult	182	72.8	100	0.28	0.18	0.02	0.10	18.3	16,511	0.15	2,477
Rob8RF	Ag-Noncult	231	92.4	95	0.28	0.28	0.02	0.15	34.4	30,969	0.15	4,645
Rob9V	Ag-Noncult	819	327.6	95	0.32	0.62	0.02	0.38	308.7	277,857	0.15	41,679
Day5FBP	Ag-Noncult	1134	453.6	90	0.28	0.4	0.02	0.20	228.6	205,753	0.15	30,863
Day6BB	Ag-Noncult	2016	806.4	90	0.28	2.5	0.02	1.26	2540.2	2,286,144	0.15	342,922
Gra5VL	Res-LowDen	253	101.2	100	0.32	0.63	0.03	0.60	153.0	137,713	0.15	20,657
Gra6RFD	Res-LowDen	215	86.0	100	0.28	0.27	0.03	0.23	48.8	43,886	0.15	6,583
Gra7LPD	Res-LowDen	10	4.0	100	0.28	0.18	0.03	0.15	1.5	1,361	0.15	204
Rob8RF	Res-LowDen	12	4.8	95	0.28	0.28	0.03	0.22	2.7	2,413	0.15	362
Rob9V	Res-LowDen	43	17.2	95	0.32	0.62	0.03	0.57	24.3	21,883	0.15	3,282
Day5FBP	Res-LowDen	59	23.6	90	0.28	0.4	0.03	0.30	17.8	16,057	0.15	2,409
Day6BB	Res-LowDen	106	42.4	90	0.28	2.5	0.03	1.89	200.3	180,306	0.15	27,046
Gra5VL	Res-HiDen	47	18.8	100	0.32	0.63	0.04	0.81	37.9	34,111	0.15	5,117
Gra6RFD	Res-HiDen	40	16.0	100	0.28	0.27	0.04	0.30	12.1	10,886	0.15	1,633
Gra7LPD	Res-HiDen	2	0.8	100	0.28	0.18	0.04	0.20	0.4	363	0.15	54
Rob8RF	Res-HiDen	2	0.8	95	0.28	0.28	0.04	0.30	0.6	536	0.15	80
Rob9V	Res-HiDen	8	3.2	95	0.32	0.62	0.04	0.75	6.0	5,428	0.15	814
Day5FBP	Res-HiDen	11	4.4	90	0.28	0.4	0.04	0.40	4.4	3,992	0.15	599
Day6BB	Res-HiDen	20	8.0	90	0.28	2.5	0.04	2.52	50.4	45,360	0.15	6,804
Gra5VL	CRP	1200	480.0	100	0.32	0.63	0.005	0.10	121.0	108,864	0.15	16,330

Gra6RFD	CRP	1019	407.6	100	0.28	0.27	0.005	0.04	38.5	34,666	0.15	5,200
Gra7LPD	CRP	45	18.0	100	0.28	0.18	0.005	0.03	1.1	1,021	0.15	153
Rob8RF	CRP	58	23.2	95	0.28	0.28	0.005	0.04	2.2	1,944	0.15	292
Rob9V	CRP	204	81.6	95	0.32	0.62	0.005	0.09	19.2	17,302	0.15	2,595
Day5FBP	CRP	283	113.2	90	0.28	0.4	0.005	0.05	14.3	12,837	0.15	1,926
Day6BB	CRP	502	200.8	90	0.28	2.5	0.005	0.32	158.1	142,317	0.15	21,348
Gra5VL	Forest	142	56.8	100	0.32	0.63	0.003	0.06	8.6	7,729	0.15	1,159
Gra6RFD	Forest	121	48.4	100	0.28	0.27	0.003	0.02	2.7	2,470	0.15	370
Gra7LPD	Forest	5	2.0	100	0.28	0.18	0.003	0.02	0.1	68	0.15	10
Rob8RF	Forest	7	2.8	95	0.28	0.28	0.003	0.02	0.2	141	0.15	21
Rob9V	Forest	24	9.6	95	0.32	0.62	0.003	0.06	1.4	1,221	0.15	183
Day5FBP	Forest	33	13.2	90	0.28	0.4	0.003	0.03	1.0	898	0.15	135
Day6BB	Forest	59	23.6	90	0.28	2.5	0.003	0.19	11.2	10,036	0.15	1,505
Gra5VL	Transport	474	189.6	100	0.32	0.63	0.01	0.20	95.6	86,003	0.15	12,900
Gra6RFD	Transport	402	160.8	100	0.28	0.27	0.01	0.08	30.4	27,352	0.15	4,103
Gra7LPD	Transport	18	7.2	100	0.28	0.18	0.01	0.05	0.9	816	0.15	122
Rob8RF	Transport	23	9.2	95	0.28	0.28	0.01	0.07	1.7	1,542	0.15	231
Rob9V	Transport	80	32.0	95	0.32	0.62	0.01	0.19	15.1	13,571	0.15	2,036
Day5FBP	Transport	112	44.8	90	0.28	0.4	0.01	0.10	11.3	10,161	0.15	1,524
Day6BB	Transport	198	79.2	90	0.28	2.5	0.01	0.63	124.7	112,266	0.15	16,840
TOTALS:									120836.0	108,752,394		16,312,859

SOIL LOSS ESTIMATES FROM VARIOUS LANDUSES BY SOIL ASSOCIATION
SUB-WATERSHED: MUD CREEK

SOIL ASSOC.	LAND USE	AREA (Ac)	AREA (Ha)	R	K	LS	C	Tons/Ac/Yr	Total Tons	Total Kgs	DR	Delivered Sediments Kg/Yr
Cod3BKV	Ag-Cult	22093	8837.2	95	0.32	0.63	0.22	4.21	93087.5	83,778,777	0.15	12,566,817
Cod6EFR	Ag-Cult	3682	1472.8	95	0.24	0.27	0.22	1.35	4986.6	4,487,946	0.15	673,192
Cod7LR	Ag-Cult	2549	1019.6	95	0.28	0.18	0.22	1.05	2685.0	2,416,513	0.15	362,477
Cod3BKV	Ag-Noncult	10324	4129.6	95	0.32	0.63	0.02	0.38	3954.5	3,559,054	0.15	533,858
Cod6EFR	Ag-Noncult	1721	688.4	95	0.24	0.27	0.02	0.12	211.9	190,701	0.15	28,605
Cod7LR	Ag-Noncult	1191	476.4	95	0.28	0.18	0.02	0.10	114.1	102,645	0.15	15,397
Cod3BKV	Res-LowDen	564	225.6	95	0.32	0.63	0.03	0.57	324.1	291,647	0.15	43,747
Cod6EFR	Res-LowDen	94	37.6	95	0.24	0.27	0.03	0.18	17.4	15,624	0.15	2,344
Cod7LR	Res-LowDen	65	26.0	95	0.28	0.18	0.03	0.14	9.3	8,403	0.15	1,260
Cod3BKV	Res-HiDen	35	14.0	95	0.32	0.63	0.04	0.77	26.8	24,132	0.15	3,620
Cod6EFR	Res-HiDen	6	2.4	95	0.24	0.27	0.04	0.25	1.5	1,330	0.15	199
Cod7LR	Res-HiDen	4	1.6	95	0.28	0.18	0.04	0.19	0.8	689	0.15	103
Cod3BKV	CRP	352	140.8	95	0.32	0.63	0.005	0.10	33.7	30,337	0.15	4,551
Cod6EFR	CRP	59	23.6	95	0.24	0.27	0.005	0.03	1.8	1,634	0.15	245
Cod7LR	CRP	40	16.0	95	0.28	0.18	0.005	0.02	1.0	862	0.15	129
Cod3BKV	Forest	705	282.0	95	0.32	0.63	0.003	0.06	40.5	36,456	0.15	5,468
Cod6EFR	Forest	117	46.8	95	0.24	0.27	0.003	0.02	2.2	1,945	0.15	292
Cod7LR	Forest	81	32.4	95	0.28	0.18	0.003	0.01	1.2	1,047	0.15	157
Cod3BKV	Transport	1128	451.2	95	0.32	0.63	0.01	0.19	216.0	194,431	0.15	29,165
Cod6EFR	Transport	188	75.2	95	0.24	0.27	0.01	0.06	11.6	10,416	0.15	1,562
Cod7LR	Transport	130	52.0	95	0.28	0.18	0.01	0.05	6.2	5,602	0.15	840
TOTALS:									105733.5	95,160,190		14,274,028

SOIL LOSS ESTIMATES FROM VARIOUS LANDUSES BY SOIL ASSOCIATION

SUB-WATERSHED: MAHONEY CREEK

SOIL ASSOC.	LAND USE	AREA (Ac)	AREA (Ha)	R	K	LS	C	Tons/Ac/Yr	Total Tons	Total Kgs	DR	Delivered Sediments Kg/Yr
Cod3BKV	Ag-Cult	6862	2744.8	95	0.32	0.63	0.22	4.21	28912.6	26,021,363	0.23	5,984,913
Cod6EFR	Ag-Cult	2178	871.2	95	0.24	0.27	0.22	1.35	2949.7	2,654,738	0.23	610,590
Cod7LR	Ag-Cult	1852	740.8	95	0.28	0.18	0.22	1.05	1950.8	1,755,740	0.23	403,820
Cod3BKV	Ag-Noncult	1720	688.0	95	0.32	0.63	0.02	0.38	658.8	592,946	0.23	136,378
Cod6EFR	Ag-Noncult	546	218.4	95	0.24	0.27	0.02	0.12	67.2	60,501	0.23	13,915
Cod7LR	Ag-Noncult	464	185.6	95	0.28	0.18	0.02	0.10	44.4	39,989	0.23	9,198
Cod3BKV	Res-LowDen	166	66.4	95	0.32	0.63	0.03	0.57	95.4	85,839	0.23	19,743
Cod6EFR	Res-LowDen	53	21.2	95	0.24	0.27	0.03	0.18	9.8	8,809	0.23	2,026
Cod7LR	Res-LowDen	45	18.0	95	0.28	0.18	0.03	0.14	6.5	5,817	0.23	1,338
Cod3BKV	Res-HiDen	0	0.0	95	0.32	0.63	0.04	0.77	0.0	0	0.23	0
Cod6EFR	Res-HiDen	0	0.0	95	0.24	0.27	0.04	0.25	0.0	0	0.23	0
Cod7LR	Res-HiDen	0	0.0	95	0.28	0.18	0.04	0.19	0.0	0	0.23	0
Cod3BKV	CRP	28	11.2	95	0.32	0.63	0.005	0.10	2.7	2,413	0.23	555
Cod6EFR	CRP	9	3.6	95	0.24	0.27	0.005	0.03	0.3	249	0.23	57
Cod7LR	CRP	8	3.2	95	0.28	0.18	0.005	0.02	0.2	172	0.23	40
Cod3BKV	Forest	110	44.0	95	0.32	0.63	0.003	0.06	6.3	5,688	0.23	1,308
Cod6EFR	Forest	35	14.0	95	0.24	0.27	0.003	0.02	0.6	582	0.23	134
Cod7LR	Forest	30	12.0	95	0.28	0.18	0.003	0.01	0.4	388	0.23	89
Cod3BKV	Transport	304	121.6	95	0.32	0.63	0.01	0.19	58.2	52,400	0.23	12,052
Cod6EFR	Transport	96	38.4	95	0.24	0.27	0.01	0.06	5.9	5,319	0.23	1,223
Cod7LR	Transport	82	32.8	95	0.28	0.18	0.01	0.05	3.9	3,534	0.23	813
TOTALS:									34773.9	31,296,488		7,198,192

SOIL LOSS ESTIMATES FROM VARIOUS LANDUSES BY SOIL ASSOCIATION

SUB-WATERSHED: SOO CREEK

SOIL ASSOC.	LAND USE	AREA (Ac)	AREA (Ha)	R	K	LS	C	Tons/Ac/Yr	Total Tons	Total Kgs	DR	Delivered Sediments Kg/Yr
Cod3BKV	Ag-Cult	8519	3407.6	95	0.32	0.63	0.22	4.21	35894.3	32,304,866	0.21	6,784,022
Cod6EFR	Ag-Cult	784	313.6	95	0.24	0.27	0.22	1.35	1061.8	955,608	0.21	200,678
Cod7LR	Ag-Cult	490	196.0	95	0.28	0.18	0.22	1.05	516.1	464,532	0.21	97,552
Gra5VL	Ag-Cult	2963	1185.2	100	0.32	0.63	0.22	4.44	13141.5	11,827,348	0.21	2,483,743
Cod3BKV	Ag-Noncult	4058	1623.2	95	0.32	0.63	0.02	0.38	1554.4	1,398,939	0.21	293,777
Cod6EFR	Ag-Noncult	373	149.2	95	0.24	0.27	0.02	0.12	45.9	41,331	0.21	8,680
Cod7LR	Ag-Noncult	233	93.2	95	0.28	0.18	0.02	0.10	22.3	20,081	0.21	4,217
Gra5VL	Ag-Noncult	1412	564.8	100	0.32	0.63	0.02	0.40	569.3	512,387	0.21	107,601
Cod3BKV	Res-LowDen	188	75.2	95	0.32	0.63	0.03	0.57	108.0	97,216	0.21	20,415
Cod6EFR	Res-LowDen	17	6.8	95	0.24	0.27	0.03	0.18	3.1	2,826	0.21	593
Cod7LR	Res-LowDen	11	4.4	95	0.28	0.18	0.03	0.14	1.6	1,422	0.21	299
Gra5VL	Res-LowDen	65	26.0	100	0.32	0.63	0.03	0.60	39.3	35,381	0.21	7,430
Cod3BKV	Res-HiDen	0	0.0	95	0.32	0.63	0.04	0.77	0.0	0	0.21	0
Cod6EFR	Res-HiDen	0	0.0	95	0.24	0.27	0.04	0.25	0.0	0	0.21	0
Cod7LR	Res-HiDen	0	0.0	95	0.28	0.18	0.04	0.19	0.0	0	0.21	0
Gra5VL	Res-HiDen	0	0.0	100	0.32	0.63	0.04	0.81	0.0	0	0.21	0
Cod3BKV	CRP	40	16.0	95	0.32	0.63	0.005	0.10	3.8	3,447	0.21	724
Cod6EFR	CRP	4	1.6	95	0.24	0.27	0.005	0.03	0.1	111	0.21	23
Cod7LR	CRP	2	0.8	95	0.28	0.18	0.005	0.02	0.0	43	0.21	9
Gra5VL	CRP	14	5.6	100	0.32	0.63	0.005	0.10	1.4	1,270	0.21	267
Cod3BKV	Forest	175	70.0	95	0.32	0.63	0.003	0.06	10.1	9,049	0.21	1,900
Cod6EFR	Forest	16	6.4	95	0.24	0.27	0.003	0.02	0.3	266	0.21	56
Cod7LR	Forest	10	4.0	95	0.28	0.18	0.003	0.01	0.1	129	0.21	27
Gra5VL	Forest	61	24.4	100	0.32	0.63	0.003	0.06	3.7	3,320	0.21	697
Cod3BKV	Transport	444	177.6	95	0.32	0.63	0.01	0.19	85.0	76,531	0.21	16,072
Cod6EFR	Transport	41	16.4	95	0.24	0.27	0.01	0.06	2.5	2,272	0.21	477
Cod7LR	Transport	25	10.0	95	0.28	0.18	0.01	0.05	1.2	1,077	0.21	226
Gra5VL	Transport	154	61.6	100	0.32	0.63	0.01	0.20	31.0	27,942	0.21	5,868
TOTALS:									53097.1	47,787,393		10,035,353

SOIL LOSS ESTIMATES FROM VARIOUS LANDUSES BY SOIL ASSOCIATION

SUB-WATERSHED: INDIAN RIVER

SOIL ASSOC.	LAND USE	AREA (Ac)	AREA (Ha)	R	K	LS	C	Tons/Ac/Yr	Total Tons	Total Kgs	DR	Delivered Sediments Kg/Yr
Gra5VL	Ag-Cult	9102	3640.8	100	0.32	0.63	0.22	4.44	40369.2	36,332,271	0.19	6,903,132
Gra6RFD	Ag-Cult	4768	1907.2	100	0.28	0.27	0.22	1.66	7930.1	7,137,124	0.19	1,356,054
Gra7LDP	Ag-Cult	578	231.2	100	0.28	0.18	0.22	1.11	640.9	576,798	0.19	109,592
Gra5VL	Ag-Noncult	5197	2078.8	100	0.32	0.63	0.02	0.40	2095.4	1,885,887	0.19	358,319
Gra6RFD	Ag-Noncult	2722	1088.8	100	0.28	0.27	0.02	0.15	411.6	370,410	0.19	70,378
Gra7LDP	Ag-Noncult	330	132.0	100	0.28	0.18	0.02	0.10	33.3	29,938	0.19	5,688
Gra5VL	Res-LowDen	161	64.4	100	0.32	0.63	0.03	0.60	97.4	87,636	0.19	16,651
Gra6RFD	Res-LowDen	85	34.0	100	0.28	0.27	0.03	0.23	19.3	17,350	0.19	3,297
Gra7LDP	Res-LowDen	10	4.0	100	0.28	0.18	0.03	0.15	1.5	1,361	0.19	259
Gra5VL	Res-HiDen	0	0.0	100	0.32	0.63	0.04	0.81	0.0	0	0.19	0
Gra6RFD	Res-HiDen	0	0.0	100	0.28	0.27	0.04	0.30	0.0	0	0.19	0
Gra7LDP	Res-HiDen	0	0.0	100	0.28	0.18	0.04	0.20	0.0	0	0.19	0
Gra5VL	CRP	984	393.6	100	0.32	0.63	0.005	0.10	99.2	89,268	0.19	16,961
Gra6RFD	CRP	516	206.4	100	0.28	0.27	0.005	0.04	19.5	17,554	0.19	3,335
Gra7LDP	CRP	63	25.2	100	0.28	0.18	0.005	0.03	1.6	1,429	0.19	271
Gra5VL	Forest	113	45.2	100	0.32	0.63	0.003	0.06	6.8	6,151	0.19	1,169
Gra6RFD	Forest	59	23.6	100	0.28	0.27	0.003	0.02	1.3	1,204	0.19	229
Gra7LDP	Forest	7	2.8	100	0.28	0.18	0.003	0.02	0.1	95	0.19	18
Gra5VL	Transport	549	219.6	100	0.32	0.63	0.01	0.20	110.7	99,611	0.19	18,926
Gra6RFD	Transport	287	114.8	100	0.28	0.27	0.01	0.08	21.7	19,527	0.19	3,710
Gra7LDP	Transport	35	14.0	100	0.28	0.18	0.01	0.05	1.8	1,588	0.19	302
TOTALS:									51861.3	46,675,202		8,868,288

APPENDIX B. Summary of Concentration Data for Tributary Sites

Appendix B1

SAMPLE DATA FOR SITE 4 INLET (BIG SIOUX LAKE KAMPESKA INLET), 1992

DATE	TIME	SITE	SAMP	WTEMP C	ATEMP C	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSOL mg/L	VOLSOL mg/L	FIXSOL mg/L	AMMONIA mg/L	UNIONIZED AMMONIA mg/L	NO3+2 mg/L	TKN-N mg/L	TPO4 mg/L	TDPO4 mg/L
23-Apr-92	17:00	SITE 4	GRAB	4.7	3.5	8.4	10	292	490	476	14	10	4	0.02	0.0005	0.10	0.79	0.093	0.027
17-Jun-92	15:30	SITE 4	GRAB	19.4	18.2	8.2	130	223	416	360	56	12	44	0.02	0.0010	0.10	0.90	0.744	0.365
18-Jun-92	16:00	SITE 4	GRAB	20.2	25.1	8.3	140	156	388	325	63	18	45	0.15	0.0117	0.30	1.28	0.352	0.166
19-Jun-92	16:45	SITE 4	GRAB	18.9	12.0	7.5	150	155	345	307	38	20	18	0.14	0.0016	0.02	1.19	0.322	0.173
20-Jun-92	16:30	SITE 4	GRAB	17.0	23.0	7.7	160	169	372	326	46	13	33	0.09	0.0013	0.30	1.40	0.329	0.166
22-Jun-92	16:30	SITE 4	GRAB	20.4	24.0	7.8	170	182	356	334	22	10	12	0.07	0.0017	0.20	1.14	0.229	0.153
01-Jul-92	17:30	SITE 4	GRAB	17.0	14.5	8.0	90	236	412	392	20	12	8	0.02	0.0006	0.10	0.86	0.305	0.193
02-Jul-92	17:30	SITE 4	GRAB	15.0	14.0	7.7	90	158	306	256	50	12	38	0.04	0.0005	0.30	1.15	0.292	0.159
03-Jul-92	13:30	SITE 4	GRAB	15.0	20.5	7.6	90	142	299	240	59	15	44	0.02	0.0002	0.30	1.13	0.342	0.183
03-Nov-92		SITE 4	GRAB	3.0	0.0	8.1	80	234	399	390	9	4	5	0.02	0.0002	0.10	0.82	0.196	0.086
Min				3.0	0.0	7.5	10	142	299	240	9	4	4	0.02	0.0002	0.02	0.79	0.093	0.027
Max				20.4	25.1	8.4	170	292	490	476	63	20	45	0.15	0.0117	0.30	1.40	0.744	0.365
Mean				7.2	7.3	8.1	49	242	424	400	24	10	14	0.02	0.0005	0.15	0.89	0.183	0.083

Appendix B2

SAMPLE DATA FOR SITE 4 OUTLET (BIG SIOUX LAKE KAMPESKA OUTLET), 1992

DATE	TIME	SITE	SAMP	WTEMP C	ATEMP C	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSOL mg/L	VOLSOL mg/L	FIXSOL mg/L	AMMONIA mg/L	UNIONIZED AMMONIA mg/L	NO3+2 mg/L	TKN-N mg/L	TPO4 mg/L	TDPO4 mg/L
MIN				4.5	3.5	7.8	10	188	349	315	14	10	4	0.02	0.0002	0.10	0.79	0.093	0.027
MAX				18.7	19.3	8.3	130	292	490	476	34	11	25	0.05	0.0012	0.20	1.00	0.269	0.173
MEAN				9.3	10.2	7.9	79	202	369	339	30	10	21	0.02	0.0003	0.18	0.95	0.247	0.124

Appendix B3

SAMPLE DATA FOR SITE 5 (MUD CREEK), 1992

DATE	TIME	SITE	SAMP	WTEMP C	ATEMP C	FPH units	COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSOL mg/L	VOLSOL mg/L	FIXSOL mg/L	AMMONIA mg/L	unionized AMMONIA mg/L	NO3+2 mg/L	TKN-N mg/L	TPO4 mg/L	TDPO4 mg/L
05-Mar-92	13:45	SITE 5	GRAB	5.0	5.5	7.7	9	200	406	399	7	6	1	0.05	0.0003	0.30	0.97	0.093	0.043
23-Apr-92	16:15	SITE 5	GRAB	6.0	6.0	7.7	9	237	527	514	13	8	5	0.02	0.0001	0.20	0.18	0.056	0.020
17-Jun-92	12:05	SITE 5	GRAB	16.4	18.8	7.4	9000	74	469	233	236	36	200	0.07	0.0005	0.40	0.59	0.395	0.163
18-Jun-92	11:00	SITE 5	GRAB	17.9	24.0	8.3	10000	126	403	355	48	20	28	0.05	0.0032	0.20	0.73	0.286	0.146
19-Jun-92	15:30	SITE 5	GRAB	17.9	15.0	7.3		154	470	440	30	14	16	0.05	0.0003	0.40	0.90	0.256	0.143
20-Jun-92	14:30	SITE 5	GRAB	17.5	16.5	7.4		163	425	403	22	6	16	0.05	0.0004	0.20	1.28	0.219	0.139
01-Jul-92	13:15	SITE 5	GRAB	15.5	16.0	7.2	17000	123	429	323	106	30	76	0.02	0.0001	0.40	0.74	0.312	0.120
02-Jul-92	11:30	SITE 5	GRAB	15.0	13.3	7.7		158	388	362	26	18	8	0.02	0.0003	0.20	0.71	0.199	0.116
03-Sep-92	13:00	SITE 5	GRAB	19.0	19.0	8.0	1500	222	443	419	24	11	13	0.02	0.0007	0.20	0.85	0.100	0.063
03-Nov-92	12:15	SITE 5	GRAB	2.0	0.0	7.9		233	452		7	2		0.02		0.30	0.25	0.070	0.040
Min				0.0	0.0	0.0	0	0	0	0	0	0	0	0.00	0.0000	0.00	0.00	0.000	0.000
Max				19.0	24.0	8.3	17000	237	527	514	236	36	200	0.07	0.0032	0.40	1.28	0.395	0.163
Mean				11.4	11.3	7.6	1974	192	446	400	45	13	32	0.03	0.0004	0.25	0.60	0.141	0.070

Appendix B 4

SAMPLE DATA FOR SITE 6 (BIG SIOUX RIVER WEST OF CASINO), 1992

DATE	TIME	SITE	SAMP	WTEMP C	ATEMP C	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSOL mg/L	VOLSOL mg/L	FIXSOL mg/L	AMMONIA mg/L	UNIONIZED AMMONIA mg/L	NO3+2 mg/L	TKN-N mg/L	TPO4 mg/L	TDPO4 mg/L
25-Feb-92	1500	6	GRAB	4.5	4.0	8.0	4	245	424	416	8	4	4	0.02	0.0003	1.40	1.03	0.070	0.050
27-Feb-92	1245	6	GRAB	0.8	5.0	7.9	10	236	419	407	12	6	6	0.02	0.0001	1.40	1.06	0.073	0.043
05-Mar-92	1245	6	GRAB	1.0	3.0	7.9	30	128	256	244	12	11	1	0.27	0.0017	0.60	1.92	0.196	0.133
12-Mar-92	1600	6	GRAB	1.0	0.0	7.7	2	215	416	401	15	3	12	0.14	0.0007	1.40	1.20	0.156	0.106
18-Mar-92	1230	6	GRAB	2.7	2.0	7.9	2	249	435	424	11	0	11	0.07	0.0006	0.80	1.08	0.113	0.056
12-Mar-92	1600	6	GRAB	1.0	0.0	7.7	2	215	416	401	15	3	12	0.14	0.0007	1.40	1.20	0.156	0.106
23-Mar-93	1630	6	GRAB	7.2	9.3	8.2	4	252	428	400	28	9	19	0.02	0.0005	0.70	0.80	0.126	0.040
23-Apr-92	1530	6	GRAB	4.4	4.0	8.1	10	295	505	465	40	10	30	0.02	0.0003	0.20	0.75	0.083	0.023
17-Jun-92	1430	6	GRAB	18.5	17.2	8.0	1900	242	469	399	70	6	64	0.13	0.0045	0.30	1.27	0.272	0.100
18-Jun-92	1200	6	GRAB	18.5	23.0	8.4	7000	123	403	303	100	22	78	0.12	0.0090	0.60	1.01	0.402	0.232
19-Jun-92	1615	6	GRAB	18.0	12.5	7.7	4000	191	404	376	28	10	18	0.10	0.0017	0.30	1.21	0.286	0.169
20-Jun-92	1030	6	GRAB	15.1	11.1	7.5	1100	163	367	326	41	13	28	0.08	0.0007	0.30	1.15	0.335	0.196
01-Jul-92	1645	6	GRAB	15.8	14.9	7.8	17000	188	393	311	82	26	56	0.02	0.0004	0.40	1.11	0.289	0.153
02-Jul-92	1230	6	GRAB	14.9	14.0	7.7	8000	134	271	236	35	9	26	0.02	0.0002	0.30	1.01	0.312	0.179
03-Sep-92	1400	6	GRAB	22.0	20.0	8.2	650	337	442	378	64	22	42	0.02	372.2187	0.20	0.98	0.229	0.023
03-Nov-92	1330	6	GRAB	7.5	0.0	8.4	NA	230	393	379	14	6	8	0.02	0.0708	0.60	0.71	0.076	0.046
MIN				0.8	0.0	7.5	0	123	256	236	8	0	1	0.02	0.0001	0.20	0.71	0.070	0.013
MAX				22.0	23.0	9.4	17000	337	505	465	100	26	78	0.27	372.2187	1.40	1.92	0.402	0.232
MEAN				12.4	10.7	8.1	2017	251	416	373	42	12	30	0.05	91.2253	0.39	0.99	0.188	0.069

Appendix B 5

SAMPLE DATA FOR SITE 7 (BIG SIOUX RIVER EAST OF LONESOME LAKE), 1992

DATE	TIME	SITE	SAMP	WTEMP C	ATEMP C	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSOL mg/L	VOLSOL mg/L	FIXSOL mg/L	AMMONIA mg/L	UNIONIZED AMMONIA mg/L	NO3+2 mg/L	TKN-N mg/L	TPO4 mg/L	TDPO4 mg/L
25-Feb-92	1630	7	GRAB	2.0	4.0	7.5	2	287	462	454	8	3	5	0.02	0.0001	0.80	1.05	0.100	0.070
27-Feb-92	1115	7	GRAB	0.5	4.0	7.5	110	259	456	440	16	8	8	0.07	0.0002	0.80	1.95	0.352	0.289
05-Mar-92	1130	7	GRAB	1.0	3.0	7.6	30	136	247	235	12	10	2	0.09	0.0003	0.50	1.67	0.176	0.113
12-Mar-92	1430	7	GRAB	1.0	1.3	7.5	2	232	391	375	16	4	12	0.02	0.0001	0.60	1.06	0.136	0.103
18-Mar-92	1130	7	GRAB	2.0	2.0	7.9	2	281	419	409	10	2	8	0.04	0.0003	0.60	0.92	0.086	0.053
23-Mar-92	1530	7	GRAB	12.0	12.5	8.1	2	282	391	383	8	4	4	0.02	0.0005	0.50	0.63	0.106	0.053
02-Apr-92	1045	7	GRAB	2.3	2.5	9.1	2	292	415	400	15	8	7	0.02	0.0021	0.40	0.71	0.076	0.040
23-Apr-92	1445	7	GRAB	5.3	4.7	8.0	10	309	470	455	15	11	4	0.02	0.0002	0.20	0.90	0.063	0.033
17-Jun-92	1330	7	GRAB	17.5	17.0	7.9	1600	188	353	331	22	2	20	0.06	0.0014	0.50	0.81	0.475	0.342
18-Jun-92	945	7	GRAB	17.0	19.1	8.6	700	204	382	352	30	12	18	0.10	0.0110	0.40	1.36	0.458	0.359
19-Jun-92	1130	7	GRAB	17.9	13.5	7.5	515	200	383	354	29	7	22	0.11	0.0011	0.60	1.89	0.491	0.375
20-Jun-92	930	7	GRAB	14.0	10.4	7.7	330	167	325	287	38	9	29	0.10	0.0013	0.40	1.47	0.448	0.319
01-Jul-92	1500	7	GRAB	15.0	15.0	7.3	11000	132	231	197	34	13	21	0.02	0.0001	0.50	0.98	0.438	0.299
02-Jul-92	1300	7	GRAB	14.9	13.0	7.7	5000	171	297	257	40	10	30	0.06	0.0007	0.40	1.42	0.402	0.302
03-Sep-92	1500	7	GRAB	22.5	21.0	8.3	330	283	456	434	22	11	11	0.02	0.0016	1.00	1.67	0.252	0.093
03-Nov-92	1415	7	GRAB	5.5	0.0	8.1	N/A	268	415	396	19	7	12	0.02	0.0003	2.40	0.85	0.110	0.037
Min				0.5	0.0	7.3	0	132	231	197	8	2	2	0.02	0.0001	0.20	0.63	0.063	0.033
Max				22.5	21.0	9.1	11000	309	470	455	40	13	30	0.11	0.0110	2.40	1.95	0.491	0.375
Mean				12.8	11.9	8.0	1208	237	386	365	22	8	13	0.04	0.0009	0.57	1.19	0.238	0.142

APPENDIX C. 1992 Tributary Loading Tables

SAMPLE DATA FOR SITE 4 INLET(BIG SIOUX LAKE KAMPESKA INLET)

DATE	TIME	SITE	CUBIC CALC AVG CFS	FLOWS L/DAY	TALKAL Kg/Day	TSOL Kg/Day	TDSOL Kg/Day	TSSOL Kg/Day	VOLSOL Kg/Day	FIXSOL Kg/Day	AMMONIA Kg/Day	UNIONIZED AMMONIA Kg/Day	NO3+2 Kg/Day	TKN-N Kg/Day	TPO4 Kg/Day	TDPO4 Kg/Day
25-Feb-92			15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01817	3.67	28.99	3.413	0.991
26-Feb-92			13	31805490	9287.20	15584.69	15139.41	445.28	318.05	127.22	0.64	0.01575	3.18	25.13	2.958	0.859
27-Feb-92			14	34252066	10001.60	16783.51	16303.98	479.53	342.52	137.01	0.69	0.01696	3.43	27.06	3.185	0.925
28-Feb-92			28	68504131	20003.21	33567.02	32607.97	959.06	685.04	274.02	1.37	0.03391	6.85	54.12	6.371	1.850
29-Feb-92			77	188386361	55008.82	92309.32	89671.91	2637.41	1883.86	753.55	3.77	0.09326	18.84	148.83	17.520	5.086
01-Mar-92			90	220191851	64296.02	107894.01	104811.32	3082.69	2201.92	880.77	4.40	0.11165	22.02	173.95	20.478	5.945
02-Mar-92			70	171260329	50008.02	83917.56	81519.92	2397.64	1712.60	685.04	3.43	0.08684	17.13	135.30	15.927	4.624
03-Mar-92			63	154134296	45007.21	75525.80	73367.92	2157.88	1541.34	616.54	3.08	0.07815	15.41	121.77	14.334	4.162
04-Mar-92			57	139454839	40720.81	68332.87	66380.50	1952.37	1394.55	557.82	2.79	0.07128	13.95	110.17	12.969	3.765
05-Mar-92			62	151687720	44292.81	74326.98	72203.35	2123.63	1516.88	606.75	3.03	0.07753	15.17	119.83	14.107	4.096
06-Mar-92			65	159027448	46436.01	77923.45	75697.07	2226.38	1590.27	636.11	3.18	0.08128	15.90	125.63	14.790	4.294
07-Mar-92			89	217745275	63581.62	106695.18	103646.75	3048.43	2177.45	870.98	4.35	0.11129	21.77	172.02	20.250	5.879
08-Mar-92			129	315608320	92157.63	154648.08	150229.56	4418.52	3156.08	1262.43	6.31	0.16131	31.56	249.33	29.352	8.521
09-Mar-92			99	242211036	70725.62	118683.41	115292.45	3390.95	2422.11	968.84	4.84	0.12380	24.22	191.35	22.526	6.540
10-Mar-92			79	193279514	56437.62	94706.96	92001.05	2705.91	1932.80	773.12	3.87	0.09879	19.33	152.69	17.975	5.219
11-Mar-92			70	171260329	50008.02	83917.56	81519.92	2397.64	1712.60	685.04	3.43	0.08753	17.13	135.30	15.927	4.624
12-Mar-92			65	159027448	46436.01	77923.45	75697.07	2226.38	1590.27	636.11	3.18	0.08128	15.90	125.63	14.790	4.294
13-Mar-92			55	134561687	39292.01	65935.23	64051.36	1883.86	1345.62	538.25	2.69	0.06878	13.46	106.30	12.514	3.633
14-Mar-92			49	119882230	35005.61	58742.29	57063.94	1678.35	1198.82	479.53	2.40	0.06127	11.99	94.71	11.149	3.237
15-Mar-92			43	105202773	30719.21	51549.36	50076.52	1472.84	1052.03	420.81	2.10	0.05420	10.52	83.11	9.784	2.840
16-Mar-92			40	97863045	28576.01	47952.89	46582.81	1370.08	978.63	391.45	1.96	0.05042	9.79	77.31	9.101	2.642
17-Mar-92			20	48931522	14288.00	23976.45	23291.40	685.04	489.32	195.73	0.98	0.02521	4.89	38.66	4.551	1.321
18-Mar-92			10	24465761	7144.00	11988.22	11645.70	342.52	244.66	97.86	0.49	0.01260	2.45	19.33	2.275	0.661
19-Mar-92			10	24465761	7144.00	11988.22	11645.70	342.52	244.66	97.86	0.49	0.01271	2.45	19.33	2.275	0.661
20-Mar-92			17	41591794	12144.80	20379.98	19797.69	582.29	415.92	166.37	0.83	0.02160	4.16	32.86	3.868	1.123
21-Mar-92			15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01906	3.67	28.99	3.413	0.991
22-Mar-92			15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01906	3.67	28.99	3.413	0.991
23-Mar-92			16	39145218	11430.40	19181.16	18633.12	548.03	391.45	156.58	0.78	0.02033	3.91	30.92	3.641	1.057
24-Mar-92			15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01906	3.67	28.99	3.413	0.991
25-Mar-92			16	39145218	11430.40	19181.16	18633.12	548.03	391.45	156.58	0.78	0.02033	3.91	30.92	3.641	1.057
26-Mar-92			16	39145218	11430.40	19181.16	18633.12	548.03	391.45	156.58	0.78	0.02033	3.91	30.92	3.641	1.057
27-Mar-92			15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01906	3.67	28.99	3.413	0.991
28-Mar-92			16	39145218	11430.40	19181.16	18633.12	548.03	391.45	156.58	0.78	0.02033	3.91	30.92	3.641	1.057
29-Mar-92			16	39145218	11430.40	19181.16	18633.12	548.03	391.45	156.58	0.78	0.02033	3.91	30.92	3.641	1.057
30-Mar-92			16	39145218	11430.40	19181.16	18633.12	548.03	391.45	156.58	0.78	0.02049	3.91	30.92	3.641	1.057
31-Mar-92			15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01921	3.67	28.99	3.413	0.991
01-Apr-92			14	34252066	10001.60	16783.51	16303.98	479.53	342.52	137.01	0.69	0.01793	3.43	27.06	3.185	0.925
02-Apr-92			15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01921	3.67	28.99	3.413	0.991
03-Apr-92			15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01921	3.67	28.99	3.413	0.991
04-Apr-92			16	39145218	11430.40	19181.16	18633.12	548.03	391.45	156.58	0.78	0.02065	3.91	30.92	3.641	1.057
05-Apr-92			17	41591794	12144.80	20379.98	19797.69	582.29	415.92	166.37	0.83	0.02194	4.16	32.86	3.868	1.123
06-Apr-92			17	41591794	12144.80	20379.98	19797.69	582.29	415.92	166.37	0.83	0.02194	4.16	32.86	3.868	1.123
07-Apr-92			14	34252066	10001.60	16783.51	16303.98	479.53	342.52	137.01	0.69	0.01807	3.43	27.06	3.185	0.925
08-Apr-92			16	39145218	11430.40	19181.16	18633.12	548.03	391.45	156.58	0.78	0.02065	3.91	30.92	3.641	1.057
09-Apr-92			18	44038370	12859.20	21578.80	20962.26	616.54	440.38	176.15	0.88	0.02342	4.40	34.79	4.096	1.189
10-Apr-92			20	48931522	14288.00	23976.45	23291.40	685.04	489.32	195.73	0.98	0.02602	4.89	38.66	4.551	1.321

11-Apr-92		18	44038370	12859.20	21578.80	20962.26	616.54	440.38	176.15	0.88	0.02342	4.40	34.79	4.096	1.189
12-Apr-92		20	48931522	14288.00	23976.45	23291.40	685.04	489.32	195.73	0.98	0.02602	4.89	38.66	4.551	1.321
13-Apr-92		25	61164403	17860.01	29970.56	29114.26	856.30	611.64	244.66	1.22	0.03253	6.12	48.32	5.688	1.651
14-Apr-92		20	48931522	14288.00	23976.45	23291.40	685.04	489.32	195.73	0.98	0.02602	4.89	38.66	4.551	1.321
15-Apr-92		20	48931522	14288.00	23976.45	23291.40	685.04	489.32	195.73	0.98	0.02602	4.89	38.66	4.551	1.321
16-Apr-92		21	51378099	15002.40	25175.27	24455.97	719.29	513.78	205.51	1.03	0.02732	5.14	40.59	4.778	1.387
17-Apr-92		24	58717827	17145.61	28771.74	27949.69	822.05	587.18	234.87	1.17	0.03123	5.87	46.39	5.461	1.585
18-Apr-92		25	61164403	17860.01	29970.56	29114.26	856.30	611.64	244.66	1.22	0.03253	6.12	48.32	5.688	1.651
19-Apr-92		30	73397284	21432.01	35964.67	34937.11	1027.56	733.97	293.59	1.47	0.03903	7.34	57.98	6.826	1.982
20-Apr-92		38	92969893	27147.21	45555.25	44253.67	1301.58	929.70	371.88	1.86	0.04944	9.30	73.45	8.646	2.510
21-Apr-92		36	88076740	25718.41	43157.60	41924.53	1233.07	880.77	352.31	1.76	0.04684	8.81	69.58	8.191	2.378
22-Apr-92		42	102756197	30004.81	50350.54	48911.95	1438.59	1027.56	411.02	2.06	0.05465	10.28	81.18	9.556	2.774
23-Apr-92	17:00 SITE 4	50	122328806	35720.01	59941.12	58228.51	1712.60	1223.29	489.32	2.45	0.06506	12.23	96.64	11.377	3.303
24-Apr-92		53	129668535	37863.21	63537.58	61722.22	1815.36	1296.69	518.67	2.59	0.06581	12.97	102.44	12.059	3.501
25-Apr-92		59	144347991	42149.61	70730.52	68709.64	2020.87	1443.48	577.39	2.89	0.07334	14.43	114.03	13.424	3.897
26-Apr-92		60	146794567	42864.01	71929.34	69874.21	2055.12	1467.95	587.18	2.94	0.07473	14.68	115.97	13.652	3.963
27-Apr-92		67	163920600	47864.82	80321.09	78026.21	2294.89	1639.21	655.68	3.28	0.08378	16.39	129.50	15.245	4.426
28-Apr-92		53	129668535	37863.21	63537.58	61722.22	1815.36	1296.69	518.67	2.59	0.06627	12.97	102.44	12.059	3.501
29-Apr-92		52	127221958	37148.81	62338.76	60557.65	1781.11	1272.22	508.89	2.54	0.06503	12.72	100.51	11.832	3.435
30-Apr-92		54	132115111	38577.61	64736.40	62886.79	1849.61	1321.15	528.46	2.64	0.06753	13.21	104.37	12.287	3.567
01-May-92		50	122328806	35720.01	59941.12	58228.51	1712.60	1223.29	489.32	2.45	0.06253	12.23	96.64	11.377	3.303
02-May-92		43	105202773	30719.21	51549.36	50076.52	1472.84	1052.03	420.81	2.10	0.05378	10.52	83.11	9.784	2.840
03-May-92		40	97863045	28576.01	47952.89	46582.81	1370.08	978.63	391.45	1.96	0.05003	9.79	77.31	9.101	2.642
04-May-92		36	88076740	25718.41	43157.60	41924.53	1233.07	880.77	352.31	1.76	0.04504	8.81	69.58	8.191	2.378
05-May-92		32	78290436	22860.81	38362.31	37266.25	1096.07	782.90	313.16	1.57	0.04006	7.83	61.85	7.281	2.114
06-May-92		30	73397284	21432.01	35964.67	34937.11	1027.56	733.97	293.59	1.47	0.03759	7.34	57.98	6.826	1.982
07-May-92		27	66057555	19288.81	32368.20	31443.40	924.81	660.58	264.23	1.32	0.03391	6.61	52.19	6.143	1.784
08-May-92		23	56271251	16431.21	27572.91	26785.12	787.80	562.71	225.09	1.13	0.02900	5.63	44.45	5.233	1.519
09-May-92		17	41591794	12144.80	20379.98	19797.69	582.29	415.92	166.37	0.83	0.02145	4.16	32.86	3.868	1.123
10-May-92		15	36698642	10716.00	17982.33	17468.55	513.78	366.99	146.79	0.73	0.01894	3.67	28.99	3.413	0.991
11-May-92		12	29358913	8572.80	14385.87	13974.84	411.02	293.59	117.44	0.59	0.01519	2.94	23.19	2.730	0.793
12-May-92		12	29358913	8572.80	14385.87	13974.84	411.02	293.59	117.44	0.59	0.01525	2.94	23.19	2.730	0.793
13-May-92		12	29358913	8572.80	14385.87	13974.84	411.02	293.59	117.44	0.59	0.01525	2.94	23.19	2.730	0.793
14-May-92		12	29358913	8572.80	14385.87	13974.84	411.02	293.59	117.44	0.59	0.01525	2.94	23.19	2.730	0.793
15-May-92		13	31805490	9287.20	15584.69	15139.41	445.28	318.05	127.22	0.64	0.01652	3.18	25.13	2.958	0.859
16-May-92		8	19572609	5715.20	9590.58	9316.56	274.02	195.73	78.29	0.39	0.01016	1.96	15.46	1.820	0.528
17-May-92		9	22019185	6429.60	10789.40	10481.13	308.27	220.19	88.08	0.44	0.01144	2.20	17.40	2.048	0.595
18-May-92		8	19572609	5715.20	9590.58	9316.56	274.02	195.73	78.29	0.39	0.01017	1.96	15.46	1.820	0.528
19-May-92		8	19572609	5715.20	9590.58	9316.56	274.02	195.73	78.29	0.39	0.01017	1.96	15.46	1.820	0.528
20-May-92		10	24465761	7144.00	11988.22	11645.70	342.52	244.66	97.86	0.49	0.01272	2.45	19.33	2.275	0.661
21-May-92		6	14679457	4286.40	7192.93	6987.42	205.51	146.79	58.72	0.29	0.00764	1.47	11.60	1.365	0.396
22-May-92		3	7339728	2143.20	3596.47	3493.71	102.76	73.40	29.36	0.15	0.00383	0.73	5.80	0.683	0.198
26-May-92		3	7339728	2143.20	3596.47	3493.71	102.76	73.40	29.36	0.15	0.00385	0.73	5.80	0.683	0.198
27-May-92		3	7339728	2143.20	3596.47	3493.71	102.76	73.40	29.36	0.15	0.00386	0.73	5.80	0.683	0.198
28-May-92		7.8	19083294	5572.32	9350.81	9083.65	267.17	190.83	76.33	0.38	0.01007	1.91	15.08	1.775	0.198
29-May-92		6.8	16636718	4857.92	8151.99	7919.07	232.92	166.37	66.55	0.33	0.00878	1.66	13.14	1.547	0.515
30-May-92		5.6	13700826	4000.64	6713.40	6521.59	191.81	137.01	54.81	0.27	0.00724	1.37	10.82	1.274	0.449
31-May-92		4.9	11988223	3500.55	5874.22	5706.38	167.84	119.88	47.96	0.24	0.00634	1.20	9.47	1.115	0.370
01-Jun-92		4.3	10520277	3071.91	5154.92	5007.63	147.29	105.20	42.09	0.21	0.00557	1.05	8.31	0.978	0.324
02-Jun-92		4	9786304	2857.58	4795.27	4658.25	137.02	97.86	39.16	0.20	0.00520	0.98	7.73	0.910	0.284
03-Jun-92		4	9786304	2857.56	4795.25	4658.21	137.03	97.86	39.17	0.20	0.00520	0.98	7.73	0.911	0.264

04-Jun-92			6	14679457	4286.28	7192.80	6987.21	205.59	146.80	58.79	0.29	0.00781	1.47	11.60	1.366	0.397
08-Jun-92			3	7339728	2142.21	3595.41	3492.05	103.36	73.43	29.93	0.15	0.00391	0.73	5.80	0.692	0.203
09-Jun-92			7	17126033	4996.19	8386.81	8144.23	242.57	171.39	71.18	0.34	0.00913	1.71	13.54	1.636	0.485
10-Jun-92			6	14679457	4278.49	7184.45	6974.12	210.33	147.02	63.31	0.29	0.00785	1.47	11.61	1.440	0.435
11-Jun-92			12	29358913	8541.15	14351.92	13921.63	430.29	294.51	135.78	0.59	0.01579	2.94	23.24	3.029	0.948
12-Jun-92			12	29358913	8509.50	14317.98	13868.42	449.56	295.42	154.13	0.59	0.01598	2.94	23.29	3.328	1.103
13-Jun-92			8	19572609	5630.79	9500.06	9174.66	325.39	198.17	127.22	0.39	0.01090	1.96	15.60	2.617	0.942
14-Jun-92			7	17126033	4853.09	8233.34	7903.66	329.68	175.54	154.13	0.34	0.00998	1.71	13.77	2.986	1.186
15-Jun-92			23	56271251	15460.53	26531.89	25153.25	1378.65	590.85	787.80	1.13	0.03584	5.63	46.00	14.391	6.274
16-Jun-92			24	58717827	15119.84	26599.18	24544.05	2055.12	645.90	1409.23	1.17	0.04442	5.87	49.62	24.573	11.509
17-Jun-92	15:30	SITE 4	95	232424732	51830.72	96688.69	83672.90	13015.78	2789.10	10226.69	4.65	0.24212	23.24	209.18	172.924	84.835
18-Jun-92	16:00	SITE 4	270	660575553	103049.79	256303.31	214687.05	41616.26	11890.36	29725.90	99.09	7.69640	198.17	845.54	232.523	109.656
19-Jun-92	16:45	SITE 4	298	729079685	113007.35	251532.49	223827.46	27705.03	14581.59	13123.43	102.07	1.14286	14.58	867.60	234.764	126.131
20-Jun-92	16:30	SITE 4	475	1162123658	196398.90	432310.00	378852.31	53457.69	15107.61	38350.08	104.59	1.49973	348.64	1626.97	382.339	192.913
21-Jun-92			370	905233166	158868.42	329504.87	298726.94	30777.93	10410.18	20367.75	72.42	1.34671	226.31	1149.65	252.560	144.385
22-Jun-92	16:30	SITE 4	99	242211036	44082.41	86227.13	80898.49	5328.64	2422.11	2906.53	16.95	0.40780	48.44	276.12	55.466	37.058
23-Jun-92			50	122328806	25566.72	46974.26	44405.36	2568.90	1345.62	1223.29	5.50	0.14840	18.35	122.33	32.662	21.163
24-Jun-92			20	48931522	10226.69	18789.70	17762.14	1027.56	538.25	489.32	2.20	0.05936	7.34	48.93	13.065	8.465
29-Jun-92			32	78290436	16362.70	30063.53	28419.43	1644.10	861.19	782.90	3.52	0.09498	11.74	78.29	20.904	13.544
30-Jun-92			35	85630164	17896.70	32881.98	31083.75	1798.23	941.93	856.30	3.85	0.10388	12.84	85.63	22.863	14.814
01-Jul-92	17:30	SITE 4	265	648342673	153008.87	267117.18	254150.33	12966.85	7780.11	5186.74	12.97	0.39113	64.83	557.57	197.745	125.130
02-Jul-92	17:30	SITE 4	442	1081386646	170859.09	330904.31	276834.98	54069.33	12976.64	41092.69	43.26	0.52272	324.42	1243.59	315.765	171.940
03-Jul-92	13:30	SITE 4	103	251997341	35783.62	75347.20	60479.36	14867.84	3779.96	11087.88	5.04	0.05561	75.60	284.76	86.183	46.116
04-Jul-92			80	195726090	36796.50	68308.41	61653.72	6654.69	1859.40	4795.29	3.91	0.04557	39.15	190.83	52.650	26.325
05-Jul-92			25	61164403	11498.91	21346.38	19266.79	2079.59	581.06	1498.53	1.22	0.01424	12.23	59.64	16.453	8.227
10-Jul-92			30	73397284	13798.69	25615.65	23120.14	2495.51	697.27	1798.23	1.47	0.01709	14.68	71.56	19.744	9.872
11-Jul-92			20	48931522	9199.13	17077.10	15413.43	1663.67	464.85	1198.82	0.98	0.01139	9.79	47.71	13.163	6.581
12-Jul-92			30	73397284	13798.69	25615.65	23120.14	2495.51	697.27	1798.23	1.47	0.01709	14.68	71.56	19.744	9.872
13-Jul-92			27	66057555	12418.82	23054.09	20808.13	2245.96	627.55	1618.41	1.32	0.01538	13.21	64.41	17.769	8.885
14-Jul-92			25	61164403	11498.91	21346.38	19266.79	2079.59	581.06	1498.53	1.22	0.01424	12.23	59.64	16.453	8.227
15-Jul-92			15	36698642	6899.34	12807.83	11560.07	1247.75	348.64	899.12	0.73	0.00854	7.34	35.78	9.872	4.936
16-Jul-92			17	41591794	7819.26	14515.54	13101.42	1414.12	395.12	1019.00	0.83	0.00968	8.32	40.55	11.188	5.594
17-Jul-92			12	29358913	5519.48	10246.26	9248.06	998.20	278.91	719.29	0.59	0.00684	5.87	28.62	7.898	3.949
18-Jul-92			14	34252066	6439.39	11953.97	10789.40	1164.57	325.39	839.18	0.69	0.00798	6.85	33.40	9.214	4.607
19-Jul-92			15	36698642	6899.34	12807.83	11560.07	1247.75	348.64	899.12	0.73	0.00854	7.34	35.78	9.872	4.936
20-Jul-92			11	26912337	5059.52	9392.41	8477.39	915.02	255.67	659.35	0.54	0.00627	5.38	26.24	7.239	3.620
21-Jul-92			6	14679457	2759.74	5123.13	4624.03	499.10	139.45	359.65	0.29	0.00342	2.94	14.31	3.949	1.974
22-Jul-92			12	29358913	5519.48	10246.26	9248.06	998.20	278.91	719.29	0.59	0.00684	5.87	28.62	7.898	3.949
23-Jul-92			16	39145218	7359.30	13661.68	12330.74	1330.94	371.88	959.06	0.78	0.00911	7.83	38.17	10.530	5.265
24-Jul-92			18	44038370	8279.21	15369.39	13872.09	1497.30	418.36	1078.94	0.88	0.01025	8.81	42.94	11.846	5.923
25-Jul-92			20	48931522	9199.13	17077.10	15413.43	1663.67	464.85	1198.82	0.98	0.01139	9.79	47.71	13.163	6.581
26-Jul-92			20	48931522	9199.13	17077.10	15413.43	1663.67	464.85	1198.82	0.98	0.01139	9.79	47.71	13.163	6.581
27-Jul-92			21	51378099	9659.08	17930.96	16184.10	1746.86	488.09	1258.76	1.03	0.01196	10.28	50.09	13.821	6.910
28-Jul-92			23	56271251	10579.00	19638.67	17725.44	1913.22	534.58	1378.65	1.13	0.01310	11.25	54.86	15.137	7.568
29-Jul-92			26	63610979	11958.86	22200.23	20037.46	2162.77	604.30	1558.47	1.27	0.01481	12.72	62.02	17.111	8.556
30-Jul-92			19	46484946	8739.17	16223.25	14642.76	1580.49	441.61	1138.88	0.93	0.01082	9.30	45.32	12.504	6.252
31-Jul-92			18	44038370	8279.21	15369.39	13872.09	1497.30	418.36	1078.94	0.88	0.01025	8.81	42.94	11.846	5.923
01-Aug-92			15	36698642	6899.34	12807.83	11560.07	1247.75	348.64	899.12	0.73	0.00854	7.34	35.78	9.872	4.936
02-Aug-92			10	24465761	4599.56	8538.55	7706.71	831.84	232.42	599.41	0.49	0.00570	4.89	23.85	6.581	3.291
03-Aug-92			10	24465761	4599.56	8538.55	7706.71	831.84	232.42	599.41	0.49	0.00570	4.89	23.85	6.581	3.291
04-Aug-92			11	26912337	5059.52	9392.41	8477.39	915.02	255.67	659.35	0.54	0.00627	5.38	26.24	7.239	3.620

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
06-Aug-92	8	19572609	3679.65	6830.84	6165.37	665.47	185.94	479.53	0.39	0.00456	3.91	19.08	5.265	2.633
07-Aug-92	9	22019185	4139.61	7684.70	6936.04	748.65	209.18	539.47	0.44	0.00513	4.40	21.47	5.923	2.962
08-Aug-92	8	19572609	3679.65	6830.84	6165.37	665.47	185.94	479.53	0.39	0.00456	3.91	19.08	5.265	2.633
09-Aug-92	5	12232881	2299.78	4269.28	3853.36	415.92	116.21	299.71	0.24	0.00285	2.45	11.93	3.291	1.645
10-Aug-92	6	14679457	2759.74	5123.13	4624.03	499.10	139.45	359.65	0.29	0.00342	2.94	14.31	3.949	1.974
11-Aug-92	3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
12-Aug-92	4	9786304	1839.83	3415.42	3082.69	332.73	92.97	239.76	0.20	0.00228	1.96	9.54	2.633	1.316
13-Aug-92	7	17126033	3219.69	5976.99	5394.70	582.29	162.70	419.59	0.34	0.00399	3.43	16.70	4.607	2.303
14-Aug-92	4	9786304	1839.83	3415.42	3082.69	332.73	92.97	239.76	0.20	0.00228	1.96	9.54	2.633	1.316
17-Aug-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
18-Aug-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
19-Aug-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
22-Aug-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
24-Aug-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
27-Aug-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
29-Aug-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
01-Sep-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
04-Sep-92	0.3	733973	137.99	256.16	231.20	24.96	6.97	17.98	0.01	0.00017	0.15	0.72	0.197	0.099
07-Sep-92	0.3	733973	137.99	256.16	231.20	24.96	6.97	17.98	0.01	0.00017	0.15	0.72	0.197	0.099
08-Sep-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
10-Sep-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
11-Sep-92	5	12232881	2299.78	4269.28	3853.36	415.92	116.21	299.71	0.24	0.00285	2.45	11.93	3.291	1.645
12-Sep-92	8	19572609	3679.65	6830.84	6165.37	665.47	185.94	479.53	0.39	0.00456	3.91	19.08	5.265	2.633
13-Sep-92	10	24465761	4599.56	8538.55	7706.71	831.84	232.42	599.41	0.49	0.00570	4.89	23.85	6.581	3.291
14-Sep-92	12	29358913	5519.48	10246.26	9248.06	998.20	278.91	719.29	0.59	0.00684	5.87	28.62	7.898	3.949
15-Sep-92	8	19572609	3679.65	6830.84	6165.37	665.47	185.94	479.53	0.39	0.00456	3.91	19.08	5.265	2.633
16-Sep-92	6	14679457	2759.74	5123.13	4624.03	499.10	139.45	359.65	0.29	0.00342	2.94	14.31	3.949	1.974
17-Sep-92	4	9786304	1839.83	3415.42	3082.69	332.73	92.97	239.76	0.20	0.00228	1.96	9.54	2.633	1.316
18-Sep-92	8	19572609	3679.65	6830.84	6165.37	665.47	185.94	479.53	0.39	0.00456	3.91	19.08	5.265	2.633
19-Sep-92	4	9786304	1839.83	3415.42	3082.69	332.73	92.97	239.76	0.20	0.00228	1.96	9.54	2.633	1.316
20-Sep-92	4	9786304	1839.83	3415.42	3082.69	332.73	92.97	239.76	0.20	0.00228	1.96	9.54	2.633	1.316
21-Sep-92	5	12232881	2299.78	4269.28	3853.36	415.92	116.21	299.71	0.24	0.00285	2.45	11.93	3.291	1.645
22-Sep-92	6	14679457	2759.74	5123.13	4624.03	499.10	139.45	359.65	0.29	0.00342	2.94	14.31	3.949	1.974
23-Sep-92	7	17126033	3219.69	5976.99	5394.70	582.29	162.70	419.59	0.34	0.00399	3.43	16.70	4.607	2.303
24-Sep-92	3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
25-Sep-92	7	17126033	3219.69	5976.99	5394.70	582.29	162.70	419.59	0.34	0.00399	3.43	16.70	4.607	2.303
26-Sep-92	2	4893152	919.91	1707.71	1541.34	166.37	46.48	119.88	0.10	0.00114	0.98	4.77	1.316	0.658
27-Sep-92	3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
01-Oct-92	3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
02-Oct-92	2	4893152	919.91	1707.71	1541.34	166.37	46.48	119.88	0.10	0.00114	0.98	4.77	1.316	0.658
03-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
04-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
05-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
14-Oct-92	3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
15-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
16-Oct-92	2	4893152	919.91	1707.71	1541.34	166.37	46.48	119.88	0.10	0.00114	0.98	4.77	1.316	0.658
17-Oct-92	3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
18-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
21-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
26-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329

29-Oct-92		2	4893152	919.91	1707.71	1541.34	166.37	46.48	119.88	0.10	0.00114	0.98	4.77	1.316	0.658
31-Oct-92		3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
01-Nov-92		3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
02-Nov-92		1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
03-Nov-92	SITE 4	1	2446576	572.50	976.18	954.16	22.02	9.79	12.23	0.05	0.00059	0.24	2.01	0.480	0.210
TOTAL LOADS L/YR KG/YR			15488050147	3595702.47	6512881.07	6083031.62	429849.46	176960.82	252888.64	660.91	17.96282	2486.63	15048.87	3241.945	1564.386

SAMPLE FOR SITE 4 (BIG SIOUX LAKE KAMPESKA OUTLET), 1992

DATE	TIME	SITE	CUBIC CALC AVG CFS	FLOWS L/DAY	TALKAL Kg/Day	TSOL Kg/Day	TDSOL Kg/Day	TSSOL Kg/Day	VOLSOL Kg/Day	FIXSOL Kg/Day	AMMON Kg/Day	UNIONIZED AMMON Kg/Day	NO3+2 Kg/Day	TKN-N Kg/Day	TPO4 Kg/Day	TDPO4 Kg/Day
23-May-92			3	7339728	2143.20	3596.47	3493.71	102.76	73.40	29.36	0.15	0.00384	0.73	5.80	0.683	0.198
24-May-92			2	4893152	1428.80	2397.64	2329.14	68.50	48.93	19.57	0.10	0.00256	0.49	3.87	0.455	0.132
25-May-92			3	7339728	2143.20	3596.47	3493.71	102.76	73.40	29.36	0.15	0.00385	0.73	5.80	0.683	0.198
05-Jun-92			5	12232881	3571.80	5993.89	5822.50	171.39	122.33	49.05	0.24	0.00651	1.22	9.66	1.140	0.331
06-Jun-92			3	7339728	2142.95	3596.20	3493.29	102.91	73.40	29.50	0.15	0.00390	0.73	5.80	0.685	0.199
07-Jun-92			2	4893152	1428.47	2397.29	2328.59	68.70	48.94	19.76	0.10	0.00260	0.49	3.87	0.458	0.134
25-Jun-92			10	24465761	5113.34	9394.85	8881.07	513.78	269.12	244.66	1.10	0.02968	3.67	24.47	6.532	4.233
26-Jun-92			7	17126033	3579.34	6576.40	6216.75	359.65	188.39	171.26	0.77	0.02078	2.57	17.13	4.573	2.963
27-Jun-92			8	19572609	4090.68	7515.88	7104.86	411.02	215.30	195.73	0.88	0.02374	2.94	19.57	5.226	3.386
28-Jun-92			6	14679457	3068.01	5636.91	5328.64	308.27	161.47	146.79	0.66	0.01781	2.20	14.68	3.919	2.540
06-Jul-92			15	36698642	6899.34	12807.83	11560.07	1247.75	348.64	899.12	0.73	0.00854	7.34	35.78	9.872	4.936
07-Jul-92			11	26912337	5059.52	9392.41	8477.39	915.02	255.67	659.35	0.54	0.00627	5.38	26.24	7.239	3.620
08-Jul-92			8	19572609	3679.65	6830.84	6165.37	665.47	185.94	479.53	0.39	0.00456	3.91	19.08	5.265	2.633
09-Jul-92			2	4893152	919.91	1707.71	1541.34	166.37	46.48	119.88	0.10	0.00114	0.98	4.77	1.316	0.658
15-Aug-92			2	4893152	919.91	1707.71	1541.34	166.37	46.48	119.88	0.10	0.00114	0.98	4.77	1.316	0.658
16-Aug-92			2	4893152	919.91	1707.71	1541.34	166.37	46.48	119.88	0.10	0.00114	0.98	4.77	1.316	0.658
20-Aug-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
21-Aug-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
23-Aug-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
25-Aug-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
26-Aug-92			1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
28-Aug-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
30-Aug-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
31-Aug-92			1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
02-Sep-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
03-Sep-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
05-Sep-92			0.3	733973	137.99	256.16	231.20	24.96	6.97	17.98	0.01	0.00017	0.15	0.72	0.197	0.099
06-Sep-92			0.3	733973	137.99	256.16	231.20	24.96	6.97	17.98	0.01	0.00017	0.15	0.72	0.197	0.099
09-Sep-92			0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
28-Sep-92			1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
29-Sep-92			3	7339728	1379.87	2561.57	2312.01	249.55	69.73	179.82	0.15	0.00171	1.47	7.16	1.974	0.987
30-Sep-92			1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329

06-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
07-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
08-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
09-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
10-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
11-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
12-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
13-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
19-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
20-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
22-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
23-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
24-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
25-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
27-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
28-Oct-92	0.5	1223288	229.98	426.93	385.34	41.59	11.62	29.97	0.02	0.00028	0.24	1.19	0.329	0.165
30-Oct-92	1	2446576	459.96	853.86	770.67	83.18	23.24	59.94	0.05	0.00057	0.49	2.39	0.658	0.329
TOTAL LOADS L/YR KG/YR		276707760	58193	105434	97892.31	7541.80	2764.53	4777.27	7.43	0.15179	47.15	263.54	66.539	35.407

SAMPLE DATA FOR SITE 5 (MUD CREEK), 1992

DATE	TIME	SITE	CUBIC CALC AVG CFS	FLOWS L/DAY	TALKAL Kg/Day	TSOL Kg/Day	TDSOL Kg/Day	TSSOL Kg/Day	VOLSOL Kg/Day	FIXSOL Kg/Day	AMMON Kg/Day	UNIONIZED AMMONIA Kg/Day	NO3+2 Kg/Day	TKN-N Kg/Day	TPO4 Kg/Day	TDPO4 Kg/Day
03-Mar-92			6	14679457	2935.89	5959.86	5857.10	102.76	88.08	14.68	0.73	0.00417	4.40	14.24	1.365	0.631
04-Mar-92			4.3	10520277	2104.06	4271.23	4197.59	73.64	63.12	10.52	0.53	0.00299	3.16	10.20	0.978	0.452
05-Mar-92	13:45	SITE 5	4.75	11621237	2324.25	4718.22	4636.87	81.35	69.73	11.62	0.58	0.00330	3.49	11.27	1.081	0.500
06-Mar-92			8.5	20795897	4543.90	9701.29	9493.33	207.96	145.57	62.39	0.73	0.00436	5.20	11.96	1.549	0.655
07-Mar-92			10.9	26667680	5826.89	12440.47	12173.80	266.68	186.67	80.00	0.93	0.00559	6.67	15.33	1.987	0.840
08-Mar-92			9.1	22263843	4864.65	10386.08	10163.44	222.64	155.85	66.79	0.78	0.00466	5.57	12.80	1.659	0.701
09-Mar-92			7.8	19083294	4169.70	8902.36	8711.52	190.83	133.58	57.25	0.67	0.00400	4.77	10.97	1.422	0.601
10-Mar-92			7.9	19327951	4223.16	9016.49	8823.21	193.28	135.30	57.98	0.68	0.00405	4.83	11.11	1.440	0.609
11-Mar-92			7.9	19327951	4223.16	9016.49	8823.21	193.28	135.30	57.98	0.68	0.00405	4.83	11.11	1.440	0.609
12-Mar-92			8	19572609	4276.62	9130.62	8934.90	195.73	137.01	58.72	0.69	0.00410	4.89	11.25	1.458	0.617
13-Mar-92			7	17126033	3742.04	7989.29	7818.03	171.26	119.88	51.38	0.60	0.00359	4.28	9.85	1.276	0.539
14-Mar-92			8.3	20306582	4436.99	9473.02	9269.95	203.07	142.15	60.92	0.71	0.00425	5.08	11.68	1.513	0.640
15-Mar-92			9.5	23242473	5078.48	10842.61	10610.19	232.42	162.70	69.73	0.81	0.00487	5.81	13.36	1.732	0.732
16-Mar-92			6.6	16147402	3528.21	7532.76	7371.29	161.47	113.03	48.44	0.57	0.00338	4.04	9.28	1.203	0.509
17-Mar-92			6.6	16147402	3528.21	7532.76	7371.29	161.47	113.03	48.44	0.57	0.00338	4.04	9.28	1.203	0.509
18-Mar-92			6.6	16147402	3528.21	7532.76	7371.29	161.47	113.03	48.44	0.57	0.00338	4.04	9.28	1.203	0.509
19-Mar-92			6.6	16147402	3528.21	7532.76	7371.29	161.47	113.03	48.44	0.57	0.00338	4.04	9.28	1.203	0.509
20-Mar-92			6.7	16392060	3581.67	7646.90	7482.98	163.92	114.74	49.18	0.57	0.00343	4.10	9.43	1.221	0.516
21-Mar-92			7	17126033	3742.04	7989.29	7818.03	171.26	119.88	51.38	0.60	0.00359	4.28	9.85	1.276	0.539
22-Mar-92			6.75	16514389	3608.39	7703.96	7538.82	165.14	115.60	49.54	0.58	0.00346	4.13	9.50	1.230	0.520
23-Mar-92			6.7	16392060	3581.67	7646.90	7482.98	163.92	114.74	49.18	0.57	0.00343	4.10	9.43	1.221	0.516
24-Mar-92			6.75	16514389	3608.39	7703.96	7538.82	165.14	115.60	49.54	0.58	0.00346	4.13	9.50	1.230	0.520
25-Mar-92			7	17126033	3742.04	7989.29	7818.03	171.26	119.88	51.38	0.60	0.00359	4.28	9.85	1.276	0.539
26-Mar-92			7	17126033	3742.04	7989.29	7818.03	171.26	119.88	51.38	0.60	0.00359	4.28	9.85	1.276	0.539
27-Mar-92			6.6	16147402	3528.21	7532.76	7371.29	161.47	113.03	48.44	0.57	0.00338	4.04	9.28	1.203	0.509
28-Mar-92			6.6	16147402	3528.21	7532.76	7371.29	161.47	113.03	48.44	0.57	0.00338	4.04	9.28	1.203	0.509
29-Mar-92			6.5	15902745	3474.75	7418.63	7259.60	159.03	111.32	47.71	0.56	0.00333	3.98	9.14	1.185	0.501
30-Mar-92			6.25	15291101	3341.11	7133.30	6980.39	152.91	107.04	45.87	0.54	0.00320	3.82	8.79	1.139	0.482
31-Mar-92			6.5	15902745	3474.75	7418.63	7259.60	159.03	111.32	47.71	0.56	0.00333	3.98	9.14	1.185	0.501
01-Apr-92			6.75	16514389	3608.39	7703.96	7538.82	165.14	115.60	49.54	0.58	0.00346	4.13	9.50	1.230	0.520
02-Apr-92			6	14679457	3207.46	6847.97	6701.17	146.79	102.76	44.04	0.51	0.00307	3.67	8.44	1.094	0.462
03-Apr-92			5.7	13945484	3047.09	6505.57	6366.11	139.45	97.62	41.84	0.49	0.00292	3.49	8.02	1.039	0.439
04-Apr-92			5.5	13456169	2940.17	6277.30	6142.74	134.56	94.19	40.37	0.47	0.00282	3.36	7.74	1.002	0.424
05-Apr-92			6	14679457	3207.46	6847.97	6701.17	146.79	102.76	44.04	0.51	0.00307	3.67	8.44	1.094	0.462
06-Apr-92			6.25	15291101	3341.11	7133.30	6980.39	152.91	107.04	45.87	0.54	0.00320	3.82	8.79	1.139	0.482
07-Apr-92			6.7	16392060	3581.67	7646.90	7482.98	163.92	114.74	49.18	0.57	0.00343	4.10	9.43	1.221	0.516
08-Apr-92			6.7	16392060	3581.67	7646.90	7482.98	163.92	114.74	49.18	0.57	0.00343	4.10	9.43	1.221	0.516
09-Apr-92			6.75	16514389	3608.39	7703.96	7538.82	165.14	115.60	49.54	0.58	0.00346	4.13	9.50	1.230	0.520

10-Apr-92			7	17126033	3742.04	7989.29	7818.03	171.26	119.88	51.38	0.60	0.00359	4.28	9.85	1.276	0.539
11-Apr-92			7	17126033	3742.04	7989.29	7818.03	171.26	119.88	51.38	0.60	0.00359	4.28	9.85	1.276	0.539
12-Apr-92			6.75	16514389	3608.39	7703.96	7538.82	165.14	115.60	49.54	0.58	0.00346	4.13	9.50	1.230	0.520
13-Apr-92			6.5	15902745	3474.75	7418.63	7259.60	159.03	111.32	47.71	0.56	0.00333	3.98	9.14	1.185	0.501
14-Apr-92			6.25	15291101	3341.11	7133.30	6980.39	152.91	107.04	45.87	0.54	0.00320	3.82	8.79	1.139	0.482
15-Apr-92			6.25	15291101	3341.11	7133.30	6980.39	152.91	107.04	45.87	0.54	0.00320	3.82	8.79	1.139	0.482
16-Apr-92			6.5	15902745	3474.75	7418.63	7259.60	159.03	111.32	47.71	0.56	0.00333	3.98	9.14	1.185	0.501
17-Apr-92			6.5	15902745	3474.75	7418.63	7259.60	159.03	111.32	47.71	0.56	0.00333	3.98	9.14	1.185	0.501
18-Apr-92			7.65	18716307	4089.51	8731.16	8543.99	187.16	131.01	56.15	0.66	0.00392	4.68	10.76	1.394	0.590
19-Apr-92			9.1	22263843	4864.65	10386.08	10163.44	222.64	155.85	66.79	0.78	0.00466	5.57	12.80	1.659	0.701
20-Apr-92			9.5	23242473	5078.48	10842.61	10610.19	232.42	162.70	69.73	0.81	0.00487	5.81	13.36	1.732	0.732
21-Apr-92			10.25	25077405	5479.41	11698.61	11447.84	250.77	175.54	75.23	0.88	0.00525	6.27	14.42	1.868	0.790
22-Apr-92			9.1	22263843	4864.65	10386.08	10163.44	222.64	155.85	66.79	0.78	0.00466	5.57	12.80	1.659	0.701
23-Apr-92	16:15	SITE 5	8.3	20306582	4812.66	10701.57	10437.58	263.99	162.45	101.53	0.41	0.00256	4.06	3.66	1.137	0.406
24-Apr-92			9.5	23242473	3618.85	11574.75	8681.06	2893.69	511.33	2382.35	1.05	0.00712	6.97	8.95	5.241	2.127
25-Apr-92			10.75	26300693	4095.02	13097.75	9823.31	3274.44	578.62	2695.82	1.18	0.00806	7.89	10.13	5.931	2.407
26-Apr-92			9.5	23242473	3618.85	11574.75	8681.06	2893.69	511.33	2382.35	1.05	0.00712	6.97	8.95	5.241	2.127
27-Apr-92			8	19572609	3047.46	9747.16	7310.37	2436.79	430.60	2006.19	0.88	0.00600	5.87	7.54	4.414	1.791
28-Apr-92			7.25	17737677	2761.76	8833.36	6625.02	2208.34	390.23	1818.11	0.80	0.00543	5.32	6.83	4.000	1.623
29-Apr-92			7	17126033	2666.52	8528.76	6396.57	2132.19	376.77	1755.42	0.77	0.00525	5.14	6.59	3.862	1.567
30-Apr-92			6.6	16147402	2514.15	8041.41	6031.05	2010.35	355.24	1655.11	0.73	0.00495	4.84	6.22	3.641	1.477
01-May-92			6.5	15902745	2476.06	7919.57	5939.68	1979.89	349.86	1630.03	0.72	0.00487	4.77	6.12	3.586	1.455
02-May-92			5.5	13456169	2095.13	6701.17	5025.88	1675.29	296.04	1379.26	0.61	0.00412	4.04	5.18	3.034	1.231
03-May-92			4.75	11621237	1809.43	5787.38	4340.53	1446.84	255.67	1191.18	0.52	0.00356	3.49	4.47	2.621	1.063
04-May-92			4.65	11376579	1771.33	5665.54	4249.15	1416.38	250.28	1166.10	0.51	0.00349	3.41	4.38	2.565	1.041
05-May-92			3.75	9174660	1428.49	4568.98	3426.74	1142.25	201.84	940.40	0.41	0.00281	2.75	3.53	2.069	0.839
06-May-92			3.65	8930003	1390.40	4447.14	3335.36	1111.79	196.46	915.33	0.40	0.00274	2.68	3.44	2.014	0.817
07-May-92			3.3	8073701	1257.08	4020.70	3015.53	1005.18	177.62	827.55	0.36	0.00247	2.42	3.11	1.821	0.739
08-May-92			3.2	7829044	1218.98	3898.86	2924.15	974.72	172.24	802.48	0.35	0.00240	2.35	3.01	1.765	0.716
09-May-92			2.75	6728084	1047.56	3350.59	2512.94	837.65	148.02	689.63	0.30	0.00206	2.02	2.59	1.517	0.616
10-May-92			2.4	5871783	914.24	2924.15	2193.11	731.04	129.18	601.86	0.26	0.00180	1.76	2.26	1.324	0.537
11-May-92			2.4	5871783	914.24	2924.15	2193.11	731.04	129.18	601.86	0.26	0.00180	1.76	2.26	1.324	0.537
12-May-92			2.4	5871783	914.24	2924.15	2193.11	731.04	129.18	601.86	0.26	0.00180	1.76	2.26	1.324	0.537
13-May-92			2.2	5382467	838.05	2680.47	2010.35	670.12	118.41	551.70	0.24	0.00165	1.61	2.07	1.214	0.492
14-May-92			2.15	5260139	819.00	2619.55	1964.66	654.89	115.72	539.16	0.24	0.00161	1.58	2.03	1.186	0.481
15-May-92			2	4893152	761.86	2436.79	1827.59	609.20	107.65	501.55	0.22	0.00150	1.47	1.88	1.103	0.448
16-May-92			2.15	5260139	819.00	2619.55	1964.66	654.89	115.72	539.16	0.24	0.00161	1.58	2.03	1.186	0.481
17-May-92			2	4893152	761.86	2436.79	1827.59	609.20	107.65	501.55	0.22	0.00150	1.47	1.88	1.103	0.448
18-May-92			1.7	4159179	647.58	2071.27	1553.45	517.82	91.50	426.32	0.19	0.00127	1.25	1.60	0.938	0.381
19-May-92			1.25	3058220	476.16	1522.99	1142.25	380.75	67.28	313.47	0.14	0.00094	0.92	1.18	0.690	0.280
20-May-92			1	2446576	380.93	1218.39	913.80	304.60	53.82	250.77	0.11	0.00075	0.73	0.94	0.552	0.224
21-May-92			0.75	1834932	285.70	913.80	685.35	228.45	40.37	188.08	0.08	0.00056	0.55	0.71	0.414	0.168
22-May-92			0.75	1834932	285.70	913.80	685.35	228.45	40.37	188.08	0.08	0.00056	0.55	0.71	0.414	0.168
23-May-92			0.6	1467946	228.56	731.04	548.28	182.76	32.29	150.46	0.07	0.00045	0.44	0.57	0.331	0.134

24-May-92			0.5	1223288	190.47	609.20	456.90	152.30	26.91	125.39	0.06	0.00037	0.37	0.47	0.276	0.112
25-May-92			1.7	4159179	647.58	2071.27	1553.45	517.82	91.50	426.32	0.19	0.00127	1.25	1.60	0.938	0.381
26-May-92			1.7	4159179	647.58	2071.27	1553.45	517.82	91.50	426.32	0.19	0.00127	1.25	1.60	0.938	0.381
27-May-92			1.25	3058220	476.16	1522.99	1142.25	380.75	67.28	313.47	0.14	0.00094	0.92	1.18	0.690	0.280
28-May-92			0.75	1834932	285.70	913.80	685.35	228.45	40.37	188.08	0.08	0.00056	0.55	0.71	0.414	0.168
29-May-92			0.6	1467946	228.56	731.04	548.28	182.76	32.29	150.46	0.07	0.00045	0.44	0.57	0.331	0.134
30-May-92			0.45	1100959	171.42	548.28	411.21	137.07	24.22	112.85	0.05	0.00034	0.33	0.42	0.248	0.101
31-May-92			0.01	24466	3.81	12.18	9.14	3.05	0.54	2.51	0.00	0.00001	0.01	0.01	0.006	0.002
01-Jun-92			0.4	978630	152.37	487.36	365.52	121.84	21.53	100.31	0.04	0.00030	0.29	0.38	0.221	0.090
02-Jun-92			0.4	978630	152.37	487.36	365.52	121.84	21.53	100.31	0.04	0.00030	0.29	0.38	0.221	0.090
03-Jun-92			0.4	978630	152.37	487.36	365.52	121.84	21.53	100.31	0.04	0.00030	0.29	0.38	0.221	0.090
04-Jun-92			0.45	1100959	171.42	548.28	411.21	137.07	24.22	112.85	0.05	0.00034	0.33	0.42	0.248	0.101
05-Jun-92			0.4	978630	152.37	487.36	365.52	121.84	21.53	100.31	0.04	0.00030	0.29	0.38	0.221	0.090
06-Jun-92			0.45	1100959	171.42	548.28	411.21	137.07	24.22	112.85	0.05	0.00034	0.33	0.38	0.221	0.090
07-Jun-92			0.6	1467946	228.56	731.04	548.28	182.76	32.29	150.46	0.07	0.00045	0.33	0.42	0.248	0.101
08-Jun-92			2.15	5260139	819.00	2619.55	1964.66	654.89	115.72	539.16	0.24	0.00161	0.44	0.57	0.331	0.134
09-Jun-92			2.15	5260139	819.00	2619.55	1964.66	654.89	115.72	539.16	0.24	0.00161	1.58	2.03	1.186	0.481
													1.58	2.03	1.186	0.481
10-Jun-92			1.7	4159179	647.58	2071.27	1553.45	517.82	91.50	426.32	0.19	0.00127	1.25	1.60	0.938	0.381
11-Jun-92			1	2446576	380.93	1218.39	913.80	304.60	53.82	250.77	0.11	0.00075	0.73	0.94	0.552	0.224
12-Jun-92			0.6	1467946	228.56	731.04	548.28	182.76	32.29	150.46	0.07	0.00045	0.44	0.57	0.331	0.134
13-Jun-92			0.45	1100959	171.42	548.28	411.21	137.07	24.22	112.85	0.05	0.00034	0.33	0.42	0.248	0.101
14-Jun-92			0.4	978630	152.37	487.36	365.52	121.84	21.53	100.31	0.04	0.00030	0.29	0.38	0.221	0.090
15-Jun-92			0.6	1467946	228.56	731.04	548.28	182.76	32.29	150.46	0.07	0.00045	0.44	0.57	0.331	0.134
16-Jun-92			4.65	11376579	1771.33	5665.54	4249.15	1416.38	250.28	1166.10	0.51	0.00349	3.41	4.38	2.565	1.041
17-Jun-92	12:05	SITE 5	165.8	405642321	30179.79	190246.25	94514.66	95731.59	14603.12	81128.46	28.39	0.20577	162.26	239.33	160.229	66.120
18-Jun-92	11:00	SITE 5	85.6	209426916	26387.79	84399.05	74346.56	10052.49	4188.54	5863.95	10.47	0.66580	41.89	152.88	59.896	30.576
19-Jun-92	15:30	SITE 5	71.4	174685535	26901.57	82102.20	76861.64	5240.57	2445.60	2794.97	8.73	0.05891	69.87	157.22	44.719	24.980
20-Jun-92	14:30	SITE 5	69.6	170281698	27755.92	72369.72	68623.52	3746.20	1021.69	2724.51	8.51	0.07007	34.06	217.96	37.292	23.669
21-Jun-92			38.49	94168715	13466.13	40210.04	34183.24	6026.80	1695.04	4331.76	3.30	0.02074	28.25	95.11	25.002	12.195
22-Jun-92			30.2	73886599	10565.78	31549.58	26820.84	4728.74	1329.96	3398.78	2.59	0.01627	22.17	74.63	19.617	9.568
23-Jun-92			24.05	58840156	8414.14	25124.75	21358.98	3765.77	1059.12	2706.65	2.06	0.01296	17.65	59.43	15.622	7.620
24-Jun-92			18.59	45481850	6503.90	19420.75	16509.91	2910.84	818.67	2092.17	1.59	0.01002	13.64	45.94	12.075	5.890
25-Jun-92			14.95	36576313	5230.41	15618.09	13277.20	2340.88	658.37	1682.51	1.28	0.00806	10.97	36.94	9.711	4.737
26-Jun-92			11.85	28991927	4145.85	12379.55	10524.07	1855.48	521.85	1333.63	1.01	0.00638	8.70	29.28	7.697	3.754
27-Jun-92			9.65	23609460	3376.15	10081.24	8570.23	1511.01	424.97	1086.04	0.83	0.00520	7.08	23.85	6.268	3.057
28-Jun-92			8.15	19939595	2851.36	8514.21	7238.07	1276.13	358.91	917.22	0.70	0.00439	5.98	20.14	5.294	2.582
29-Jun-92			6.6	16147402	2309.08	6894.94	5861.51	1033.43	290.65	742.78	0.57	0.00356	4.84	16.31	4.287	2.091
30-Jun-92			12	29358913	4198.32	12536.26	10657.29	1878.97	528.46	1350.51	1.03	0.00647	8.81	29.65	7.795	3.802
01-Jul-92	13:15	SITE 5	86	210405547	25879.88	90263.98	67960.99	22302.99	6312.17	15990.82	4.21	0.02023	84.16	155.70	65.647	25.249
02-Jul-92	11:30	SITE 5	69	168813752	26672.57	65499.74	61110.58	4389.16	3038.65	1350.51	3.38	0.04270	33.76	119.86	33.594	19.582
03-Jul-92			56.3	137742236	26171.02	57231.90	53788.34	3443.56	1997.26	1446.29	2.75	0.05935	27.55	107.44	20.592	12.328
04-Jul-92			40.8	99820306	18965.86	41475.34	38979.83	2495.51	1447.39	1048.11	2.00	0.04301	19.96	77.86	14.923	8.934
05-Jul-92			26	63610979	12086.09	26430.36	24840.09	1590.27	922.36	667.92	1.27	0.02741	12.72	49.62	9.510	5.693
06-Jul-92			20.89	51108975	9710.71	21235.78	19958.05	1277.72	741.08	536.64	1.02	0.02202	10.22	39.87	7.641	4.574

07-Jul-92	17.5	42815082	8134.87	17789.67	16719.29	1070.38	620.82	449.56	0.86	0.01845	8.56	33.40	6.401	3.832
08-Jul-92	15.1	36943299	7019.23	15349.94	14426.36	923.58	535.68	387.90	0.74	0.01592	7.39	28.82	5.523	3.306
09-Jul-92	13.1	32050147	6089.53	13316.84	12515.58	801.25	464.73	336.53	0.64	0.01381	6.41	25.00	4.791	2.868
10-Jul-92	14	34252066	6507.89	14231.73	13375.43	856.30	496.65	359.65	0.69	0.01476	6.85	26.72	5.121	3.066
11-Jul-92	14.65	35842340	6810.04	14892.49	13996.43	896.06	519.71	376.34	0.72	0.01544	7.17	27.96	5.358	3.208
12-Jul-92	17.5	42815082	8134.87	17789.67	16719.29	1070.38	620.82	449.56	0.86	0.01845	8.56	33.40	6.401	3.832
13-Jul-92	18.45	45139329	8576.47	18755.39	17626.91	1128.48	654.52	473.96	0.90	0.01945	9.03	35.21	6.748	4.040
14-Jul-92	19	46484946	8832.14	19314.50	18152.37	1162.12	674.03	488.09	0.93	0.02003	9.30	36.26	6.949	4.160
15-Jul-92	15.9	38900560	7391.11	16163.18	15190.67	972.51	564.06	408.46	0.78	0.01676	7.78	30.34	5.816	3.482
16-Jul-92	13.1	32050147	6089.53	13316.84	12515.58	801.25	464.73	336.53	0.64	0.01381	6.41	25.00	4.791	2.868
17-Jul-92	11.85	28991927	5508.47	12046.15	11321.35	724.80	420.38	304.42	0.58	0.01249	5.80	22.61	4.334	2.595
18-Jul-92	10.75	26300693	4997.13	10927.94	10270.42	657.52	381.36	276.16	0.53	0.01133	5.26	20.51	3.932	2.354
19-Jul-92	8.75	21407541	4067.43	8894.83	8359.64	535.19	310.41	224.78	0.43	0.00922	4.28	16.70	3.200	1.916
20-Jul-92	7.5	18349321	3486.37	7624.14	7165.41	458.73	266.07	192.67	0.37	0.00791	3.67	14.31	2.743	1.642
21-Jul-92	6.75	16514389	3137.73	6861.73	6448.87	412.86	239.46	173.40	0.33	0.00712	3.30	12.88	2.469	1.478
22-Jul-92	9.8	23976446	4555.52	9962.21	9362.80	599.41	347.66	251.75	0.48	0.01033	4.80	18.70	3.584	2.146
23-Jul-92	13.25	32417134	6159.26	13469.32	12658.89	810.43	470.05	340.38	0.65	0.01397	6.48	25.29	4.846	2.901
24-Jul-92	15.1	36943299	7019.23	15349.94	14426.36	923.58	535.68	387.90	0.74	0.01592	7.39	28.82	5.523	3.306
25-Jul-92	15.35	37554943	7135.44	15604.08	14665.21	938.87	544.55	394.33	0.75	0.01618	7.51	29.29	5.614	3.361
26-Jul-92	11.25	27523981	5229.56	11436.21	10748.11	688.10	399.10	289.00	0.55	0.01186	5.50	21.47	4.115	2.463
27-Jul-92	8.3	20306582	3858.25	8437.38	7929.72	507.66	294.45	213.22	0.41	0.00875	4.06	15.84	3.036	1.817
28-Jul-92	7	17126033	3253.95	7115.87	6687.72	428.15	248.33	179.82	0.34	0.00738	3.43	13.36	2.560	1.533
29-Jul-92	6.6	16147402	3068.01	6709.25	6305.56	403.69	234.14	169.55	0.32	0.00696	3.23	12.59	2.414	1.445
30-Jul-92	6.6	16147402	3068.01	6709.25	6305.56	403.69	234.14	169.55	0.32	0.00696	3.23	12.59	2.414	1.445
31-Jul-92	6	14679457	2789.10	6099.31	5732.33	366.99	212.85	154.13	0.29	0.00633	2.94	11.45	2.195	1.314
01-Aug-92	5.2	12722196	2417.22	5286.07	4968.02	318.05	184.47	133.58	0.25	0.00548	2.54	9.92	1.902	1.139
02-Aug-92	4.65	11376579	2161.55	4726.97	4442.55	284.41	164.96	119.45	0.23	0.00490	2.28	8.87	1.701	1.018
03-Aug-92	4.3	10520277	1998.85	4371.18	4108.17	263.01	152.54	110.46	0.21	0.00453	2.10	8.21	1.573	0.942
04-Aug-92	3.75	9174660	1743.19	3812.07	3582.70	229.37	133.03	96.33	0.18	0.00395	1.83	7.16	1.372	0.821
05-Aug-92	3.65	8930003	1696.70	3710.42	3487.17	223.25	129.49	93.77	0.18	0.00385	1.79	6.97	1.335	0.799
06-Aug-92	3.3	8073701	1534.00	3354.62	3152.78	201.84	117.07	84.77	0.16	0.00348	1.61	6.30	1.207	0.723
07-Aug-92	3.45	8440688	1603.73	3507.11	3296.09	211.02	122.39	88.63	0.17	0.00364	1.69	6.58	1.262	0.755
08-Aug-92	3	7339728	1394.55	3049.66	2866.16	183.49	106.43	77.07	0.15	0.00316	1.47	5.72	1.097	0.657
09-Aug-92	3	7339728	1394.55	3049.66	2866.16	183.49	106.43	77.07	0.15	0.00316	1.47	5.72	1.097	0.657
10-Aug-92	4.3	10520277	1998.85	4371.18	4108.17	263.01	152.54	110.46	0.21	0.00453	2.10	8.21	1.573	0.942
11-Aug-92	4.3	10520277	1998.85	4371.18	4108.17	263.01	152.54	110.46	0.21	0.00453	2.10	8.21	1.573	0.942
12-Aug-92	4.5	11009593	2091.82	4574.49	4299.25	275.24	159.64	115.60	0.22	0.00474	2.20	8.59	1.646	0.985
13-Aug-92	4.3	10520277	1998.85	4371.18	4108.17	263.01	152.54	110.46	0.21	0.00453	2.10	8.21	1.573	0.942
14-Aug-92	4	9786304	1859.40	4066.21	3821.55	244.66	141.90	102.76	0.20	0.00422	1.96	7.63	1.463	0.876
15-Aug-92	3.75	9174660	1743.19	3812.07	3582.70	229.37	133.03	96.33	0.18	0.00395	1.83	7.16	1.372	0.821
16-Aug-92	3.45	8440688	1603.73	3507.11	3296.09	211.02	122.39	88.63	0.17	0.00364	1.69	6.58	1.262	0.755
17-Aug-92	3.45	8440688	1603.73	3507.11	3296.09	211.02	122.39	88.63	0.17	0.00364	1.69	6.58	1.262	0.755
18-Aug-92	3.3	8073701	1534.00	3354.62	3152.78	201.84	117.07	84.77	0.16	0.00348	1.61	6.30	1.207	0.723
19-Aug-92	3.2	7829044	1487.52	3252.97	3057.24	195.73	113.52	82.20	0.16	0.00337	1.57	6.11	1.170	0.701

20-Aug-92			2.75	6728084	1278.34	2795.52	2627.32	168.20	97.56	70.64	0.13	0.00290	1.35	5.25	1.006	0.602
21-Aug-92			3.3	8073701	1534.00	3354.62	3152.78	201.84	117.07	84.77	0.16	0.00348	1.61	6.30	1.207	0.723
22-Aug-92			3.65	8930003	1696.70	3710.42	3487.17	223.25	129.49	93.77	0.18	0.00385	1.79	6.97	1.335	0.799
23-Aug-92			3.45	8440688	1603.73	3507.11	3296.09	211.02	122.39	88.63	0.17	0.00364	1.69	6.58	1.262	0.755
24-Aug-92			3.75	9174660	1743.19	3812.07	3582.70	229.37	133.03	96.33	0.18	0.00395	1.83	7.16	1.372	0.821
25-Aug-92			4.65	11376579	2161.55	4726.97	4442.55	284.41	164.96	119.45	0.23	0.00490	2.28	8.87	1.701	1.018
26-Aug-92			4.75	11621237	2208.03	4828.62	4538.09	290.53	168.51	122.02	0.23	0.00501	2.32	9.06	1.737	1.040
27-Aug-92			4.5	11009593	2091.82	4574.49	4299.25	275.24	159.64	115.60	0.22	0.00474	2.20	8.59	1.646	0.985
28-Aug-92			4	9786304	1859.40	4066.21	3821.55	244.66	141.90	102.76	0.20	0.00422	1.96	7.63	1.463	0.876
29-Aug-92			3.65	8930003	1696.70	3710.42	3487.17	223.25	129.49	93.77	0.18	0.00385	1.79	6.97	1.335	0.799
30-Aug-92			3.3	8073701	1534.00	3354.62	3152.78	201.84	117.07	84.77	0.16	0.00348	1.61	6.30	1.207	0.723
31-Aug-92			3	7339728	1394.55	3049.66	2866.16	183.49	106.43	77.07	0.15	0.00316	1.47	5.72	1.097	0.657
01-Sep-92			4.3	10520277	1998.85	4371.18	4108.17	263.01	152.54	110.46	0.21	0.00453	2.10	8.21	1.573	0.942
02-Sep-92			14.95	36576313	6949.50	15197.46	14283.05	914.41	530.36	384.05	0.73	0.01576	7.32	28.53	5.468	3.274
03-Sep-92	13:00	SITE 5	11.45	28013297	6218.95	12409.89	11737.57	672.32	308.15	364.17	0.56	0.02039	5.60	23.81	2.801	1.765
04-Sep-92			9.1	22263843	5069.48	9963.07	9617.98	345.09	144.71	200.37	0.45	0.00800	5.57	12.25	1.892	1.147
05-Sep-92			11.1	27156995	6183.65	12152.76	11731.82	420.93	176.52	244.41	0.54	0.00976	6.79	14.94	2.308	1.399
06-Sep-92			14.95	36576313	8328.43	16367.90	15800.97	566.93	237.75	329.19	0.73	0.01314	9.14	20.12	3.109	1.884
07-Sep-92			24.9	60919745	13871.43	27261.59	26317.33	944.26	395.98	548.28	1.22	0.02189	15.23	33.51	5.178	3.137
08-Sep-92			21.82	53384291	12155.60	23889.47	23062.01	827.46	347.00	480.46	1.07	0.01918	13.35	29.36	4.538	2.749
09-Sep-92			17.75	43426726	9888.27	19433.46	18760.35	673.11	282.27	390.84	0.87	0.01560	10.86	23.88	3.691	2.236
10-Sep-92			14.65	35842340	8161.30	16039.45	15483.89	555.56	232.98	322.58	0.72	0.01288	8.96	19.71	3.047	1.846
11-Sep-92			11.1	27156995	6183.65	12152.76	11731.82	420.93	176.52	244.41	0.54	0.00976	6.79	14.94	2.308	1.399
12-Sep-92			9.5	23242473	5292.31	10401.01	10040.75	360.26	151.08	209.18	0.46	0.00835	5.81	12.78	1.976	1.197
13-Sep-92			8.15	19939595	4540.25	8922.97	8613.91	309.06	129.61	179.46	0.40	0.00716	4.98	10.97	1.695	1.027
14-Sep-92			6.7	16392060	3732.47	7335.45	7081.37	254.08	106.55	147.53	0.33	0.00589	4.10	9.02	1.393	0.844
15-Sep-92			6.25	15291101	3481.78	6842.77	6605.76	237.01	99.39	137.62	0.31	0.00549	3.82	8.41	1.300	0.787
16-Sep-92			6	14679457	3342.51	6569.06	6341.53	227.53	95.42	132.12	0.29	0.00527	3.67	8.07	1.248	0.756
17-Sep-92			5.7	13945484	3175.39	6240.60	6024.45	216.16	90.65	125.51	0.28	0.00501	3.49	7.67	1.185	0.718
18-Sep-92			5.2	12722196	2896.84	5693.18	5495.99	197.19	82.69	114.50	0.25	0.00457	3.18	7.00	1.081	0.655
19-Sep-92			4.65	11376579	2590.45	5091.02	4914.68	176.34	73.95	102.39	0.23	0.00409	2.84	6.26	0.967	0.586
20-Sep-92			4.5	11009593	2506.88	4926.79	4756.14	170.65	71.56	99.09	0.22	0.00396	2.75	6.06	0.936	0.567
21-Sep-92			4.65	11376579	2590.45	5091.02	4914.68	176.34	73.95	102.39	0.23	0.00409	2.84	6.26	0.967	0.586
22-Sep-92			4.3	10520277	2395.47	4707.82	4544.76	163.06	68.38	94.68	0.21	0.00378	2.63	5.79	0.894	0.542
23-Sep-92			4	9786304	2228.34	4379.37	4227.68	151.69	63.61	88.08	0.20	0.00352	2.45	5.38	0.832	0.504
24-Sep-92			3.75	9174660	2089.07	4105.66	3963.45	142.21	59.64	82.57	0.18	0.00330	2.29	5.05	0.780	0.472
25-Sep-92			3.75	9174660	2089.07	4105.66	3963.45	142.21	59.64	82.57	0.18	0.00330	2.29	5.05	0.780	0.472
26-Sep-92			3.65	8930003	2033.36	3996.18	3857.76	138.42	58.05	80.37	0.18	0.00321	2.23	4.91	0.759	0.460
27-Sep-92			3.45	8440688	1921.94	3777.21	3646.38	130.83	54.86	75.97	0.17	0.00303	2.11	4.64	0.717	0.435
28-Sep-92			3.2	7829044	1782.67	3503.50	3382.15	121.35	50.89	70.46	0.16	0.00281	1.96	4.31	0.665	0.403
29-Sep-92			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000
30-Sep-92			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000
01-Oct-92			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000
02-Oct-92			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000

03-Oct-92	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000
04-Oct-92	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000
05-Oct-92	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000
06-Oct-92	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000
07-Oct-92	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.000	0.000
08-Oct-92	4.3	10520277	2395.47	4707.82	4544.76	163.06	68.38	94.68	0.21	0.00378	2.63	5.79	0.894	0.542
09-Oct-92	4.5	11009593	2506.88	4926.79	4756.14	170.65	71.56	99.09	0.22	0.00396	2.75	6.06	0.936	0.567
10-Oct-92	4.5	11009593	2506.88	4926.79	4756.14	170.65	71.56	99.09	0.22	0.00396	2.75	6.06	0.936	0.567
11-Oct-92	4	9786304	2228.34	4379.37	4227.68	151.69	63.61	88.08	0.20	0.00352	2.45	5.38	0.832	0.504
12-Oct-92	4	9786304	2228.34	4379.37	4227.68	151.69	63.61	88.08	0.20	0.00352	2.45	5.38	0.832	0.504
13-Oct-92	4.3	10520277	2395.47	4707.82	4544.76	163.06	68.38	94.68	0.21	0.00378	2.63	5.79	0.894	0.542
14-Oct-92	4.3	10520277	2395.47	4707.82	4544.76	163.06	68.38	94.68	0.21	0.00378	2.63	5.79	0.894	0.542
15-Oct-92	4.3	10520277	2395.47	4707.82	4544.76	163.06	68.38	94.68	0.21	0.00378	2.63	5.79	0.894	0.542
16-Oct-92	4.5	11009593	2506.88	4926.79	4756.14	170.65	71.56	99.09	0.22	0.00396	2.75	6.06	0.936	0.567
17-Oct-92	4.5	11009593	2506.88	4926.79	4756.14	170.65	71.56	99.09	0.22	0.00396	2.75	6.06	0.936	0.567
18-Oct-92	4.65	11376579	2590.45	5091.02	4914.68	176.34	73.95	102.39	0.23	0.00409	2.84	6.26	0.967	0.586
19-Oct-92	3	7339728	1671.26	3284.53	3170.76	113.77	47.71	66.06	0.15	0.00264	1.83	4.04	0.624	0.378
20-Oct-92	3	7339728	1671.26	3284.53	3170.76	113.77	47.71	66.06	0.15	0.00264	1.83	4.04	0.624	0.378
21-Oct-92	3	7339728	1671.26	3284.53	3170.76	113.77	47.71	66.06	0.15	0.00264	1.83	4.04	0.624	0.378
22-Oct-92	3	7339728	1671.26	3284.53	3170.76	113.77	47.71	66.06	0.15	0.00264	1.83	4.04	0.624	0.378
23-Oct-92	2.75	6728084	1531.98	3010.82	2906.53	104.29	43.73	60.55	0.13	0.00242	1.68	3.70	0.572	0.346
24-Oct-92	2.4	5871783	1337.00	2627.62	2536.61	91.01	38.17	52.85	0.12	0.00211	1.47	3.23	0.499	0.302
25-Oct-92	2.4	5871783	1337.00	2627.62	2536.61	91.01	38.17	52.85	0.12	0.00211	1.47	3.23	0.499	0.302
26-Oct-92	2.4	5871783	1337.00	2627.62	2536.61	91.01	38.17	52.85	0.12	0.00211	1.47	3.23	0.499	0.302
27-Oct-92	2.4	5871783	1337.00	2627.62	2536.61	91.01	38.17	52.85	0.12	0.00211	1.47	3.23	0.499	0.302
28-Oct-92	2.4	5871783	1337.00	2627.62	2536.61	91.01	38.17	52.85	0.12	0.00211	1.47	3.23	0.499	0.302
29-Oct-92	2.4	5871783	1337.00	2627.62	2536.61	91.01	38.17	52.85	0.12	0.00211	1.47	3.23	0.499	0.302
30-Oct-92	2.75	6728084	1531.98	3010.82	2906.53	104.29	43.73	60.55	0.13	0.00242	1.68	3.70	0.572	0.346
31-Oct-92	3.2	7829044	1782.67	3503.50	3382.15	121.35	50.89	70.46	0.16	0.00281	1.96	4.31	0.665	0.403
TOTAL LOADS L/YR KG/YR		5203745085	919509.04	2293637.13	2024333.68	269303.44	79098.28	190205.16	170.03	2.35202	1359.09	3672.80	939.870	473.327

SAMPLE DATA FOR SITE 6 (BIG SIOUX RIVER WEST OF CASINO), 1992

DATE	TIME	SITE	CUBIC CALC AVG CFS	FLOW L/DAY	TALKAL KG/DAY	TSOL KG/DAY	TDSOL KG/DAY	TSSOL KG/DAY	VOLSOL KG/DAY	FIXSOL KG/DAY	AMMON KG/DAY	UNIONIZED AMMONIA KG/DAY	NO3+2 KG/DAY	TKN-N KG/DAY	TPO4 KG/DAY	TDPO4 KG/DAY
25-Feb-92	1500	6	14	34252065.7	8391.76	14522.88	14248.86	274.02	137.01	137.01	0.69	0.00870	47.95	35.28	2.398	1.713
26-Feb-92			12	29358913.5	7060.82	12374.78	12081.19	293.59	146.79	146.79	0.59	0.00592	41.10	30.68	2.099	1.365
27-Feb-92	1245	6	13	31805489.6	7506.10	13326.50	12944.83	381.67	190.83	190.83	0.64	0.00475	44.53	33.71	2.322	1.368
28-Feb-92			27	66057555.3	12022.48	22294.42	21501.73	792.69	561.49	231.20	9.58	0.06677	66.06	98.43	8.885	5.813
29-Feb-92			76	185939785.3	33841.04	62754.68	60523.40	2231.28	1580.49	650.79	26.96	0.18796	185.94	277.05	25.009	16.363
01-Mar-92			89	217745274.9	39629.64	73489.03	70876.09	2612.94	1850.83	762.11	31.57	0.22011	217.75	324.44	29.287	19.162
02-Mar-92			69	168813752.5	30724.10	56974.64	54948.88	2025.77	1434.92	590.85	24.48	0.17065	168.81	251.53	22.705	14.856
03-Mar-92			62	151687719.6	27607.16	51194.61	49374.35	1820.25	1289.35	530.91	21.99	0.15333	151.69	226.01	20.402	13.349
04-Mar-92			56	137008262.9	24935.50	46240.29	44596.19	1644.10	1164.57	479.53	19.87	0.13850	137.01	204.14	18.428	12.057
05-Mar-92	1245	6	58	141901415.1	18163.38	36326.76	34623.95	1702.82	1560.92	141.90	38.31	0.24797	85.14	272.45	27.813	18.873
06-Mar-92			62	151687719.6	26014.44	50967.07	48919.29	2047.78	1061.81	985.97	31.10	0.17366	151.69	236.63	26.697	18.127
07-Mar-92			85	207958970.5	35664.96	69874.21	67066.77	2807.45	1455.71	1351.73	42.63	0.23808	207.96	324.42	36.601	24.851
08-Mar-92			122	298482287.0	51189.71	100290.05	96260.54	4029.51	2089.38	1940.13	61.19	0.34172	298.48	465.63	52.533	35.669
09-Mar-92			97	237317883.9	40700.02	79738.81	76535.02	3203.79	1661.23	1542.57	48.65	0.27170	237.32	370.22	41.768	28.359
10-Mar-92			71	173706904.7	29790.73	58365.52	56020.48	2345.04	1215.95	1129.09	35.61	0.19887	173.71	270.98	30.572	20.758
11-Mar-92			66	161474024.1	27692.80	54255.27	52075.37	2179.90	1130.32	1049.58	33.10	0.18487	161.47	251.90	28.419	19.296
12-Mar-92	1600	6	60	146794567.4	31560.83	61066.54	58864.62	2201.92	440.38	1761.53	20.55	0.09653	205.51	176.15	22.900	15.560
13-Mar-92			47	114989077.8	26677.47	48927.85	47432.99	1494.86	172.48	1322.37	12.07	0.08111	126.49	131.09	15.466	9.314
14-Mar-92			42	102756197.2	23839.44	43722.76	42386.93	1335.83	154.13	1181.70	10.79	0.07248	113.03	117.14	13.821	8.323
15-Mar-92			38	92969892.7	21569.02	39558.69	38350.08	1208.61	139.45	1069.15	9.76	0.06558	102.27	105.99	12.504	7.531
16-Mar-92			35	85630164.3	19866.20	36435.63	35322.44	1113.19	128.45	984.75	8.99	0.06040	94.19	97.62	11.517	6.936
17-Mar-92			32	78290435.9	18163.38	33312.58	32294.80	1017.78	117.44	900.34	8.22	0.05522	86.12	89.25	10.530	6.342
18-Mar-92	1230	6	30	73397283.7	18275.92	31927.82	31120.45	807.37	0.00	807.37	5.14	0.04489	58.72	79.27	8.294	4.110
19-Mar-92			28	68504131.4	17160.28	29559.53	28223.70	1335.83	308.27	1027.56	3.08	0.04909	51.38	64.39	8.186	3.288
20-Mar-92			26	63610979.2	15934.55	27448.14	26207.72	1240.41	286.25	954.16	2.86	0.04559	47.71	59.79	7.602	3.053
21-Mar-92			26	63610979.2	15934.55	27448.14	26207.72	1240.41	286.25	954.16	2.86	0.04559	47.71	59.79	7.602	3.053
22-Mar-92			24	58717827.0	14708.82	25336.74	24191.74	1145.00	264.23	880.77	2.64	0.04208	44.04	55.19	7.017	2.818
23-Mar-92	1630	6	24	58717827.0	14796.89	25131.23	23487.13	1644.10	528.46	1115.64	1.17	0.02714	41.10	46.97	7.398	2.349
24-Mar-92			23	56271250.8	14180.36	23943.42	22649.18	1294.24	450.17	844.07	1.13	0.13999	28.14	50.64	6.077	1.491
25-Mar-92			24	58717827.0	14796.89	24984.44	23633.93	1350.51	469.74	880.77	1.17	0.14607	29.36	52.85	6.342	1.556
26-Mar-92			24	58717827.0	14796.89	24984.44	23633.93	1350.51	469.74	880.77	1.17	0.14607	29.36	52.85	6.342	1.556
27-Mar-92			24	58717827.0	14796.89	24984.44	23633.93	1350.51	469.74	880.77	1.17	0.14607	29.36	52.85	6.342	1.556
28-Mar-92			26	63610979.2	16029.97	27066.47	25603.42	1463.05	508.89	954.16	1.27	0.15824	31.81	57.25	6.870	1.686
29-Mar-92			26	63610979.2	16029.97	27066.47	25603.42	1463.05	508.89	954.16	1.27	0.15824	31.81	57.25	6.870	1.686
30-Mar-92			25	61164403.1	15413.43	26025.45	24618.67	1406.78	489.32	917.47	1.22	0.15216	30.58	55.05	6.606	1.621
31-Mar-92			23	56271250.8	14180.36	23943.42	22649.18	1294.24	450.17	844.07	1.13	0.13999	28.14	50.64	6.077	1.491
01-Apr-92			22	53824674.7	13563.82	22902.40	21664.43	1237.97	430.60	807.37	1.08	0.13390	26.91	48.44	5.813	1.426
02-Apr-92	1130	6	21	51378098.6	12947.28	21732.94	20808.13	924.81	359.65	565.16	1.03	0.23188	15.41	51.38	4.624	0.668
03-Apr-92			21	51378098.6	14051.91	23839.44	22349.47	1489.96	436.71	1053.25	1.03	0.12353	12.84	44.96	4.444	0.925
04-Apr-92			20	48931522.5	13382.77	22704.23	21285.21	1419.01	415.92	1003.10	0.98	0.11764	12.23	42.82	4.233	0.881

05-Apr-92			20	48931522.5	13382.77	22704.23	21285.21	1419.01	415.92	1003.10	0.98	0.11764	12.23	42.82	4.233	0.881
06-Apr-92			19	46484946.3	12713.63	21569.02	20220.95	1348.06	395.12	952.94	0.93	0.11176	11.62	40.67	4.021	0.837
07-Apr-92			20	48931522.5	13382.77	22704.23	21285.21	1419.01	415.92	1003.10	0.98	0.11764	12.23	42.82	4.233	0.881
08-Apr-92			22	53824674.7	14721.05	24974.65	23413.73	1560.92	457.51	1103.41	1.08	0.12941	13.46	47.10	4.656	0.969
09-Apr-92			23	56271250.8	15390.19	26109.86	24477.99	1631.87	478.31	1153.56	1.13	0.13529	14.07	49.24	4.867	1.013
10-Apr-92			25	61164403.1	16728.46	28380.28	26606.52	1773.77	519.90	1253.87	1.22	0.14705	15.29	53.52	5.291	1.101
11-Apr-92			27	66057555.3	18066.74	30650.71	28735.04	1915.67	561.49	1354.18	1.32	0.15882	16.51	57.80	5.714	1.189
12-Apr-92			27	66057555.3	18066.74	30650.71	28735.04	1915.67	561.49	1354.18	1.32	0.15882	16.51	57.80	5.714	1.189
13-Apr-92			27	66057555.3	18066.74	30650.71	28735.04	1915.67	561.49	1354.18	1.32	0.15882	16.51	57.80	5.714	1.189
14-Apr-92			26	63610979.2	17397.60	29515.49	27670.78	1844.72	540.69	1304.03	1.27	0.15294	15.90	55.66	5.502	1.145
15-Apr-92			26	63610979.2	17397.60	29515.49	27670.78	1844.72	540.69	1304.03	1.27	0.15294	15.90	55.66	5.502	1.145
16-Apr-92			26	63610979.2	17397.60	29515.49	27670.78	1844.72	540.69	1304.03	1.27	0.15294	15.90	55.66	5.502	1.145
17-Apr-92			26	63610979.2	17397.60	29515.49	27670.78	1844.72	540.69	1304.03	1.27	0.15294	15.90	55.66	5.502	1.145
18-Apr-92			29	70950707.6	19405.02	32921.13	30863.56	2057.57	603.08	1454.49	1.42	0.17058	17.74	62.08	6.137	1.277
19-Apr-92			36	88076740.4	24088.99	40867.61	38313.38	2554.23	748.65	1805.57	1.76	0.21176	22.02	77.07	7.619	1.585
20-Apr-92			48	117435653.9	32118.65	54490.14	51084.51	3405.63	998.20	2407.43	2.35	0.28234	29.36	102.76	10.158	2.114
21-Apr-92			57	139454839.0	38140.90	64707.05	60662.85	4044.19	1185.37	2858.82	2.79	0.33528	34.86	122.02	12.063	2.510
22-Apr-92			58	141901415.1	38810.04	65842.26	61727.12	4115.14	1206.16	2908.98	2.84	0.34117	35.48	124.16	12.274	2.554
23-Apr-92	1530	6	53	129668534.5	38252.22	65482.61	60295.87	5186.74	1296.69	3890.06	2.59	0.03830	25.93	97.25	10.762	2.982
24-Apr-92			55	134561686.8	36129.81	65531.54	58130.65	7400.89	1076.49	6324.40	10.09	0.24788	33.64	135.91	23.885	8.276
25-Apr-92			59	144347991.3	38757.44	70297.47	62358.33	7939.14	1154.78	6784.36	10.83	0.26591	36.09	145.79	25.622	8.877
26-Apr-92			63	154134295.7	41385.06	75063.40	66586.02	8477.39	1233.07	7244.31	11.56	0.28393	38.53	155.68	27.359	9.479
27-Apr-92			63	154134295.7	41385.06	75063.40	66586.02	8477.39	1233.07	7244.31	11.56	0.28393	38.53	155.68	27.359	9.479
28-Apr-92			54	132115110.6	35472.91	64340.06	57073.73	7266.33	1056.92	6209.41	9.91	0.24337	33.03	133.44	23.450	8.125
29-Apr-92			50	122328806.2	32845.28	59574.13	52846.04	6728.08	978.63	5749.45	9.17	0.22535	30.58	123.55	21.713	7.523
30-Apr-92			52	127221958.4	34159.10	61957.09	54959.89	6997.21	1017.78	5979.43	9.54	0.23436	31.81	128.49	22.582	7.824
01-May-92			47	114989077.8	30874.57	55999.68	49675.28	6324.40	919.91	5404.49	8.62	0.21182	28.75	116.14	20.411	7.072
02-May-92			41	100309621.0	26933.13	48850.79	43333.76	5517.03	802.48	4714.55	7.52	0.18478	25.08	101.31	17.805	6.169
03-May-92			37	90523316.6	24305.51	44084.86	39106.07	4978.78	724.19	4254.60	6.79	0.16676	22.63	91.43	16.068	5.567
04-May-92			34	83183588.2	22334.79	40510.41	35935.31	4575.10	665.47	3909.63	6.24	0.15323	20.80	84.02	14.765	5.116
05-May-92			30	73397283.7	19707.17	35744.48	31707.63	4036.85	587.18	3449.67	5.50	0.13521	18.35	74.13	13.028	4.514
06-May-92			28	68504131.4	18393.36	33361.51	29593.78	3767.73	548.03	3219.69	5.14	0.12619	17.13	69.19	12.159	4.213
07-May-92			25	61164403.1	16422.64	29787.06	26423.02	3364.04	489.32	2874.73	4.59	0.11267	15.29	61.78	10.857	3.762
08-May-92			24	58717827.0	15765.74	28595.58	25366.10	3229.48	469.74	2759.74	4.40	0.10817	14.68	59.31	10.422	3.611
09-May-92			22	53824674.7	14451.93	26212.62	23252.26	2960.36	430.60	2529.76	4.04	0.09915	13.46	54.36	9.554	3.310
10-May-92			19	46484946.3	12481.21	22638.17	20081.50	2556.67	371.88	2184.79	3.49	0.08563	11.62	46.95	8.251	2.859
11-May-92			18	44038370.2	11824.30	21446.69	19024.58	2422.11	352.31	2069.80	3.30	0.08112	11.01	44.48	7.817	2.708
12-May-92			16	39145218.0	10510.49	19063.72	16910.73	2152.99	313.16	1839.83	2.94	0.07211	9.79	39.54	6.948	2.407
13-May-92			15	36698641.8	9853.59	17872.24	15853.81	2018.43	293.59	1724.84	2.75	0.06760	9.17	37.07	6.514	2.257
14-May-92			13	31805489.6	8539.77	15489.27	13739.97	1749.30	254.44	1494.86	2.39	0.05859	7.95	32.12	5.645	1.956
15-May-92			12	29358913.5	7882.87	14297.79	12683.05	1614.74	234.87	1379.87	2.20	0.05408	7.34	29.65	5.211	1.806
16-May-92			11	26912337.4	7225.96	13106.31	11626.13	1480.18	215.30	1264.88	2.02	0.04958	6.73	27.18	4.777	1.655
17-May-92			11	26912337.4	7225.96	13106.31	11626.13	1480.18	215.30	1264.88	2.02	0.04958	6.73	27.18	4.777	1.655
18-May-92			13	31805489.6	8539.77	15489.27	13739.97	1749.30	254.44	1494.86	2.39	0.05859	7.95	32.12	5.645	1.956
19-May-92			12	29358913.5	7882.87	14297.79	12683.05	1614.74	234.87	1379.87	2.20	0.05408	7.34	29.65	5.211	1.806
20-May-92			10	24465761.2	6569.06	11914.83	10569.21	1345.62	195.73	1149.89	1.83	0.04507	6.12	24.71	4.343	1.505

21-May-92			9	22019185.1	5912.15	10723.34	9512.29	1211.06	176.15	1034.90	1.65	0.04056	5.50	22.24	3.908	1.354
22-May-92			7.6	18593978.5	4992.48	9055.27	8032.60	1022.67	148.75	873.92	1.39	0.03425	4.65	18.78	3.300	1.144
23-May-92			7	17126032.9	4598.34	8340.38	7398.45	941.93	137.01	804.92	1.28	0.03155	4.28	17.30	3.040	1.053
24-May-92			6.4	15658087.2	4204.20	7625.49	6764.29	861.19	125.26	735.93	1.17	0.02884	3.91	15.81	2.779	0.963
25-May-92			6.7	16392060.0	4401.27	7982.93	7081.37	901.56	131.14	770.43	1.23	0.03020	4.10	16.56	2.910	1.008
26-May-92			7.3	17860005.7	4795.41	8697.82	7715.52	982.30	142.88	839.42	1.34	0.03290	4.47	18.04	3.170	1.098
27-May-92			7.9	19327951.4	5189.55	9412.71	8349.67	1063.04	154.62	908.41	1.45	0.03560	4.83	19.52	3.431	1.189
28-May-92			7.8	19083293.8	5123.86	9293.56	8243.98	1049.58	152.67	896.91	1.43	0.03515	4.77	19.27	3.387	1.174
29-May-92			6.8	16636717.6	4466.96	8102.08	7187.06	915.02	133.09	781.93	1.25	0.03065	4.16	16.80	2.953	1.023
30-May-92			5.6	13700826.3	3678.67	6672.30	5918.76	753.55	109.61	643.94	1.03	0.02524	3.43	13.84	2.432	0.843
31-May-92			4.9	11988223.0	3218.84	5838.26	5178.91	659.35	95.91	563.45	0.90	0.02208	3.00	12.11	2.128	0.737
01-Jun-92			4.3	10520277.3	2824.69	5123.38	4544.76	578.62	84.16	494.45	0.79	0.01938	2.63	10.63	1.867	0.647
02-Jun-92			4	9786304.5	2627.62	4765.93	4227.68	538.25	78.29	459.96	0.73	0.01803	2.45	9.88	1.737	0.602
03-Jun-92			3.7	9052331.7	2430.55	4408.49	3910.61	497.88	72.42	425.46	0.68	0.01668	2.26	9.14	1.607	0.557
04-Jun-92			3.3	8073701.2	2167.79	3931.89	3487.84	444.05	64.59	379.46	0.61	0.01487	2.02	8.15	1.433	0.497
05-Jun-92			2.8	6850413.1	1839.34	3336.15	2959.38	376.77	54.80	321.97	0.51	0.01262	1.71	6.92	1.216	0.421
06-Jun-92			2.9	7095070.8	1905.03	3455.30	3065.07	390.23	56.76	333.47	0.53	0.01307	1.77	7.17	1.259	0.436
07-Jun-92			3.4	8318358.8	2233.48	4051.04	3593.53	457.51	66.55	390.96	0.62	0.01532	2.08	8.40	1.477	0.512
08-Jun-92			5.2	12722195.8	3415.91	6195.71	5495.99	699.72	101.78	597.94	0.95	0.02344	3.18	12.85	2.258	0.782
09-Jun-92			5.4	13211511.1	3547.29	6434.01	5707.37	726.63	105.69	620.94	0.99	0.02434	3.30	13.34	2.345	0.813
10-Jun-92			5.5	13456168.7	3612.98	6553.15	5813.06	740.09	107.65	632.44	1.01	0.02479	3.36	13.59	2.388	0.828
11-Jun-92			5.4	13211511.1	3547.29	6434.01	5707.37	726.63	105.69	620.94	0.99	0.02434	3.30	13.34	2.345	0.813
12-Jun-92			4.6	11254250.2	3021.77	5480.82	4861.84	618.98	90.03	528.95	0.84	0.02073	2.81	11.37	1.998	0.692
13-Jun-92			3.9	9541646.9	2561.93	4646.78	4121.99	524.79	76.33	448.46	0.72	0.01758	2.39	9.64	1.694	0.587
14-Jun-92			3.3	8073701.2	2167.79	3931.89	3487.84	444.05	64.59	379.46	0.61	0.01487	2.02	8.15	1.433	0.497
15-Jun-92			3.3	8073701.2	2167.79	3931.89	3487.84	444.05	64.59	379.46	0.61	0.01487	2.02	8.15	1.433	0.497
16-Jun-92			12	29358913.5	7882.87	14297.79	12683.05	1614.74	234.87	1379.87	2.20	0.05408	7.34	29.65	5.211	1.806
17-Jun-92	1430	6	62	151687719.6	36708.43	71141.54	60523.40	10618.14	910.13	9708.01	19.72	0.67745	45.51	192.64	41.259	15.169
18-Jun-92	1200	6	252	616537183.0	75834.07	248464.48	186810.77	61653.72	13563.82	48089.90	73.98	5.57542	369.92	622.70	247.848	143.037
19-Jun-92	1615	6	208	508887833.6	97197.58	205590.68	191341.83	14248.86	5088.88	9159.98	50.89	0.87932	152.67	615.75	145.542	86.002
20-Jun-92	1030	6	408	998203058.2	162707.10	366340.52	325414.20	40926.33	12976.64	27949.69	79.86	0.65993	299.46	1147.93	334.398	195.648
21-Jun-92			273	667915281.6	117219.13	253807.81	212731.02	41076.79	13024.35	28052.44	33.40	0.43221	233.77	754.74	208.390	116.551
22-Jun-92			173	423257669.3	74281.72	160837.91	134807.57	26030.35	8253.52	17776.82	21.16	0.27389	148.14	478.28	132.056	73.858
23-Jun-92			110	269123373.5	47231.15	102266.88	85715.79	16551.09	5247.91	11303.18	13.46	0.17415	94.19	304.11	83.966	46.962
24-Jun-92			82	200619242.1	35208.68	76235.31	63897.23	12338.08	3912.08	8426.01	10.03	0.12982	70.22	226.70	62.593	35.008
25-Jun-92			64	156580871.9	27479.94	59500.73	49871.01	9629.72	3053.33	6576.40	7.83	0.10132	54.80	176.94	48.853	27.323
26-Jun-92			51	124775382.3	21898.08	47414.65	39740.96	7673.69	2433.12	5240.57	6.24	0.08074	43.67	141.00	38.930	21.773
27-Jun-92			41	100309621.0	17604.34	38117.66	31948.61	6169.04	1956.04	4213.00	5.02	0.06491	35.11	113.35	31.297	17.504
28-Jun-92			36	88076740.4	15457.47	33469.16	28052.44	5416.72	1717.50	3699.22	4.40	0.05699	30.83	99.53	27.480	15.369
29-Jun-92			32	78290435.9	13739.97	29750.37	24935.50	4814.86	1526.66	3288.20	3.91	0.05066	27.40	88.47	24.427	13.662
30-Jun-92			35	85630164.3	15028.09	32539.46	27273.21	5266.26	1669.79	3596.47	4.28	0.05541	29.97	96.76	26.717	14.942
01-Jul-92	1645	6	142	347413809.5	65313.80	136533.63	108045.69	28487.93	9032.76	19455.17	6.95	0.12243	138.97	385.63	100.403	53.154
02-Jul-92	1230	6	637	1558468990.4	208834.84	422345.10	367798.68	54546.41	14026.22	40520.19	31.17	0.38246	467.54	1574.05	486.242	278.966
03-Jul-92			358	875874252.0	206268.39	312249.17	268893.40	43355.78	13576.05	29779.72	17.52	0.73203	218.97	871.49	236.924	88.463
04-Jul-92			205	501548105.2	118114.58	178801.90	153975.27	24826.63	7774.00	17052.64	10.03	0.41918	125.39	499.04	135.669	50.656
05-Jul-92			127	310715167.6	73173.42	110769.96	95389.56	15380.40	4816.09	10564.32	6.21	0.25969	77.68	309.16	84.048	31.382

06-Jul-92	89	217745274.9	51279.01	77626.19	66847.80	10778.39	3375.05	7403.34	4.35	0.18198	54.44	216.66	58.900	21.992
07-Jul-92	71	173706904.7	40907.98	61926.51	53328.02	8598.49	2692.46	5906.03	3.47	0.14518	43.43	172.84	46.988	17.544
08-Jul-92	59	144347991.3	33993.95	51460.06	44314.83	7145.23	2237.39	4907.83	2.89	0.12064	36.09	143.63	39.046	14.579
09-Jul-92	51	124775382.3	29384.60	44482.42	38306.04	6176.38	1934.02	4242.36	2.50	0.10428	31.19	124.15	33.752	12.602
10-Jul-92	48	117435653.9	27656.10	41865.81	36052.75	5813.06	1820.25	3992.81	2.35	0.09815	29.36	116.85	31.766	11.861
11-Jul-92	68	166367176.4	39179.47	59309.90	51074.72	8235.18	2578.69	5656.48	3.33	0.13904	41.59	165.54	45.002	16.803
12-Jul-92	163	398791908.0	93915.49	142169.32	122429.12	19740.20	6181.27	13558.92	7.98	0.33330	99.70	396.80	107.873	40.278
13-Jul-92	137	335180928.9	78935.11	119492.00	102900.55	16591.46	5195.30	11396.15	6.70	0.28013	83.80	333.51	90.666	33.853
14-Jul-92	93	227531579.4	53583.69	81115.01	69852.19	11262.81	3526.74	7736.07	4.55	0.19016	56.88	226.39	61.547	22.981
15-Jul-92	72	176153480.9	41484.14	62798.72	54079.12	8719.60	2730.38	5989.22	3.52	0.14722	44.04	175.27	47.650	17.792
16-Jul-92	60	146794567.4	34570.12	52332.26	45065.93	7266.33	2275.32	4991.02	2.94	0.12269	36.70	146.06	39.708	14.826
17-Jul-92	49	119882230.0	28232.27	42738.02	36803.84	5934.17	1858.17	4076.00	2.40	0.10019	29.97	119.28	32.428	12.108
18-Jul-92	41	100309621.0	23622.92	35760.38	30795.05	4965.33	1554.80	3410.53	2.01	0.08384	25.08	99.81	27.134	10.131
19-Jul-92	36	88076740.4	20742.07	31399.36	27039.56	4359.80	1365.19	2994.61	1.76	0.07361	22.02	87.64	23.825	8.896
20-Jul-92	32	78290435.9	18437.40	27910.54	24035.16	3875.38	1213.50	2661.87	1.57	0.06543	19.57	77.90	21.178	7.907
21-Jul-92	29	70950707.6	16708.89	25293.93	21781.87	3512.06	1099.74	2412.32	1.42	0.05930	17.74	70.60	19.192	7.166
22-Jul-92	29	70950707.6	16708.89	25293.93	21781.87	3512.06	1099.74	2412.32	1.42	0.05930	17.74	70.60	19.192	7.166
23-Jul-92	30	73397283.7	17285.06	26166.13	22532.97	3633.17	1137.66	2495.51	1.47	0.06134	18.35	73.03	19.854	7.413
24-Jul-92	33	80737012.1	19013.57	28782.74	24786.26	3996.48	1251.42	2745.06	1.61	0.06748	20.18	80.33	21.839	8.154
25-Jul-92	33	80737012.1	19013.57	28782.74	24786.26	3996.48	1251.42	2745.06	1.61	0.06748	20.18	80.33	21.839	8.154
26-Jul-92	32	78290435.9	18437.40	27910.54	24035.16	3875.38	1213.50	2661.87	1.57	0.06543	19.57	77.90	21.178	7.907
27-Jul-92	29	70950707.6	16708.89	25293.93	21781.87	3512.06	1099.74	2412.32	1.42	0.05930	17.74	70.60	19.192	7.166
28-Jul-92	26	63610979.2	14980.39	22677.31	19528.57	3148.74	985.97	2162.77	1.27	0.05316	15.90	63.29	17.207	6.425
29-Jul-92	24	58717827.0	13828.05	20932.91	18026.37	2906.53	910.13	1996.41	1.17	0.04907	14.68	58.42	15.883	5.931
30-Jul-92	23	56271250.8	13251.88	20060.70	17275.27	2785.43	872.20	1913.22	1.13	0.04703	14.07	55.99	15.221	5.683
31-Jul-92	22	53824674.7	12675.71	19188.50	16524.18	2664.32	834.28	1830.04	1.08	0.04498	13.46	53.56	14.560	5.436
01-Aug-92	19	46484946.3	10947.20	16571.88	14270.88	2301.00	720.52	1580.49	0.93	0.03885	11.62	46.25	12.574	4.695
02-Aug-92	18	44038370.2	10371.04	15699.68	13519.78	2179.90	682.59	1497.30	0.88	0.03681	11.01	43.82	11.912	4.448
03-Aug-92	17	41591794.1	9794.87	14827.47	12768.68	2058.79	644.67	1414.12	0.83	0.03476	10.40	41.38	11.251	4.201
04-Aug-92	16	39145218.0	9218.70	13955.27	12017.58	1937.69	606.75	1330.94	0.78	0.03272	9.79	38.95	10.589	3.954
05-Aug-92	16	39145218.0	9218.70	13955.27	12017.58	1937.69	606.75	1330.94	0.78	0.03272	9.79	38.95	10.589	3.954
06-Aug-92	15	36698641.8	8642.53	13083.07	11266.48	1816.58	568.83	1247.75	0.73	0.03067	9.17	36.52	9.927	3.707
07-Aug-92	14	34252065.7	8066.36	12210.86	10515.38	1695.48	530.91	1164.57	0.69	0.02863	8.56	34.08	9.265	3.459
08-Aug-92	14	34252065.7	8066.36	12210.86	10515.38	1695.48	530.91	1164.57	0.69	0.02863	8.56	34.08	9.265	3.459
09-Aug-92	12	29358913.5	6914.02	10466.45	9013.19	1453.27	455.06	998.20	0.59	0.02454	7.34	29.21	7.942	2.965
10-Aug-92	11	26912337.4	6337.86	9594.25	8262.09	1332.16	417.14	915.02	0.54	0.02249	6.73	26.78	7.280	2.718
11-Aug-92	11	26912337.4	6337.86	9594.25	8262.09	1332.16	417.14	915.02	0.54	0.02249	6.73	26.78	7.280	2.718
12-Aug-92	10	24465761.2	5761.69	8722.04	7510.99	1211.06	379.22	831.84	0.49	0.02045	6.12	24.34	6.618	2.471
13-Aug-92	9.7	23731788.4	5588.84	8460.38	7285.66	1174.72	367.84	806.88	0.47	0.01983	5.93	23.61	6.419	2.397
14-Aug-92	8	19572609.0	4609.35	6977.64	6008.79	968.84	303.38	665.47	0.39	0.01636	4.89	19.47	5.294	1.977
15-Aug-92	6.2	15168772.0	3572.25	5407.67	4656.81	750.85	235.12	515.74	0.30	0.01268	3.79	15.09	4.103	1.532
16-Aug-92	5.8	14190141.5	3341.78	5058.79	4356.37	702.41	219.95	482.46	0.28	0.01186	3.55	14.12	3.838	1.433
17-Aug-92	5.5	13456168.7	3168.93	4797.12	4131.04	666.08	208.57	457.51	0.27	0.01125	3.36	13.39	3.640	1.359
18-Aug-92	5	12232880.6	2880.84	4361.02	3755.49	605.53	189.61	415.92	0.24	0.01022	3.06	12.17	3.309	1.236
19-Aug-92	4.8	11743565.4	2765.61	4186.58	3605.27	581.31	182.03	399.28	0.23	0.00981	2.94	11.68	3.177	1.186
20-Aug-92	3.7	9052331.7	2131.82	3227.16	2779.07	448.09	140.31	307.78	0.18	0.00757	2.26	9.01	2.449	0.914

21-Aug-92		3.6	8807674.0	2074.21	3139.94	2703.96	435.98	136.52	299.46	0.18	0.00736	2.20	8.76	2.382	0.890
22-Aug-92		4.3	10520277.3	2477.53	3750.48	3229.73	520.75	163.06	357.69	0.21	0.00879	2.63	10.47	2.846	1.063
23-Aug-92		3.7	9052331.7	2131.82	3227.16	2779.07	448.09	140.31	307.78	0.18	0.00757	2.26	9.01	2.449	0.914
24-Aug-92		4	9786304.5	2304.67	3488.82	3004.40	484.42	151.69	332.73	0.20	0.00818	2.45	9.74	2.647	0.988
25-Aug-92		4.9	11988223.0	2823.23	4273.80	3680.38	593.42	185.82	407.60	0.24	0.01002	3.00	11.93	3.243	1.211
26-Aug-92		5.2	12722195.8	2996.08	4535.46	3905.71	629.75	197.19	432.55	0.25	0.01063	3.18	12.66	3.441	1.285
27-Aug-92		5.2	12722195.8	2996.08	4535.46	3905.71	629.75	197.19	432.55	0.25	0.01063	3.18	12.66	3.441	1.285
28-Aug-92		4.9	11988223.0	2823.23	4273.80	3680.38	593.42	185.82	407.60	0.24	0.01002	3.00	11.93	3.243	1.211
29-Aug-92		4	9786304.5	2304.67	3488.82	3004.40	484.42	151.69	332.73	0.20	0.00818	2.45	9.74	2.647	0.988
30-Aug-92		3.7	9052331.7	2131.82	3227.16	2779.07	448.09	140.31	307.78	0.18	0.00757	2.26	9.01	2.449	0.914
31-Aug-92		3.5	8563016.4	2016.59	3052.72	2628.85	423.87	132.73	291.14	0.17	0.00716	2.14	8.52	2.316	0.865
01-Sep-92		4.2	10275619.7	2419.91	3663.26	3154.62	508.64	159.27	349.37	0.21	0.00859	2.57	10.22	2.780	1.038
02-Sep-92		12	29358913.5	6914.02	10466.45	9013.19	1453.27	455.06	998.20	0.59	0.02454	7.34	29.21	7.942	2.965
03-Sep-92	6	31	75843859.8	25559.38	33522.99	28668.98	4854.01	1668.56	3185.44	1.52	0.10816	15.17	74.33	17.368	1.744
04-Sep-92		29	70950707.6	20128.72	29621.92	26854.84	2767.08	993.31	1773.77	1.42	0.07570	28.38	59.95	10.820	2.448
05-Sep-92		29	70950707.6	20128.72	29621.92	26854.84	2767.08	993.31	1773.77	1.42	0.07570	28.38	59.95	10.820	2.448
06-Sep-92		28	68504131.4	19434.62	28600.47	25928.81	2671.66	959.06	1712.60	1.37	0.07309	27.40	57.89	10.447	2.363
07-Sep-92		26	63610979.2	18046.43	26557.58	24076.76	2480.83	890.55	1590.27	1.27	0.06787	25.44	53.75	9.701	2.195
08-Sep-92		29	70950707.6	20128.72	29621.92	26854.84	2767.08	993.31	1773.77	1.42	0.07570	28.38	59.95	10.820	2.448
09-Sep-92		31	75843859.8	21516.90	31664.81	28706.90	2957.91	1061.81	1896.10	1.52	0.08092	30.34	64.09	11.566	2.617
10-Sep-92		31	75843859.8	21516.90	31664.81	28706.90	2957.91	1061.81	1896.10	1.52	0.08092	30.34	64.09	11.566	2.617
11-Sep-92		29	70950707.6	20128.72	29621.92	26854.84	2767.08	993.31	1773.77	1.42	0.07570	28.38	59.95	10.820	2.448
12-Sep-92		26	63610979.2	18046.43	26557.58	24076.76	2480.83	890.55	1590.27	1.27	0.06787	25.44	53.75	9.701	2.195
13-Sep-92		23	56271250.8	15964.15	23493.25	21298.67	2194.58	787.80	1406.78	1.13	0.06003	22.51	47.55	8.581	1.941
14-Sep-92		20	48931522.5	13881.87	20428.91	18520.58	1908.33	685.04	1223.29	0.98	0.05220	19.57	41.35	7.462	1.688
15-Sep-92		18	44038370.2	12493.69	18386.02	16668.52	1717.50	616.54	1100.96	0.88	0.04698	17.62	37.21	6.716	1.519
16-Sep-92		16	39145218.0	11105.50	16343.13	14816.47	1526.66	548.03	978.63	0.78	0.04176	15.66	33.08	5.970	1.351
17-Sep-92		14	34252065.7	9717.31	14300.24	12964.41	1335.83	479.53	856.30	0.69	0.03654	13.70	28.94	5.223	1.182
18-Sep-92		13	31805489.6	9023.22	13278.79	12038.38	1240.41	445.28	795.14	0.64	0.03393	12.72	26.88	4.850	1.097
19-Sep-92		12	29358913.5	8329.12	12257.35	11112.35	1145.00	411.02	733.97	0.59	0.03132	11.74	24.81	4.477	1.013
20-Sep-92		11	26912337.4	7635.03	11235.90	10186.32	1049.58	376.77	672.81	0.54	0.02871	10.76	22.74	4.104	0.928
21-Sep-92		9.6	23487130.8	6663.30	9805.88	8889.88	916.00	328.82	587.18	0.47	0.02506	9.39	19.85	3.582	0.810
22-Sep-92		8.7	21285212.3	6038.61	8886.58	8056.45	830.12	297.99	532.13	0.43	0.02271	8.51	17.99	3.246	0.734
23-Sep-92		9.1	22263842.7	6316.25	9295.15	8426.86	868.29	311.69	556.60	0.45	0.02375	8.91	18.81	3.395	0.768
24-Sep-92		8.4	20551239.4	5830.39	8580.14	7778.64	801.50	287.72	513.78	0.41	0.02193	8.22	17.37	3.134	0.709
25-Sep-92		7	17126032.9	4858.66	7150.12	6482.20	667.92	239.76	428.15	0.34	0.01827	6.85	14.47	2.612	0.591
26-Sep-92		6.1	14924114.4	4233.97	6230.82	5648.78	582.04	208.94	373.10	0.30	0.01592	5.97	12.61	2.276	0.515
27-Sep-92		6.1	14924114.4	4233.97	6230.82	5648.78	582.04	208.94	373.10	0.30	0.01592	5.97	12.61	2.276	0.515
28-Sep-92		5.7	13945483.9	3956.33	5822.24	5278.37	543.87	195.24	348.64	0.28	0.01488	5.58	11.78	2.127	0.481
29-Sep-92		5	12232880.6	3470.47	5107.23	4630.15	477.08	171.26	305.82	0.24	0.01305	4.89	10.34	1.866	0.422
30-Sep-92		5	12232880.6	3470.47	5107.23	4630.15	477.08	171.26	305.82	0.24	0.01305	4.89	10.34	1.866	0.422
01-Oct-92		4.8	11743565.4	3331.65	4902.94	4444.94	458.00	164.41	293.59	0.23	0.01253	4.70	9.92	1.791	0.405
02-Oct-92		4.7	11498907.8	3262.24	4800.79	4352.34	448.46	160.98	287.47	0.23	0.01227	4.60	9.72	1.754	0.397
03-Oct-92		4.5	11009592.6	3123.42	4596.50	4167.13	429.37	154.13	275.24	0.22	0.01175	4.40	9.30	1.679	0.380
04-Oct-92		4.5	11009592.6	3123.42	4596.50	4167.13	429.37	154.13	275.24	0.22	0.01175	4.40	9.30	1.679	0.380
05-Oct-92		4.3	10520277.3	2984.60	4392.22	3981.92	410.29	147.28	263.01	0.21	0.01122	4.21	8.89	1.604	0.363

06-Oct-92			4.7	11498907.8	3262.24	4800.79	4352.34	448.46	160.98	287.47	0.23	0.01227	4.60	9.72	1.754	0.397
07-Oct-92			6	14679456.7	4164.56	6128.67	5556.17	572.50	205.51	366.99	0.29	0.01566	5.87	12.40	2.239	0.506
08-Oct-92			5	12232880.6	3470.47	5107.23	4630.15	477.08	171.26	305.82	0.24	0.01305	4.89	10.34	1.866	0.422
09-Oct-92			4.7	11498907.8	3262.24	4800.79	4352.34	448.46	160.98	287.47	0.23	0.01227	4.60	9.72	1.754	0.397
10-Oct-92			4.3	10520277.3	2984.60	4392.22	3981.92	410.29	147.28	263.01	0.21	0.01122	4.21	8.89	1.604	0.363
11-Oct-92			4	9786304.5	2776.37	4085.78	3704.12	381.67	137.01	244.66	0.20	0.01044	3.91	8.27	1.492	0.338
12-Oct-92			3.9	9541646.9	2706.97	3983.64	3611.51	372.12	133.58	238.54	0.19	0.01018	3.82	8.06	1.455	0.329
13-Oct-92			3.6	8807674.0	2498.74	3677.20	3333.70	343.50	123.31	220.19	0.18	0.00940	3.52	7.44	1.343	0.304
14-Oct-92			3.6	8807674.0	2498.74	3677.20	3333.70	343.50	123.31	220.19	0.18	0.00940	3.52	7.44	1.343	0.304
15-Oct-92			3.6	8807674.0	2498.74	3677.20	3333.70	343.50	123.31	220.19	0.18	0.00940	3.52	7.44	1.343	0.304
16-Oct-92			3.6	8807674.0	2498.74	3677.20	3333.70	343.50	123.31	220.19	0.18	0.00940	3.52	7.44	1.343	0.304
17-Oct-92			3.6	8807674.0	2498.74	3677.20	3333.70	343.50	123.31	220.19	0.18	0.00940	3.52	7.44	1.343	0.304
18-Oct-92			3.6	8807674.0	2498.74	3677.20	3333.70	343.50	123.31	220.19	0.18	0.00940	3.52	7.44	1.343	0.304
19-Oct-92			3.7	9052331.7	2568.15	3779.35	3426.31	353.04	126.73	226.31	0.18	0.00966	3.62	7.65	1.380	0.312
20-Oct-92			4	9786304.5	2776.37	4085.78	3704.12	381.67	137.01	244.66	0.20	0.01044	3.91	8.27	1.492	0.338
21-Oct-92			4	9786304.5	2776.37	4085.78	3704.12	381.67	137.01	244.66	0.20	0.01044	3.91	8.27	1.492	0.338
22-Oct-92			4	9786304.5	2776.37	4085.78	3704.12	381.67	137.01	244.66	0.20	0.01044	3.91	8.27	1.492	0.338
23-Oct-92			4.2	10275619.7	2915.19	4290.07	3889.32	400.75	143.86	256.89	0.21	0.01096	4.11	8.68	1.567	0.355
24-Oct-92			4.2	10275619.7	2915.19	4290.07	3889.32	400.75	143.86	256.89	0.21	0.01096	4.11	8.68	1.567	0.355
25-Oct-92			4.6	11254250.2	3192.83	4698.65	4259.73	438.92	157.56	281.36	0.23	0.01201	4.50	9.51	1.716	0.388
26-Oct-92			3.8	9296989.3	2637.56	3881.49	3518.91	362.58	130.16	232.42	0.19	0.00992	3.72	7.86	1.418	0.321
27-Oct-92			4	9786304.5	2776.37	4085.78	3704.12	381.67	137.01	244.66	0.20	0.01044	3.91	8.27	1.492	0.338
28-Oct-92			3.8	9296989.3	2637.56	3881.49	3518.91	362.58	130.16	232.42	0.19	0.00992	3.72	7.86	1.418	0.321
29-Oct-92			3.8	9296989.3	2637.56	3881.49	3518.91	362.58	130.16	232.42	0.19	0.00992	3.72	7.86	1.418	0.321
30-Oct-92			3.9	9541646.9	2706.97	3983.64	3611.51	372.12	133.58	238.54	0.19	0.01018	3.82	8.06	1.455	0.329
31-Oct-92			4.4	10764934.9	3054.01	4494.36	4074.53	419.83	150.71	269.12	0.22	0.01148	4.31	9.10	1.642	0.371
01-Nov-92			6.3	15413429.6	4372.79	6435.11	5833.98	601.12	215.79	385.34	0.31	0.01644	6.17	13.02	2.351	0.532
02-Nov-92			8.6	21040554.7	5969.21	8784.43	7963.85	820.58	294.57	526.01	0.42	0.02245	8.42	17.78	3.209	0.726
03-Nov-92	1330	6	11	26912337.4	6200.60	10576.55	10199.78	376.77	161.47	215.30	0.54	0.01904	16.15	19.11	2.045	1.238
TOTAL LOADS L/YR KG/YR				21654400607.1	4717117.06	8374633.37	7443361.17	931272.20	268682.87	662589.33	1257.32	28.97790	8960.52	23144.82	4973.681	2306.320

SAMPLE DATA FOR SITE 7 (BIG SIOUX RIVER EAST OF LONESOME LAKE), 1992

DATE	TIME	SITE	CUBIC CALC AVG CFS	FLOW L/DAY	TALKAL KG/DAY	TSOL KG/DAY	TDSOL KG/DAY	TSSOL KG/DAY	VOLSOL KG/DAY	FIXSOL KG/DAY	AMMON KG/DAY	UNIONIZED AMMONIA KG/DAY	NO3+2 KG/DAY	TKN-N KG/DAY	TPO4 KG/DAY	TDPO4 KG/DAY
25-Feb-92	1630	site 7	1.4	3425206.5722	983.03	1582.45	1555.04	27.40	10.28	17.13	0.07	0.00023	2.74	3.60	0.343	0.240
26-Feb-92			2	4893152.246	1335.83	2245.96	2187.24	58.72	26.91	31.81	0.22	0.00058	3.91	7.34	1.106	0.878
27-Feb-92	1115	site 7	3	7339728.369	1900.99	3346.92	3229.48	117.44	58.72	58.72	0.51	0.00125	5.87	14.31	2.584	2.121
28-Feb-92			6	14679456.738	2899.19	5159.83	4954.32	205.51	132.12	73.40	1.17	0.00340	9.54	26.57	3.875	2.951
29-Feb-92			15	36698641.845	7247.98	12899.57	12385.79	513.78	330.29	183.49	2.94	0.00849	23.85	66.42	9.688	7.376
01-Mar-92			40	97863044.92	19327.95	34398.86	33028.78	1370.08	880.77	489.32	7.83	0.02264	63.61	177.13	25.836	19.670
02-Mar-92			28	68504131.444	13529.57	24079.20	23120.14	959.06	616.54	342.52	5.48	0.01585	44.53	123.99	18.085	13.769
03-Mar-92			22	53824674.706	10630.37	18919.37	18165.83	753.55	484.42	269.12	4.31	0.01245	34.99	97.42	14.210	10.819
04-Mar-92			18	44038370.214	8697.58	15479.49	14862.95	616.54	396.35	220.19	3.52	0.01019	28.62	79.71	11.626	8.852
05-Mar-92	1130	site 7	19	46484946.337	6321.95	11481.78	10923.96	557.82	464.85	92.97	4.18	0.01361	23.24	77.63	8.181	5.253
06-Mar-92			43	105202773.29	19357.31	33559.68	32086.85	1472.84	736.42	736.42	5.79	0.01832	57.86	143.60	16.412	11.362
07-Mar-92			43	,105202773.29	19357.31	33559.68	32086.85	1472.84	736.42	736.42	5.79	0.01832	57.86	143.60	16.412	11.362
08-Mar-92			31	75843859.813	13955.27	24194.19	23132.38	1061.81	530.91	530.91	4.17	0.01321	41.71	103.53	11.832	8.191
09-Mar-92			20	48931522.46	9003.40	15609.16	14924.11	685.04	342.52	342.52	2.69	0.00852	26.91	66.79	7.633	5.285
10-Mar-92			17	41591794.091	7652.89	13267.78	12685.50	582.29	291.14	291.14	2.29	0.00724	22.88	56.77	6.488	4.492
11-Mar-92			14	34252065.722	6302.38	10926.41	10446.88	479.53	239.76	239.76	1.88	0.00597	18.84	46.75	5.343	3.699
12-Mar-92	1430	site 7	13	31805489.599	7378.87	12435.95	11927.06	508.89	127.22	381.67	0.64	0.00176	19.08	33.71	4.326	3.276
13-Mar-92			12	29358913.476	7530.56	11890.36	11508.69	381.67	88.08	293.59	0.88	0.00494	17.62	29.07	3.259	2.290
14-Mar-92			11	26912337.353	6903.01	10899.50	10549.64	349.86	80.74	269.12	0.81	0.00453	16.15	26.64	2.987	2.099
15-Mar-92			8.7	21285212.27	5459.66	8620.51	8343.80	276.71	63.86	212.85	0.64	0.00358	12.77	21.07	2.363	1.660
16-Mar-92			8.1	19817266.596	5083.13	8025.99	7768.37	257.62	59.45	198.17	0.59	0.00334	11.89	19.62	2.200	1.546
17-Mar-92			6.4	15658087.187	4016.30	6341.53	6137.97	203.56	46.97	156.58	0.47	0.00264	9.39	15.50	1.738	1.221
18-Mar-92	1130	site 7	5.2	12722195.84	3574.94	5330.60	5203.38	127.22	25.44	101.78	0.51	0.00358	7.63	11.70	1.094	0.674
19-Mar-92			4.4	10764934.941	3030.33	4359.80	4262.91	96.88	32.29	64.59	0.32	0.00439	5.92	8.34	1.033	0.571
20-Mar-92			4	9786304.492	2754.84	3963.45	3875.38	88.08	29.36	58.72	0.29	0.00399	5.38	7.58	0.939	0.519
21-Mar-92			3.5	8563016.4305	2410.49	3468.02	3390.95	77.07	25.69	51.38	0.26	0.00349	4.71	6.64	0.822	0.454
22-Mar-92			3.6	8807674.0428	2479.36	3567.11	3487.84	79.27	26.42	52.85	0.26	0.00359	4.84	6.83	0.846	0.467
23-Mar-92	1530	site 7	3.4	8318358.8182	2345.78	3252.48	3185.93	66.55	33.27	33.27	0.17	0.00444	4.16	5.24	0.882	0.441
24-Mar-92			3.9	9541646.8797	2738.45	3845.28	3735.55	109.73	57.25	52.48	0.19	0.01239	4.29	6.39	0.868	0.444
25-Mar-92			4.4	10764934.941	3089.54	4338.27	4214.47	123.80	64.59	59.21	0.22	0.01398	4.84	7.21	0.980	0.501
26-Mar-92			4.4	10764934.941	3089.54	4338.27	4214.47	123.80	64.59	59.21	0.22	0.01398	4.84	7.21	0.980	0.501
27-Mar-92			4.5	11009592.554	3159.75	4436.87	4310.26	126.61	66.06	60.55	0.22	0.01430	4.95	7.38	1.002	0.512
28-Mar-92			4.5	11009592.554	3159.75	4436.87	4310.26	126.61	66.06	60.55	0.22	0.01430	4.95	7.38	1.002	0.512
29-Mar-92			4.4	10764934.941	3089.54	4338.27	4214.47	123.80	64.59	59.21	0.22	0.01398	4.84	7.21	0.980	0.501
30-Mar-92			4.1	10030962.104	2878.89	4042.48	3927.12	115.36	60.19	55.17	0.20	0.01303	4.51	6.72	0.913	0.466
31-Mar-92			4.2	10275619.717	2949.10	4141.07	4022.91	118.17	61.65	56.52	0.21	0.01334	4.62	6.88	0.935	0.478
01-Apr-92			4	9786304.492	2808.67	3943.88	3831.34	112.54	58.72	53.82	0.20	0.01271	4.40	6.56	0.891	0.455
02-Apr-92	1045	site 7	4	9786304.492	2857.60	4061.32	3914.52	146.79	78.29	68.50	0.20	0.02019	3.91	6.95	0.744	0.391
03-Apr-92			3.6	8807674.0428	2646.71	3897.40	3765.28	132.12	83.67	48.44	0.18	0.01010	2.64	7.09	0.612	0.321

04-Apr-92			3.4	8318358.8182	2499.67	3680.87	3556.10	124.78	79.02	45.75	0.17	0.00954	2.50	6.70	0.578	0.304
05-Apr-92			3.2	7829043.5936	2352.63	3464.35	3346.92	117.44	74.38	43.06	0.16	0.00898	2.35	6.30	0.544	0.286
06-Apr-92			3.7	9052331.6551	2720.23	4005.66	3869.87	135.78	86.00	49.79	0.18	0.01038	2.72	7.29	0.629	0.330
07-Apr-92			4.4	10764934.941	3234.86	4763.48	4602.01	161.47	102.27	59.21	0.22	0.01235	3.23	8.67	0.748	0.393
08-Apr-92			5.3	12966853.452	3896.54	5737.83	5543.33	194.50	123.19	71.32	0.26	0.01488	3.89	10.44	0.901	0.473
09-Apr-92			6.3	15413429.575	4631.74	6820.44	6589.24	231.20	146.43	84.77	0.31	0.01768	4.62	12.41	1.071	0.563
10-Apr-92			6.8	16636717.636	4999.33	7361.75	7112.20	249.55	158.05	91.50	0.33	0.01909	4.99	13.39	1.156	0.607
11-Apr-92			7.1	17370690.473	5219.89	7686.53	7425.97	260.56	165.02	95.54	0.35	0.01993	5.21	13.98	1.207	0.634
12-Apr-92			7.1	17370690.473	5219.89	7686.53	7425.97	260.56	165.02	95.54	0.35	0.01993	5.21	13.98	1.207	0.634
13-Apr-92			8.4	20551239.433	6175.65	9093.92	8785.65	308.27	195.24	113.03	0.41	0.02358	6.17	16.54	1.428	0.750
14-Apr-92			7.2	17615348.086	5293.41	7794.79	7530.56	264.23	167.35	96.88	0.35	0.02021	5.28	14.18	1.224	0.643
15-Apr-92			6.8	16636717.636	4999.33	7361.75	7112.20	249.55	158.05	91.50	0.33	0.01909	4.99	13.39	1.156	0.607
16-Apr-92			7.2	17615348.086	5293.41	7794.79	7530.56	264.23	167.35	96.88	0.35	0.02021	5.28	14.18	1.224	0.643
17-Apr-92			7.4	18104663.31	5440.45	8011.31	7739.74	271.57	171.99	99.58	0.36	0.02077	5.43	14.57	1.258	0.661
18-Apr-92			10	24465761.23	7351.96	10826.10	10459.11	366.99	232.42	134.56	0.49	0.02807	7.34	19.69	1.700	0.893
19-Apr-92			23	56271250.829	16909.51	24900.03	24055.96	844.07	534.58	309.49	1.13	0.06456	16.88	45.30	3.911	2.054
20-Apr-92			25	61164403.075	18379.90	27065.25	26147.78	917.47	581.06	336.40	1.22	0.07017	18.35	49.24	4.251	2.233
21-Apr-92			18	44038370.214	13233.53	19486.98	18826.40	660.58	418.36	242.21	0.88	0.05052	13.21	35.45	3.061	1.607
22-Apr-92			19	46484946.337	13968.73	20569.59	19872.31	697.27	441.61	255.67	0.93	0.05333	13.95	37.42	3.231	1.697
23-Apr-92	1445	site 7	19	46484946.337	14363.85	21847.92	21150.65	697.27	511.33	185.94	0.93	0.01074	9.30	41.84	2.929	1.534
24-Apr-92			21	51378098.583	12767.46	21142.09	20191.59	950.49	333.96	616.54	2.06	0.04196	17.98	43.93	13.821	9.633
25-Apr-92			21	51378098.583	12767.46	21142.09	20191.59	950.49	333.96	616.54	2.06	0.04196	17.98	43.93	13.821	9.633
26-Apr-92			19	46484946.337	11551.51	19128.56	18268.58	859.97	302.15	557.82	1.86	0.03796	16.27	39.74	12.504	8.716
27-Apr-92			16	39145217.968	9727.59	16108.26	15384.07	724.19	254.44	469.74	1.57	0.03197	13.70	33.47	10.530	7.340
28-Apr-92			25	61164403.075	15199.35	25169.15	24037.61	1131.54	397.57	733.97	2.45	0.04995	21.41	52.30	16.453	11.468
29-Apr-92			24	58717826.952	14591.38	24162.39	23076.11	1086.28	381.67	704.61	2.35	0.04795	20.55	50.20	15.795	11.010
30-Apr-92			20	48931522.46	12159.48	20135.32	19230.09	905.23	318.05	587.18	1.96	0.03996	17.13	41.84	13.163	9.175
01-May-92			18	44038370.214	10943.53	18121.79	17307.08	814.71	286.25	528.46	1.76	0.03596	15.41	37.65	11.846	8.257
02-May-92			16	39145217.968	9727.59	16108.26	15384.07	724.19	254.44	469.74	1.57	0.03197	13.70	33.47	10.530	7.340
03-May-92			14	34252065.722	8511.64	14094.73	13461.06	633.66	222.64	411.02	1.37	0.02797	11.99	29.29	9.214	6.422
04-May-92			13	31805489.599	7903.66	13087.96	12499.56	588.40	206.74	381.67	1.27	0.02597	11.13	27.19	8.556	5.964
05-May-92			11	26912337.353	6687.72	11074.43	10576.55	497.88	174.93	322.95	1.08	0.02198	9.42	23.01	7.239	5.046
06-May-92			10	24465761.23	6079.74	10067.66	9615.04	452.62	159.03	293.59	0.98	0.01998	8.56	20.92	6.581	4.587
07-May-92			8.7	21285212.27	5289.38	8758.86	8365.09	393.78	138.35	255.42	0.85	0.01738	7.45	18.20	5.726	3.991
08-May-92			7.2	17615348.086	4377.41	7248.72	6922.83	325.88	114.50	211.38	0.70	0.01439	6.17	15.06	4.739	3.303
09-May-92			5.9	14434799.126	3587.05	5939.92	5672.88	267.04	93.83	173.22	0.58	0.01179	5.05	12.34	3.883	2.707
10-May-92			4.5	11009592.554	2735.88	4530.45	4326.77	203.68	71.56	132.12	0.44	0.00899	3.85	9.41	2.962	2.064
11-May-92			3.8	9296989.2674	2310.30	3825.71	3653.72	171.99	60.43	111.56	0.37	0.00759	3.25	7.95	2.501	1.743
12-May-92			2.9	7095070.7567	1763.13	2919.62	2788.36	131.26	46.12	85.14	0.28	0.00579	2.48	6.07	1.909	1.330
13-May-92			2.2	5382467.4706	1337.54	2214.89	2115.31	99.58	34.99	64.59	0.22	0.00440	1.88	4.60	1.448	1.009
14-May-92			1.8	4403837.0214	1094.35	1812.18	1730.71	81.47	28.62	52.85	0.18	0.00360	1.54	3.77	1.185	0.826
15-May-92			1.5	3669864.1845	911.96	1510.15	1442.26	67.89	23.85	44.04	0.15	0.00300	1.28	3.14	0.987	0.688
16-May-92			1.6	3914521.7968	972.76	1610.83	1538.41	72.42	25.44	46.97	0.16	0.00320	1.37	3.35	1.053	0.734
17-May-92			1.8	4403837.0214	1094.35	1812.18	1730.71	81.47	28.62	52.85	0.18	0.00360	1.54	3.77	1.185	0.826

18-May-92			1.4	3425206.5722	851.16	1409.47	1346.11	63.37	22.26	41.10	0.14	0.00280	1.20	2.93	0.921	0.642
19-May-92			1.1	2691233.7353	668.77	1107.44	1057.65	49.79	17.49	32.29	0.11	0.00220	0.94	2.30	0.724	0.505
20-May-92			0.92	2250850.0332	559.34	926.22	884.58	41.64	14.63	27.01	0.09	0.00184	0.79	1.92	0.605	0.422
21-May-92			0.8	1957260.8984	486.38	805.41	769.20	36.21	12.72	23.49	0.08	0.00160	0.69	1.67	0.527	0.367
22-May-92			0.78	1908329.3759	474.22	785.28	749.97	35.30	12.40	22.90	0.08	0.00156	0.67	1.63	0.513	0.358
23-May-92			0.74	1810466.331	449.90	745.01	711.51	33.49	11.77	21.73	0.07	0.00148	0.63	1.55	0.487	0.339
24-May-92			0.65	1590274.48	395.18	654.40	624.98	29.42	10.34	19.08	0.06	0.00130	0.56	1.36	0.428	0.298
25-May-92			0.74	1810466.331	449.90	745.01	711.51	33.49	11.77	21.73	0.07	0.00148	0.63	1.55	0.487	0.339
26-May-92			0.79	1932795.1372	480.30	795.35	759.59	35.76	12.56	23.19	0.08	0.00158	0.68	1.65	0.520	0.362
27-May-92			0.81	1981726.6596	492.46	815.48	778.82	36.66	12.88	23.78	0.08	0.00162	0.69	1.69	0.533	0.372
28-May-92			0.77	1883863.6147	468.14	775.21	740.36	34.85	12.25	22.61	0.08	0.00154	0.66	1.61	0.507	0.353
29-May-92			0.66	1614740.2412	401.26	664.47	634.59	29.87	10.50	19.38	0.06	0.00132	0.57	1.38	0.434	0.303
30-May-92			0.62	1516877.1963	376.94	624.19	596.13	28.06	9.86	18.20	0.06	0.00124	0.53	1.30	0.408	0.284
31-May-92			0.58	1419014.1513	352.63	583.92	557.67	26.25	9.22	17.03	0.06	0.00116	0.50	1.21	0.382	0.266
01-Jun-92			0.54	1321151.1064	328.31	543.65	519.21	24.44	8.59	15.85	0.05	0.00108	0.46	1.13	0.355	0.248
02-Jun-92			0.54	1321151.1064	328.31	543.65	519.21	24.44	8.59	15.85	0.05	0.00108	0.46	1.13	0.355	0.248
03-Jun-92			0.53	1296685.3452	322.23	533.59	509.60	23.99	8.43	15.56	0.05	0.00106	0.45	1.11	0.349	0.243
04-Jun-92			0.54	1321151.1064	328.31	543.65	519.21	24.44	8.59	15.85	0.05	0.00108	0.46	1.13	0.355	0.248
05-Jun-92			0.51	1247753.8227	310.07	513.45	490.37	23.08	8.11	14.97	0.05	0.00102	0.44	1.07	0.336	0.234
06-Jun-92			0.52	1272219.584	316.15	523.52	499.98	23.54	8.27	15.27	0.05	0.00104	0.45	1.09	0.342	0.239
07-Jun-92			0.61	1492411.435	370.86	614.13	586.52	27.61	9.70	17.91	0.06	0.00122	0.52	1.28	0.401	0.280
08-Jun-92			0.82	2006192.4209	498.54	825.55	788.43	37.11	13.04	24.07	0.08	0.00164	0.70	1.72	0.540	0.376
09-Jun-92			0.84	2055123.9433	510.70	845.68	807.66	38.02	13.36	24.66	0.08	0.00168	0.72	1.76	0.553	0.385
10-Jun-92			0.79	1932795.1372	480.30	795.35	759.59	35.76	12.56	23.19	0.08	0.00158	0.68	1.65	0.520	0.362
11-Jun-92			0.79	1932795.1372	480.30	795.35	759.59	35.76	12.56	23.19	0.08	0.00158	0.68	1.65	0.520	0.362
12-Jun-92			0.75	1834932.0923	455.98	755.07	721.13	33.95	11.93	22.02	0.08	0.00158	0.68	1.65	0.520	0.362
13-Jun-92			0.73	1786000.5698	443.82	734.94	701.90	33.04	11.61	21.43	0.07	0.00150	0.64	1.57	0.494	0.344
14-Jun-92			0.69	1688137.5249	419.50	694.67	663.44	31.23	10.97	20.26	0.07	0.00146	0.63	1.53	0.480	0.335
15-Jun-92			1	2446576.123	607.97	1006.77	961.50	45.26	15.90	29.36	0.07	0.00138	0.59	1.44	0.454	0.317
16-Jun-92			8.4	20551239.433	5106.98	8456.84	8076.64	380.20	133.58	246.61	0.10	0.00200	0.86	2.09	0.658	0.459
17-Jun-92	1330	site 7	19	46484946.337	8739.17	16409.19	15386.52	1022.67	92.97	929.70	0.82	0.01678	7.19	17.57	5.528	3.853
18-Jun-92	945	site 7	51	124775382.27	25454.18	47664.20	43920.93	3743.26	1497.30	2245.96	2.79	0.06519	23.24	37.65	22.080	15.898
19-Jun-92	1130	site 7	62	151687719.63	30337.54	58096.40	53697.45	4398.94	1061.81	3337.13	12.48	1.37475	49.91	169.69	57.147	44.794
20-Jun-92	930	site 7	64	156580871.87	26149.01	50888.78	44938.71	5950.07	1409.23	4540.85	16.69	0.17365	91.01	286.69	74.479	56.883
21-Jun-92			39	95416468.797	14264.76	26525.78	23090.79	3434.99	1049.58	2385.41	15.66	0.19669	62.63	230.17	70.148	49.949
22-Jun-92			39	95416468.797	14264.76	26525.78	23090.79	3434.99	1049.58	2385.41	5.72	0.06536	42.94	116.89	42.269	29.484
23-Jun-92			37	90523316.551	13533.24	25165.48	21906.64	3258.84	995.76	2263.08	5.72	0.06536	42.94	116.89	42.269	29.484
24-Jun-92			29	70950707.567	10607.13	19724.30	17170.07	2554.23	780.46	1773.77	5.43	0.06200	40.74	110.89	40.102	27.972
25-Jun-92			21	51378098.583	7681.03	14283.11	12433.50	1849.61	565.16	1284.45	4.26	0.04860	31.93	86.91	31.431	21.924
26-Jun-92			16	39145217.968	5852.21	10882.37	9473.14	1409.23	430.60	978.63	3.08	0.03519	23.12	62.94	22.760	15.876
27-Jun-92			12	29358913.476	4389.16	8161.78	7104.86	1056.92	322.95	733.97	2.35	0.02681	17.62	47.95	17.341	12.096
28-Jun-92			9.4	22997815.556	3438.17	6393.39	5565.47	827.92	252.98	574.95	1.76	0.02011	13.21	35.96	13.006	9.072
29-Jun-92			6.3	15413429.575	2304.31	4284.93	3730.05	554.88	169.55	385.34	1.38	0.01575	10.35	28.17	10.188	7.106
30-Jun-92			60	146794567.38	21945.79	40808.89	35524.29	5284.60	1614.74	3669.86	0.92	0.01056	6.94	18.88	6.828	4.763

01-Jul-92	1500	site 7	132	322948048.24	42629.14	74601.00	63620.77	10980.23	4198.32	6781.91	6.46	0.03674	161.47	316.49	141.451	96.561
02-Jul-92	1300	site 7	45	110095925.54	18826.40	32698.49	28294.65	4403.84	1100.96	3302.88	6.61	0.08106	44.04	156.34	44.259	33.249
03-Jul-92			22	53824674.706	12218.20	20264.99	18596.43	1668.56	565.16	1103.41	2.15	0.06183	37.68	83.16	17.601	10.630
04-Jul-92			16	39145217.968	8885.96	14738.17	13524.67	1213.50	411.02	802.48	1.57	0.04497	27.40	60.48	12.800	7.731
05-Jul-92			19	46484946.337	10552.08	17501.58	16060.55	1441.03	488.09	952.94	1.86	0.05340	32.54	71.82	15.201	9.181
06-Jul-92			19	46484946.337	10552.08	17501.58	16060.55	1441.03	488.09	952.94	1.86	0.05340	32.54	71.82	15.201	9.181
07-Jul-92			16	39145217.968	8885.96	14738.17	13524.67	1213.50	411.02	802.48	1.57	0.04497	27.40	60.48	12.800	7.731
08-Jul-92			13	31805489.599	7219.85	11974.77	10988.80	985.97	333.96	652.01	1.27	0.03654	22.26	49.14	10.400	6.282
09-Jul-92			9.9	24221103.618	5498.19	9119.25	8368.39	750.85	254.32	496.53	0.97	0.02782	16.95	37.42	7.920	4.784
10-Jul-92			58	141901415.13	32211.62	53425.88	49026.94	4398.94	1489.96	2908.98	5.68	0.16301	99.33	219.24	46.402	28.026
11-Jul-92			31	75843859.813	17216.56	28555.21	26204.05	2351.16	796.36	1554.80	3.03	0.08713	53.09	117.18	24.801	14.979
12-Jul-92			17	41591794.091	9441.34	15659.31	14369.96	1289.35	436.71	852.63	1.66	0.04778	29.11	64.26	13.601	8.214
13-Jul-92			13	31805489.599	7219.85	11974.77	10988.80	985.97	333.96	652.01	1.27	0.03654	22.26	49.14	10.400	6.282
14-Jul-92			8.3	20306581.821	4609.59	7645.43	7015.92	629.50	213.22	416.28	0.81	0.02333	14.21	31.37	6.640	4.011
15-Jul-92			6.8	16636717.636	3776.53	6263.72	5747.99	515.74	174.69	341.05	0.67	0.01911	11.65	25.70	5.440	3.286
16-Jul-92			6.7	16392060.024	3721.00	6171.61	5663.46	508.15	172.12	336.04	0.66	0.01883	11.47	25.33	5.360	3.237
17-Jul-92			5.5	13456168.677	3054.55	5066.25	4649.11	417.14	141.29	275.85	0.54	0.01546	9.42	20.79	4.400	2.658
18-Jul-92			4.7	11498907.778	2610.25	4329.34	3972.87	356.47	120.74	235.73	0.46	0.01321	8.05	17.77	3.760	2.271
19-Jul-92			4.1	10030962.104	2277.03	3776.66	3465.70	310.96	105.33	205.63	0.40	0.01152	7.02	15.50	3.280	1.981
20-Jul-92			3.1	7584385.9813	1721.66	2855.52	2620.41	235.12	79.64	155.48	0.30	0.00871	5.31	11.72	2.480	1.498
21-Jul-92			2.7	6605755.5321	1499.51	2487.07	2282.29	204.78	69.36	135.42	0.26	0.00759	4.62	10.21	2.160	1.305
22-Jul-92			3.1	7584385.9813	1721.66	2855.52	2620.41	235.12	79.64	155.48	0.30	0.00871	5.31	11.72	2.480	1.498
23-Jul-92			3.3	8073701.2059	1832.73	3039.75	2789.46	250.28	84.77	165.51	0.32	0.00927	5.65	12.47	2.640	1.595
24-Jul-92			3.1	7584385.9813	1721.66	2855.52	2620.41	235.12	79.64	155.48	0.30	0.00871	5.31	11.72	2.480	1.498
25-Jul-92			2.6	6361097.9198	1443.97	2394.95	2197.76	197.19	66.79	130.40	0.25	0.00731	4.45	9.83	2.080	1.256
26-Jul-92			2.3	5627125.0829	1277.36	2118.61	1944.17	174.44	59.08	115.36	0.23	0.00646	3.94	8.69	1.840	1.111
27-Jul-92			2.1	5137809.8583	1166.28	1934.39	1775.11	159.27	53.95	105.33	0.21	0.00590	3.60	7.94	1.680	1.015
28-Jul-92			1.7	4159179.4091	944.13	1565.93	1437.00	128.93	43.67	85.26	0.17	0.00478	2.91	6.43	1.360	0.821
29-Jul-92			1.3	3180548.9599	721.98	1197.48	1098.88	98.60	33.40	65.20	0.13	0.00365	2.23	4.91	1.040	0.628
30-Jul-92			1.2	2935891.3476	666.45	1105.36	1014.35	91.01	30.83	60.19	0.12	0.00337	2.06	4.54	0.960	0.580
31-Jul-92			1.1	2691233.7353	610.91	1013.25	929.82	83.43	28.26	55.17	0.11	0.00309	1.88	4.16	0.880	0.532
01-Aug-92			0.99	2422110.3618	549.82	911.92	836.84	75.09	25.43	49.65	0.10	0.00278	1.70	3.74	0.792	0.478
02-Aug-92			0.92	2250850.0332	510.94	847.45	777.67	69.78	23.63	46.14	0.09	0.00259	1.58	3.48	0.736	0.445
03-Aug-92			0.79	1932795.1372	438.74	727.70	667.78	59.92	20.29	39.62	0.08	0.00222	1.35	2.99	0.632	0.382
04-Aug-92			0.7	1712603.2861	388.76	644.80	591.70	53.09	17.98	35.11	0.07	0.00197	1.20	2.65	0.560	0.338
05-Aug-92			0.66	1614740.2412	366.55	607.95	557.89	50.06	16.95	33.10	0.06	0.00185	1.13	2.49	0.528	0.319
06-Aug-92			0.68	1663671.7636	377.65	626.37	574.80	51.57	17.47	34.11	0.07	0.00191	1.16	2.57	0.544	0.329
07-Aug-92			0.64	1565808.7187	355.44	589.53	540.99	48.54	16.44	32.10	0.06	0.00180	1.10	2.42	0.512	0.309
08-Aug-92			0.62	1516877.1963	344.33	571.10	524.08	47.02	15.93	31.10	0.06	0.00174	1.06	2.34	0.496	0.300
09-Aug-92			0.56	1370082.6289	311.01	515.84	473.36	42.47	14.39	28.09	0.05	0.00157	0.96	2.12	0.448	0.271
10-Aug-92			0.48	1174356.539	266.58	442.15	405.74	36.41	12.33	24.07	0.05	0.00135	0.82	1.81	0.384	0.232
11-Aug-92			0.43	1052027.7329	238.81	396.09	363.48	32.61	11.05	21.57	0.04	0.00121	0.74	1.63	0.344	0.208
12-Aug-92			0.42	1027561.9717	233.26	386.88	355.02	31.85	10.79	21.07	0.04	0.00118	0.72	1.59	0.336	0.203
13-Aug-92			0.4	978630.4492	222.15	368.45	338.12	30.34	10.28	20.06	0.04	0.00112	0.69	1.51	0.320	0.193

14-Aug-92			0.37	905233.16551	205.49	340.82	312.76	28.06	9.50	18.56	0.04	0.00104	0.63	1.40	0.296	0.179
15-Aug-92			0.32	782904.35936	177.72	294.76	270.49	24.27	8.22	16.05	0.03	0.00090	0.55	1.21	0.256	0.155
16-Aug-92			0.31	758438.59813	172.17	285.55	262.04	23.51	7.96	15.55	0.03	0.00087	0.53	1.17	0.248	0.150
17-Aug-92			0.28	685041.31444	155.50	257.92	236.68	21.24	7.19	14.04	0.03	0.00079	0.48	1.06	0.224	0.135
18-Aug-92			0.28	685041.31444	155.50	257.92	236.68	21.24	7.19	14.04	0.03	0.00079	0.48	1.06	0.224	0.135
19-Aug-92			0.27	660575.55321	149.95	248.71	228.23	20.48	6.94	13.54	0.03	0.00076	0.46	1.02	0.216	0.130
20-Aug-92			0.27	660575.55321	149.95	248.71	228.23	20.48	6.94	13.54	0.03	0.00076	0.46	1.02	0.216	0.130
21-Aug-92			0.27	660575.55321	149.95	248.71	228.23	20.48	6.94	13.54	0.03	0.00076	0.46	1.02	0.216	0.130
22-Aug-92			0.28	685041.31444	155.50	257.92	236.68	21.24	7.19	14.04	0.03	0.00079	0.48	1.06	0.224	0.135
23-Aug-92			0.27	660575.55321	149.95	248.71	228.23	20.48	6.94	13.54	0.03	0.00076	0.46	1.02	0.216	0.130
24-Aug-92			0.3	733972.8369	166.61	276.34	253.59	22.75	7.71	15.05	0.03	0.00084	0.51	1.13	0.240	0.145
25-Aug-92			0.34	831835.88182	188.83	313.19	287.40	25.79	8.73	17.05	0.03	0.00096	0.58	1.29	0.272	0.164
26-Aug-92			0.34	831835.88182	188.83	313.19	287.40	25.79	8.73	17.05	0.03	0.00096	0.58	1.29	0.272	0.164
27-Aug-92			0.36	880767.40428	199.93	331.61	304.31	27.30	9.25	18.06	0.04	0.00101	0.62	1.36	0.288	0.174
28-Aug-92			0.32	782904.35936	177.72	294.76	270.49	24.27	8.22	16.05	0.03	0.00090	0.55	1.21	0.256	0.155
29-Aug-92			0.26	636109.79198	144.40	239.50	219.78	19.72	6.68	13.04	0.03	0.00073	0.45	0.98	0.208	0.126
30-Aug-92			0.23	562712.50829	127.74	211.86	194.42	17.44	5.91	11.54	0.02	0.00065	0.39	0.87	0.184	0.111
31-Aug-92			0.22	538246.74706	122.18	202.65	185.96	16.69	5.65	11.03	0.02	0.00062	0.38	0.83	0.176	0.106
01-Sep-92			0.49	1198822.3003	272.13	451.36	414.19	37.16	12.59	24.58	0.05	0.00138	0.84	1.85	0.392	0.237
02-Sep-92			1.2	2935891.3476	666.45	1105.36	1014.35	91.01	30.83	60.19	0.12	0.00337	2.06	4.54	0.960	0.580
03-Sep-92	1500	site 7	0.66	1614740.2412	456.97	736.32	700.80	35.52	17.76	17.76	0.03	0.00252	1.61	2.70	0.407	0.150
04-Sep-92			0.48	1174356.539	266.58	442.15	418.07	24.07	10.57	13.51	0.02	0.00097	0.82	1.48	0.213	0.076
05-Sep-92			0.66	1614740.2412	366.55	607.95	574.85	33.10	14.53	18.57	0.03	0.00133	1.13	2.03	0.292	0.105
06-Sep-92			0.74	1810466.331	410.98	681.64	644.53	37.11	16.29	20.82	0.04	0.00149	1.27	2.28	0.328	0.118
07-Sep-92			2.6	6361097.9198	1443.97	2394.95	2264.55	130.40	57.25	73.15	0.13	0.00524	4.45	8.01	1.151	0.413
08-Sep-92			3.1	7584385.9813	1721.66	2855.52	2700.04	155.48	68.26	87.22	0.15	0.00624	5.31	9.56	1.373	0.493
09-Sep-92			5	12232880.615	2776.86	4605.68	4354.91	250.77	110.10	140.68	0.24	0.01007	8.56	15.41	2.214	0.795
10-Sep-92			4.9	11988223.003	2721.33	4513.57	4267.81	245.76	107.89	137.86	0.24	0.00889	8.39	15.11	2.170	0.779
11-Sep-92			3.2	7829043.5936	1777.19	2947.63	2787.14	160.50	70.46	90.03	0.16	0.00581	5.48	9.86	1.417	0.509
12-Sep-92			2	4893152.246	1110.75	1842.27	1741.96	100.31	44.04	56.27	0.10	0.00363	3.43	6.17	0.886	0.318
13-Sep-92			1.4	3425206.5722	777.52	1289.59	1219.37	70.22	30.83	39.39	0.07	0.00254	2.40	4.32	0.620	0.223
14-Sep-92			1	2446576.123	555.37	921.14	870.98	50.15	22.02	28.14	0.05	0.00169	1.71	3.08	0.443	0.159
15-Sep-92			0.84	2055123.9433	466.51	773.75	731.62	42.13	18.50	23.63	0.04	0.00142	1.44	2.59	0.372	0.134
16-Sep-92			0.82	2006192.4209	455.41	755.33	714.20	41.13	18.06	23.07	0.04	0.00129	1.40	2.53	0.363	0.130
17-Sep-92			0.74	1810466.331	410.98	681.64	644.53	37.11	16.29	20.82	0.04	0.00125	1.27	2.28	0.328	0.118
18-Sep-92			0.68	1663671.7636	377.65	626.37	592.27	34.11	14.97	19.13	0.03	0.00115	1.16	2.10	0.301	0.108
19-Sep-92			0.63	1541342.9575	349.88	580.32	548.72	31.60	13.87	17.73	0.03	0.00107	1.08	1.94	0.279	0.100
20-Sep-92			0.57	1394548.3901	316.56	525.05	496.46	28.59	12.55	16.04	0.03	0.00090	0.98	1.76	0.252	0.091
21-Sep-92			0.57	1394548.3901	316.56	525.05	496.46	28.59	12.55	16.04	0.03	0.00090	0.98	1.76	0.252	0.091
22-Sep-92			0.51	1247753.8227	283.24	469.78	444.20	25.58	11.23	14.35	0.02	0.00080	0.87	1.57	0.226	0.081
23-Sep-92			0.52	1272219.584	288.79	478.99	452.91	26.08	11.45	14.63	0.03	0.00082	0.89	1.60	0.230	0.083
24-Sep-92			0.47	1149890.7778	261.03	432.93	409.36	23.57	10.35	13.22	0.02	0.00069	0.80	1.45	0.208	0.075
25-Sep-92			0.43	1052027.7329	238.81	396.09	374.52	21.57	9.47	12.10	0.02	0.00063	0.74	1.33	0.190	0.068
26-Sep-92			0.43	1052027.7329	238.81	396.09	374.52	21.57	9.47	12.10	0.02	0.00063	0.74	1.33	0.190	0.068

27-Sep-92	0.39	954164.68797	216.60	359.24	339.68	19.56	8.59	10.97	0.02	0.00057	0.67	1.20	0.173	0.062
28-Sep-92	0.38	929698.92674	211.04	350.03	330.97	19.06	8.37	10.69	0.02	0.00056	0.65	1.17	0.168	0.060
29-Sep-92	0.39	954164.68797	216.60	359.24	339.68	19.56	8.59	10.97	0.02	0.00053	0.67	1.20	0.173	0.062
30-Sep-92	0.41	1003096.2104	227.70	377.67	357.10	20.56	9.03	11.54	0.02	0.00056	0.70	1.26	0.182	0.065
01-Oct-92	0.42	1027561.9717	233.26	386.88	365.81	21.07	9.25	11.82	0.02	0.00057	0.72	1.29	0.186	0.067
02-Oct-92	0.42	1027561.9717	233.26	386.88	365.81	21.07	9.25	11.82	0.02	0.00057	0.72	1.29	0.186	0.067
03-Oct-92	1.2	2935891.3476	666.45	1105.36	1045.18	60.19	26.42	33.76	0.06	0.00164	2.06	3.70	0.531	0.191
04-Oct-92	4.8	11743565.39	2665.79	4421.45	4180.71	240.74	105.69	135.05	0.23	0.00634	8.22	14.80	2.126	0.763
05-Oct-92	2.3	5627125.0829	1277.36	2118.61	2003.26	115.36	50.64	64.71	0.11	0.00303	3.94	7.09	1.019	0.366
06-Oct-92	1.22	2984822.8701	677.55	1123.79	1062.60	61.19	26.86	34.33	0.06	0.00155	2.09	3.76	0.540	0.194
07-Oct-92	0.97	2373178.8393	538.71	893.50	844.85	48.65	21.36	27.29	0.05	0.00123	1.66	2.99	0.430	0.154
08-Oct-92	0.83	2030658.1821	460.96	764.54	722.91	41.63	18.28	23.35	0.04	0.00105	1.42	2.56	0.368	0.132
09-Oct-92	0.7	1712603.2861	388.76	644.80	609.69	35.11	15.41	19.69	0.03	0.00083	1.20	2.16	0.310	0.111
10-Oct-92	0.63	1541342.9575	349.88	580.32	548.72	31.60	13.87	17.73	0.03	0.00074	1.08	1.94	0.279	0.100
11-Oct-92	0.58	1419014.1513	322.12	534.26	505.17	29.09	12.77	16.32	0.03	0.00068	0.99	1.79	0.257	0.092
12-Oct-92	0.51	1247753.8227	283.24	469.78	444.20	25.58	11.23	14.35	0.02	0.00060	0.87	1.57	0.226	0.081
13-Oct-92	0.51	1247753.8227	283.24	469.78	444.20	25.58	11.23	14.35	0.02	0.00060	0.87	1.57	0.226	0.081
14-Oct-92	0.5	1223288.0615	277.69	460.57	435.49	25.08	11.01	14.07	0.02	0.00055	0.86	1.54	0.221	0.080
15-Oct-92	0.47	1149890.7778	261.03	432.93	409.36	23.57	10.35	13.22	0.02	0.00051	0.80	1.45	0.208	0.075
16-Oct-92	0.47	1149890.7778	261.03	432.93	409.36	23.57	10.35	13.22	0.02	0.00055	0.80	1.45	0.208	0.075
17-Oct-92	0.5	1223288.0615	277.69	460.57	435.49	25.08	11.01	14.07	0.02	0.00059	0.86	1.54	0.221	0.080
18-Oct-92	0.51	1247753.8227	283.24	469.78	444.20	25.58	11.23	14.35	0.02	0.00060	0.87	1.57	0.226	0.081
19-Oct-92	0.51	1247753.8227	283.24	469.78	444.20	25.58	11.23	14.35	0.02	0.00056	0.87	1.57	0.226	0.081
20-Oct-92	0.51	1247753.8227	283.25	469.79	444.21	25.58	11.23	14.35	0.02	0.00056	0.87	1.57	0.226	0.081
21-Oct-92	0.52	1272219.584	288.81	479.01	452.93	26.08	11.45	14.63	0.03	0.00053	0.89	1.60	0.230	0.083
22-Oct-92	0.55	1345616.8677	305.49	506.66	479.08	27.59	12.11	15.47	0.03	0.00056	0.94	1.70	0.244	0.087
23-Oct-92	0.56	1370082.6289	311.07	515.92	487.83	28.09	12.33	15.76	0.03	0.00053	0.96	1.73	0.248	0.089
24-Oct-92	0.56	1370082.6289	311.14	515.99	487.91	28.09	12.33	15.76	0.03	0.00053	0.96	1.73	0.248	0.089
25-Oct-92	0.55	1345616.8677	305.71	506.93	479.35	27.59	12.11	15.47	0.03	0.00052	0.95	1.70	0.244	0.087
26-Oct-92	0.51	1247753.8227	283.71	470.35	444.78	25.58	11.23	14.35	0.02	0.00048	0.88	1.57	0.226	0.081
27-Oct-92	0.52	1272219.584	289.76	480.16	454.08	26.08	11.45	14.63	0.03	0.00046	0.91	1.60	0.230	0.083
28-Oct-92	0.54	1321151.1064	301.90	499.85	472.77	27.08	11.89	15.19	0.03	0.00048	0.97	1.66	0.239	0.086
29-Oct-92	0.54	1321151.1064	303.90	502.29	475.20	27.08	11.89	15.19	0.03	0.00049	1.01	1.66	0.239	0.086
30-Oct-92	0.54	1321151.1064	307.89	507.16	480.07	27.08	11.89	15.19	0.03	0.00050	1.09	1.66	0.239	0.086
31-Oct-92	0.61	1492411.435	356.84	583.91	553.31	30.59	13.43	17.16	0.03	0.00048	1.42	1.88	0.270	0.097
01-Nov-92	0.94	2299781.5556	577.71	933.71	886.57	47.15	20.70	26.45	0.05	0.00083	2.76	2.90	0.416	0.149
02-Nov-92	1.1	2691233.7353	741.17	1172.03	1116.86	55.17	24.22	30.95	0.05	0.00107	4.58	3.39	0.487	0.175
03-Nov-92 1415 site 7	0.91	2226384.2719	596.23	923.95	881.65	42.30	15.58	26.72	0.04	0.00072	5.34	1.89	0.245	0.082
TOTAL LOADS KG/YR L/YR		4811094083	1021455.88	1715464.22	1598803.10	116661.12	43084.07	73577.05	233.75	4.82333	2412.04	5902.28	1401.331	953.216

APPENDIX D. 1993 Tributary Loading Tables

Table D-1. Water Quality Tributary Loadings, 1993

KAMPESKA TRIBUTARY SITE 4 INLET (BIG SIOUX LAKE KAMPESKA INLET)

DATE	TIME	SITE	CUBIC CALC AVG cfs	FLOWS L/DAY	TALKAL KG/DAY	TSOL KG/DAY	TDSOL KG/DAY	TSSOL KG/DAY	AMMONIA KG/DAY	UNIONIZED AMMONIA KG/DAY	NO3+2 KG/DAY	TKN-N KG/DAY	TPO4 KG/DAY	TDPO4 KG/DAY
28-Mar-93	1630	SITE 4	2952	7222292715.10	693340.1	3271699	1321680	1950019	2600.025	7.57527	10111.21	19427.97	4990.604	1942.797
29-Mar-93	1300	SITE 4	1647	4029510874.58	350567.4	834108.8	656810.3	177298.5	1087.968	1.836222	5238.364	10275.25	1752.837	1031.555
30-Mar-93	1745	SITE 4	545	1333383987.04	134671.8	269343.6	242675.9	26667.68	106.6707	0.183344	1466.722	2906.777	402.682	265.3434
31-Mar-93			413	1010435938.80	162680.2	300604.7	286963.8	13640.89	50.5218	0.24441	707.3052	1591.437	475.9153	395.5857
01-Apr-93			312	763331750.38	122896.4	227091.2	216786.2	10304.98	38.16659	0.184639	534.3322	1202.248	359.5293	298.8444
02-Apr-93			0	0.00	0	0	0	0	0	0	0	0	0	0
03-Apr-93			0	0.00	0	0	0	0	0	0	0	0	0	0
04-Apr-93			0	0.00	0	0	0	0	0	0	0	0	0	0
05-Apr-93			0	0.00	0	0	0	0	0	0	0	0	0	0
08-Apr-93			45	110095925.54	27028.55	47671.54	47066.01	605.5276	2.201919	0.043171	22.01919	115.6007	43.98332	38.75377
09-Apr-93			0	0.00	0	0	0	0	0	0	0	0	0	0
10-Apr-93			45	110095925.54	27028.55	47671.54	47066.01	605.5276	2.201919	0.043171	22.01919	115.6007	43.98332	38.75377
13-Apr-93			15	36698641.85	9009.517	15890.51	15688.67	201.8425	0.733973	0.01439	7.339728	38.53357	14.66111	12.91792
14-Apr-93			0	0.00	0	0	0	0	0	0	0	0	0	0
15-Apr-93			20	48931522.46	12012.69	21187.35	20918.23	269.1234	0.97863	0.019187	9.786304	51.3781	19.54814	17.2239
16-Apr-93			25	61164403.08	15015.86	26484.19	26147.78	336.4042	1.223288	0.023984	12.23288	64.22262	24.43518	21.52987
17-Apr-93			0	0.00	0	0	0	0	0	0	0	0	0	0
19-Apr-93			0	0.00	0	0	0	0	0	0	0	0	0	0
27-Apr-93			10	24465761.23	6006.344	10593.67	10459.11	134.5617	0.489315	0.009594	4.893152	25.68905	9.774072	8.611948
08-May-93			15	36698641.85	9009.517	15890.51	15688.67	201.8425	0.733973	0.01439	7.339728	38.53357	14.66111	12.91792
09-May-93			0	0.00	0	0	0	0	0	0	0	0	0	0
10-May-93	1745	SITE 4	0	0.00	0	0	0	0	0	0	0	0	0	0
TOTAL LOADS KG/YR L/YR			6044	14787106087.41	1569267	5088236	2907950	2180286	3891.915	10.19177	18143.56	35853.24	8152.614	4084.834

Table D-2. Water Quality Tributary Loadings, 1993

SAMPLE DATA FOR SITE 4 OUTLET (BIG SIOUX RIVER LAKE KAMPESKA OUTLET), 1993

DATE	TIME	SITE	CUBIC CALC AVG CFS	FLOWS L/DAY	TALKAL KG/DAY	TSOL KG/DAY	TDSOL KG/DAY	TSSOL KG/DAY	AMMON KG/DAY	UNIONIZED AMMONIA KG/DAY	NO3+2 KG/DAY	TKN-N KG/DAY	TPO4 KG/DAY	TDPO4 KG/DAY
06-Apr-93			39	95416468.80	15362.05	28386.40	27098.28	1288.12	4.77	0.02308	66.79	150.28	44.941	37.356
07-Apr-93	1715	SITE 4	12	29358913.48	6488.32	11538.05	11332.54	205.51	0.59	0.01017	8.81	28.48	18.790	17.146
11-Apr-93			14	34252065.72	8408.88	14831.14	14642.76	188.39	0.69	0.01343	6.85	35.96	13.684	12.057
12-Apr-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
18-Apr-93			30	73397283.69	18019.03	31781.02	31377.34	403.69	1.47	0.02878	14.68	77.07	29.322	25.836
20-Apr-93			20	48931522.46	12012.69	21187.35	20918.23	269.12	0.98	0.01919	9.79	51.38	19.548	17.224
21-Apr-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
22-Apr-93			5	12232880.62	3003.17	5296.84	5229.56	67.28	0.24	0.00480	2.45	12.84	4.887	4.306
23-Apr-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
24-Apr-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
25-Apr-93			5	12232880.62	3003.17	5296.84	5229.56	67.28	0.24	0.00480	2.45	12.84	4.887	4.306
26-Apr-93			3	7339728.37	1801.90	3178.10	3137.73	40.37	0.15	0.00288	1.47	7.71	2.932	2.584
28-Apr-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
29-Apr-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
30-Apr-93			5	12232880.62	3003.17	5296.84	5229.56	67.28	0.24	0.00480	2.45	12.84	4.887	4.306
01-May-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
02-May-93			15	36698641.85	9009.52	15890.51	15688.67	201.84	0.73	0.01439	7.34	38.53	14.661	12.918
03-May-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
04-May-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
05-May-93			10	24465761.23	6006.34	10593.67	10459.11	134.56	0.49	0.00959	4.89	25.69	9.774	8.612
06-May-93			5	12232880.62	3003.17	5296.84	5229.56	67.28	0.24	0.00480	2.45	12.84	4.887	4.306
07-May-93			3	7339728.37	1801.90	3178.10	3137.73	40.37	0.15	0.00288	1.47	7.71	2.932	2.584
TOTAL LOADS KG/YR L/YR				626323487.49	144980.43	257094.78	252842.63	4252.15	15.39	0.22992	175.91	705.38	264.099	231.046

Table D-3. Water Quality Tributary Loadings, 1993

SAMPLE DATA FOR SITE 5 (MUD CREEK), 1993

DATE	TIME	SITE	CUBIC CALC AVG CFS	FLOWS L/DAY	TALKAL KG/DAY	TSOL KG/DAY	TDSOL KG/DAY	TSSOL KG/DAY	AMMO KG/DA	UNIONIZED AMMONI KG/DAY	NO3+2 KG/DAY	TKN-N KG/DAY	TPO4 KG/DAY	TDPO4 KG/DAY
01-Apr-93	1645	SITE 5	40.00	97863045	18985.43	52356.73	51671.69	685.04	1.96	0.00720	234.87	163.43	14.582	11.352
02-Apr-93			38.62	94486770	20078.44	48660.69	48141.01	519.68	1.89	0.00814	155.90	111.97	10.157	7.653
03-Apr-93			36.75	89911673	19106.23	46304.51	45810.00	494.51	1.80	0.00775	148.35	106.55	9.666	7.283
04-Apr-93			34.23	83746301	17796.09	43129.34	42668.74	460.60	1.67	0.00722	138.18	99.24	9.003	6.783
05-Apr-93			27.30	66791528	14193.20	34397.64	34030.28	367.35	1.34	0.00576	110.21	79.15	7.180	5.410
06-Apr-93			25.10	61409061	13049.43	31625.67	31287.92	337.75	1.23	0.00529	101.32	72.77	6.601	4.974
07-Apr-93	1630	SITE 5	30.69	75085421	17344.73	37167.28	36866.94	300.34	1.50	0.00742	67.58	52.56	4.956	3.454
08-Apr-93			48.61	118928065	29613.09	73140.76	72783.98	356.78	2.38	0.04934	65.41	112.39	7.492	4.876
09-Apr-93			43.00	105202773	26195.49	64699.71	64384.10	315.61	2.10	0.04364	57.86	99.42	6.628	4.313
10-Apr-93			35.08	85825890	21370.65	52782.92	52525.44	257.48	1.72	0.03560	47.20	81.11	5.407	3.519
11-Apr-93			37.93	92798632	23106.86	57071.16	56792.76	278.40	1.86	0.03850	51.04	87.69	5.846	3.805
12-Apr-93			45.00	110095926	27413.89	67708.99	67378.71	330.29	2.20	0.04567	60.55	104.04	6.936	4.514
13-Apr-93			39.89	97593922	24300.89	60020.26	59727.48	292.78	1.95	0.04049	53.68	92.23	6.148	4.001
14-Apr-93			38.49	94168715	23448.01	57913.76	57631.25	282.51	1.88	0.03906	51.79	88.99	5.933	3.861
15-Apr-93			47.41	115992174	28882.05	71335.19	70987.21	347.98	2.32	0.04812	63.80	109.61	7.308	4.756
16-Apr-93			48.00	117435654	29241.48	72222.93	71870.62	352.31	2.35	0.04872	64.59	110.98	7.398	4.815
17-Apr-93			34.70	84896191	21139.15	52211.16	51956.47	254.69	1.70	0.03522	46.69	80.23	5.348	3.481
18-Apr-93			30.05	73519612	18306.38	45214.56	44994.00	220.56	1.47	0.03050	40.44	69.48	4.632	3.014
19-Apr-93			27.15	66424542	16539.71	40851.09	40651.82	199.27	1.33	0.02756	36.53	62.77	4.185	2.723
20-Apr-93			22.50	55047963	13706.94	33854.50	33689.35	165.14	1.10	0.02284	30.28	52.02	3.468	2.257
21-Apr-93			21.00	51378099	12793.15	31597.53	31443.40	154.13	1.03	0.02131	28.26	48.55	3.237	2.107
22-Apr-93			19.98	48882591	12171.77	30062.79	29916.15	146.65	0.98	0.02028	26.89	46.19	3.080	2.004
23-Apr-93			18.59	45481850	11324.98	27971.34	27834.89	136.45	0.91	0.01887	25.02	42.98	2.865	1.865
24-Apr-93			18.10	44283028	11026.47	27234.06	27101.21	132.85	0.89	0.01837	24.36	41.85	2.790	1.816
25-Apr-93			16.60	40613164	10112.68	24977.10	24855.26	121.84	0.81	0.01685	22.34	38.38	2.559	1.665
26-Apr-93			16.00	39145218	9747.16	24074.31	23956.87	117.44	0.78	0.01624	21.53	36.99	2.466	1.605
27-Apr-93			15.10	36943299	9198.88	22720.13	22609.30	110.83	0.74	0.01533	20.32	34.91	2.327	1.515
28-Apr-93			14.00	34252066	8528.76	21065.02	20962.26	102.76	0.69	0.01421	18.84	32.37	2.158	1.404
29-Apr-93			13.25	32417134	8071.87	19936.54	19839.29	97.25	0.65	0.01345	17.83	30.63	2.042	1.329
30-Apr-93			13.00	31805490	7919.57	19560.38	19464.96	95.42	0.64	0.01319	17.49	30.06	2.004	1.304
01-May-93			14.65	35842340	8924.74	22043.04	21935.51	107.53	0.72	0.01487	19.71	33.87	2.258	1.470
02-May-93			15.10	36943299	9198.88	22720.13	22609.30	110.83	0.74	0.01533	20.32	34.91	2.327	1.515
03-May-93			16.15	39512204	9838.54	24300.01	24181.47	118.54	0.79	0.01639	21.73	37.34	2.489	1.620
04-May-93			15.35	37554943	9351.18	23096.29	22983.63	112.66	0.75	0.01558	20.66	35.49	2.366	1.540
05-May-93			13.50	33028778	8224.17	20312.70	20213.61	99.09	0.66	0.01370	18.17	31.21	2.081	1.354
06-May-93			12.80	31316174	7797.73	19259.45	19165.50	93.95	0.63	0.01299	17.22	29.59	1.973	1.284
07-May-93			16.00	39145218	9747.16	24074.31	23956.87	117.44	0.78	0.01624	21.53	36.99	2.466	1.605
08-May-93			24.50	59941115	14925.34	36863.79	36683.96	179.82	1.20	0.02487	32.97	56.64	3.776	2.458
09-May-93			39.00	95416469	23758.70	58681.13	58394.88	286.25	1.91	0.03958	52.48	90.17	6.011	3.912
10-May-93	1700	SITE 5	41.40	101288251	27043.96	74446.86	74244.29	202.58	2.03	0.07403	20.26	120.53	6.077	3.646
TOTAL LOADS L/YR KG/YR				2702414588	653523.81	1617665.73	1608202.38	9463.36	54.05	0.96568	2094.18	2726.28	196.227	133.862

Table D-4. Water Quality Tributary Loadings, 1993

SAMPLE DATA FOR SITE 6 (WEST OF CASINO), 1993

DATE	TIME	SITE	CUBIC CALC AVG cfs	FLOWS L/DAY	TALKAL KG/DAY	TSOL KG/DAY	TDSOL KG/DAY	TSSOL KG/DAY	AMMONI KG/DAY	UNIONIZED AMMONIA KG/DAY	NO3+2 KG/DAY	TKN-N KG/DAY	TPO4 KG/DAY	TDPO4 KG/DAY
28-Mar-93	1800	SITE 6	2830.00	6923810428	588523.89	2000981.21	1447076.38	553904.83	2977.24	8.02169	9000.95	21948.48	4140.439	1841.734
29-Mar-93	1600	SITE 6	1600.00	3914521797	356221.48	755502.71	614579.92	140922.78	704.61	1.46249	4697.43	9708.01	1467.946	896.425
30-Mar-93			691.00	1690584101	290780.47	529998.12	491114.68	38883.43	169.06	0.40439	1944.17	3068.41	423.491	261.195
31-Mar-93			637.00	1558468990	268056.67	488580.03	452735.24	35844.79	155.85	0.37279	1792.24	2828.62	390.396	240.783
01-Apr-93			509.00	1245307247	214192.85	390403.82	361761.76	28642.07	124.53	0.29788	1432.10	2260.23	311.949	192.400
02-Apr-93			324.00	792690664	136342.79	248508.52	230276.64	18231.89	79.27	0.18961	911.59	1438.73	198.569	122.471
03-Apr-93			240.00	587178270	100994.66	184080.39	170575.29	13505.10	58.72	0.14046	675.26	1065.73	147.088	90.719
04-Apr-93			186.00	455063159	78270.86	142662.30	132195.85	10466.45	45.51	0.10885	523.32	825.94	113.993	70.307
05-Apr-93			156.00	381665875	65646.53	119652.25	110873.94	8778.32	38.17	0.09130	438.92	692.72	95.607	58.967
06-Apr-93			141.00	344967233	59334.36	108147.23	100212.98	7934.25	34.50	0.08252	396.71	626.12	86.414	53.297
07-Apr-93	1430	SITE 6	138.00	337627505	85419.76	146530.34	143154.06	3376.28	6.75	0.03538	371.39	388.27	42.541	27.010
08-Apr-93			176.00	430597398	118844.88	211423.32	207332.65	4090.68	8.61	0.26148	258.36	546.86	44.352	23.037
09-Apr-93			225.00	550479628	151932.38	270285.50	265055.94	5229.56	11.01	0.33428	330.29	699.11	56.699	29.451
10-Apr-93			202.00	494208377	136401.51	242656.31	237961.33	4694.98	9.88	0.30011	296.53	627.64	50.903	26.440
11-Apr-93			180.00	440383702	121545.90	216228.40	212044.75	4183.65	8.81	0.26743	264.23	559.29	45.360	23.561
12-Apr-93			190.00	464849463	128298.45	228241.09	223825.02	4416.07	9.30	0.28228	278.91	590.36	47.879	24.869
13-Apr-93			208.00	508887834	140453.04	249863.93	245029.49	4834.43	10.18	0.30903	305.33	646.29	52.415	27.225
14-Apr-93			235.00	574945389	158684.93	282298.19	276836.20	5461.98	11.50	0.34914	344.97	730.18	59.219	30.760
15-Apr-93			346.00	846515339	233638.23	415639.03	407597.14	8041.90	16.93	0.51405	507.91	1075.07	87.191	45.289
16-Apr-93			323.00	790244088	218107.37	388009.85	380502.53	7507.32	15.80	0.47988	474.15	1003.61	81.395	42.278
17-Apr-93			253.00	618983759	170839.52	303921.03	298040.68	5880.35	12.38	0.37588	371.39	786.11	63.755	33.116
18-Apr-93			195.00	477082344	131674.73	234247.43	229715.15	4532.28	9.54	0.28971	286.25	605.89	49.139	25.524
19-Apr-93			161.00	393898756	108716.06	193404.29	189662.25	3742.04	7.88	0.23920	236.34	500.25	40.572	21.074
20-Apr-93			135.00	330287777	91159.43	162171.30	159033.56	3137.73	6.61	0.20057	198.17	419.47	34.020	17.670
21-Apr-93			115.00	281356254	77654.33	138145.92	135473.04	2672.88	5.63	0.17086	168.81	357.32	28.980	15.053
22-Apr-93			98.00	239764460	66174.99	117724.35	115446.59	2277.76	4.80	0.14560	143.86	304.50	24.696	12.827
23-Apr-93			86.00	210405547	58071.93	103309.12	101310.27	1998.85	4.21	0.12777	126.24	267.22	21.672	11.257
24-Apr-93			78.00	190832938	52669.89	93698.97	91886.06	1812.91	3.82	0.11588	114.50	242.36	19.656	10.210
25-Apr-93			72.00	176153481	48618.36	86491.36	84817.90	1673.46	3.52	0.10697	105.69	223.71	18.144	9.424
26-Apr-93			67.00	163920600	45242.09	80485.01	78927.77	1557.25	3.28	0.09954	98.35	208.18	16.884	8.770
27-Apr-93			62.00	151687720	41865.81	74478.67	73037.64	1441.03	3.03	0.09211	91.01	192.64	15.624	8.115
28-Apr-93			59.00	144347991	39840.05	70874.86	69503.56	1371.31	2.89	0.08766	86.61	183.32	14.868	7.723
29-Apr-93			56.00	137008263	37814.28	67271.06	65969.48	1301.58	2.74	0.08320	82.20	174.00	14.112	7.330
30-Apr-93			55.00	134561687	37139.03	66069.79	64791.45	1278.34	2.69	0.08171	80.74	170.89	13.860	7.199
01-May-93			53.00	129668535	35788.52	63667.25	62435.40	1231.85	2.59	0.07874	77.80	164.68	13.356	6.937
02-May-93			55.00	134561687	37139.03	66069.79	64791.45	1278.34	2.69	0.08171	80.74	170.89	13.860	7.199
03-May-93			58.00	141901415	39164.79	69673.59	68325.53	1348.06	2.84	0.08617	85.14	180.21	14.616	7.592
04-May-93			59.00	144347991	39840.05	70874.86	69503.56	1371.31	2.89	0.08766	86.61	183.32	14.868	7.723
05-May-93			55.00	134561687	37139.03	66069.79	64791.45	1278.34	2.69	0.08171	80.74	170.89	13.860	7.199
06-May-93			51.00	124775382	34438.01	61264.71	60079.35	1185.37	2.50	0.07577	74.87	158.46	12.852	6.675
07-May-93			56.00	137008263	37814.28	67271.06	65969.48	1301.58	2.74	0.08320	82.20	174.00	14.112	7.330
08-May-93			69.00	168813752	46592.60	82887.55	81283.82	1603.73	3.38	0.10251	101.29	214.39	17.388	9.032
09-May-93			125.00	305822015	84406.88	150158.61	147253.30	2905.31	6.12	0.18571	183.49	388.39	31.500	16.361
10-May-93	1530	SITE 6	207.00	506441257	151425.94	277529.81	272971.84	4557.97	10.13	0.56200	50.64	703.95	40.515	13.674
TOTAL LOAD L/YR KG/YR			11817.00	28911190045	5202920.59	10387452.71	9425762.36	961690.36	4607.78	17.94689	28338.45	58474.76	8506.755	4413.232

Table D-5. Water Quality Tributary Loadings, 1993

SAMPLE DATA FOR SITE 7 (BIG SIOUX RIVER EAST OF LONESOME LAKE), 1993

DATE	TIME	SITE	CUBIC CALC AVG CFS	FLOWS L/DAY	TALKAL KG/DAY	TSOL KG/DAY	TDSOL KG/DAY	TSSOL KG/DAY	AMMON KG/DAY	UNIONIZED AMMONIA KG/DAY	NO3+2 KG/DAY	TKN-N KG/DAY	TPO4 KG/DAY	TDPO4 KG/DAY
28-Mar-93	800	SITE 7	884	2162773293	173021.86	365508.69	300625.49	64883.20	367.67	0.81759	2162.77	5212.28	875.923	575.298
29-Mar-93	1645	SITE 7	410	1003096210	95294.14	175541.84	161498.49	14043.35	50.15	0.10950	902.79	2036.29	266.824	183.567
30-Mar-93			199	486868648	87149.49	139001.00	133402.01	5598.99	17.04	0.05209	365.15	749.78	89.097	61.589
31-Mar-93			227	555372780	99411.73	158558.93	152172.14	6386.79	19.44	0.05942	416.53	855.27	101.633	70.255
01-Apr-93			163	398791908	71383.75	113855.09	109268.98	4586.11	13.96	0.04266	299.09	614.14	72.979	50.447
02-Apr-93			114	278909678	49924.83	79628.71	76421.25	3207.46	9.76	0.02984	209.18	429.52	51.040	35.282
03-Apr-93			80	195726090	35034.97	55879.80	53628.95	2250.85	6.85	0.02094	146.79	301.42	35.818	24.759
04-Apr-93			61	149241144	26714.16	42608.35	40892.07	1716.27	5.22	0.01597	111.93	229.83	27.311	18.879
05-Apr-93			51	124775382	22334.79	35623.37	34188.45	1434.92	4.37	0.01335	93.58	192.15	22.834	15.784
06-Apr-93			50	122328806	21896.86	34924.87	33518.09	1406.78	4.28	0.01309	91.75	188.39	22.386	15.475
07-Apr-93	1200	SITE 7	45	110095926	28955.23	43597.99	42607.12	990.86	2.20	0.01154	66.06	115.60	11.010	7.707
08-Apr-93			40	97863045	28282.42	42472.56	41738.59	733.97	1.96	0.05447	34.25	119.39	9.786	6.508
09-Apr-93			60	146794567	42423.63	63708.84	62607.88	1100.96	2.94	0.08171	51.38	179.09	14.679	9.762
10-Apr-93			100	244657612	70706.05	106181.40	104346.47	1834.93	4.89	0.13618	85.63	298.48	24.466	16.270
11-Apr-93			90	220191851	63635.44	95563.26	93911.82	1651.44	4.40	0.12256	77.07	268.63	22.019	14.643
12-Apr-93			70	171260329	49494.23	74326.98	73042.53	1284.45	3.43	0.09533	59.94	208.94	17.126	11.389
13-Apr-93			60	146794567	42423.63	63708.84	62607.88	1100.96	2.94	0.08171	51.38	179.09	14.679	9.762
14-Apr-93			60	146794567	42423.63	63708.84	62607.88	1100.96	2.94	0.08171	51.38	179.09	14.679	9.762
15-Apr-93			80	195726090	56564.84	84945.12	83477.18	1467.95	3.91	0.10895	68.50	238.79	19.573	13.016
16-Apr-93			130	318054896	91917.86	138035.82	135650.41	2385.41	6.36	0.17704	111.32	388.03	31.805	21.151
17-Apr-93			100	244657612	70706.05	106181.40	104346.47	1834.93	4.89	0.13618	85.63	298.48	24.466	16.270
18-Apr-93			90	220191851	63635.44	95563.26	93911.82	1651.44	4.40	0.12256	77.07	268.63	22.019	14.643
19-Apr-93			70	171260329	49494.23	74326.98	73042.53	1284.45	3.43	0.09533	59.94	208.94	17.126	11.389
20-Apr-93			60	146794567	42423.63	63708.84	62607.88	1100.96	2.94	0.08171	51.38	179.09	14.679	9.762
21-Apr-93			50	122328806	35353.02	53090.70	52173.24	917.47	2.45	0.06809	42.82	149.24	12.233	8.135
22-Apr-93			30	73397284	21211.81	31854.42	31303.94	550.48	1.47	0.04085	25.69	89.54	7.340	4.881
23-Apr-93			20	48931522	14141.21	21236.28	20869.29	366.99	0.98	0.02724	17.13	59.70	4.893	3.254
24-Apr-93			18	44038370	12727.09	19112.65	18782.36	330.29	0.88	0.02451	15.41	53.73	4.404	2.929
25-Apr-93			14	34252066	9898.85	14865.40	14608.51	256.89	0.69	0.01907	11.99	41.79	3.425	2.278
26-Apr-93			12	29358913	8484.73	12741.77	12521.58	220.19	0.59	0.01634	10.28	35.82	2.936	1.952
27-Apr-93			10	24465761	7070.60	10618.14	10434.65	183.49	0.49	0.01362	8.56	29.85	2.447	1.627
28-Apr-93			9	22019185	6363.54	9556.33	9391.18	165.14	0.44	0.01226	7.71	26.86	2.202	1.464
29-Apr-93			8	19572609	5656.48	8494.51	8347.72	146.79	0.39	0.01089	6.85	23.88	1.957	1.302
30-Apr-93			7	17126033	4949.42	7432.70	7304.25	128.45	0.34	0.00953	5.99	20.89	1.713	1.139
01-May-93			6	14679457	4242.36	6370.88	6260.79	110.10	0.29	0.00817	5.14	17.91	1.468	0.976
02-May-93			6	14679457	4242.36	6370.88	6260.79	110.10	0.29	0.00817	5.14	17.91	1.468	0.976
03-May-93			7	17126033	4949.42	7432.70	7304.25	128.45	0.34	0.00953	5.99	20.89	1.713	1.139
04-May-93			8	19572609	5656.48	8494.51	8347.72	146.79	0.39	0.01089	6.85	23.88	1.957	1.302
05-May-93			10	24465761	7070.60	10618.14	10434.65	183.49	0.49	0.01362	8.56	29.85	2.447	1.627
06-May-93			10	24465761	7070.60	10618.14	10434.65	183.49	0.49	0.01362	8.56	29.85	2.447	1.627
07-May-93			10	24465761	7070.60	10618.14	10434.65	183.49	0.49	0.01362	8.56	29.85	2.447	1.627
08-May-93			20	48931522	14141.21	21236.28	20869.29	366.99	0.98	0.02724	17.13	59.70	4.893	3.254
09-May-93			40	97863045	28282.42	42472.56	41738.59	733.97	1.96	0.05447	34.25	119.39	9.786	6.508
10-May-93	1430	SITE 7	100	244657612	77067.15	115478.39	114010.45	1467.95	4.89	0.24673	24.47	340.07	24.466	15.413
TOTAL LOADS L/YR KG/YR				9025419318	1710902.92	2745874.34	2613954.96	131919.38	569.70	3.20989	6007.57	15159.94	1920.599	1286.774

APPENDIX E. In-Lake Concentration Tables

Appendix E-1

SITE 9 (SOUTHWEST) SURACE

DATE	TIME	SIT	SAMP	DEPTH Feet	WTEMP SURF C	WTEMP BOTT C	ATEMP C	SDISK M	DISOX SURF mg/L	DISOX BOTT mg/L	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSO mg/L	VOLSOL mg/L	FIXSO mg/L	AMMONIA mg/L	UNIONIZE AMMONIA mg/L	PERCENT UNIONAM mg/L	PKA	NO3+2 mg/L	TKN-N mg/L	TOTAL-N mg/L	TPO4 mg/L	TPO4 TSI	TDPO4 mg/L	NITR. PHOS. RATIO
10/07/91	900	9	GRAB	0.5	9.8	9.9	5.5	0 3	9 2	9 1	8	10	212	384	372	12			0.02	0.00036	1.801	9.737	0.1	0.48	0.58	0.539	95	0.447	1.076087
02/19/92	1200	9	GRAB	0.5	0.5	4	0	1 0	11.6	2 4	8.05	2	191	315	308	7	5	2	0.02	0.00019	0.958	10.064	0.1	0.49	0.59	0.335	88	0.332	1.761194
03/24/92	1200	9	GRAB	0.5	3	2.9	4.1	0.6	13.7	13.4	8.27	2	213	367	359	8			0.02	0.00039	1.939	9.974	0.1	0.44	0.54	0.428	92	0.352	1.261682
04/15/92	1100	9	GRAB	0.5	5.5	5.3	5.5	0.5	11.65	11.62	7.96	4	213	372	350	22	8	14	0.02	0.00023	1.174	9.885	0.1	0.37	0.47	0.435	92	0.349	1.08046
04/29/92	1000	9	GRAB	0.5	8	7.1	16	0.3	11.8	11.2	8.65	10	210	386	360	26	6	20	0.02	0.00133	6.636	9.798	0.1	0.15	0.25	0.475	93	0.388	0.526316
05/12/92	1000	9	GRAB	0.5	15.7	15.6	14.9	0.3	8.2	8.05	8.48	10	231	422	393	29	3	26	0.02	0.00160	8.020	9.540	0.1	0.78	0.88	0.518	94	0.398	1.698842
05/26/92	1215	9	GRAB	0.5	15.8	12.8	20.5	0.5	9.2	8.5	8.54	10	219	380	368	12	6	6	0.02	0.00183	9.162	9.536	0.1	0.47	0.57	0.485	93	0.425	1.175258
06/09/92	1130	9	GRAB	0.5	17.1	16	17.5	0.4	8.9	7.5	8.22	10	222	406	379	27	11	16	0.02	0.00101	5.053	9.494	0.1	0.44	0.54	0.518	94	0.455	1.042471
06/23/92	800	9	GRAB	0.5	19	19	17.5	0.5	8	7.2	8.52	10	220	386	370	16	6	10	0.02	0.00218	10.892	9.433	0.1	0.54	0.64	0.491	94	0.891	1.303462
07/09/92	830	9	GRAB	0.5	19.5	19.5	17.5	0.4	7.5	5	8.42	10	215	402	384	18	2	16	0.02	0.00183	9.151	9.417	0.1	0.52	0.62	0.508	94	0.448	1.220472
07/21/92	1245	9	GRAB	0.5	20.1	19.1	20.1	0.6	7.8	6.7	8.26	10	218	384	369	15	6	9	0.02	0.00136	6.787	9.398	0.1	0.96	1.06	0.508	94	0.458	2.086614
08/04/92	1145	9	GRAB	0.5	20.9	20.9	15.5	0.5	8.3	7.9	8.56	10	218	399	383	16	7	9	0.02	0.00267	13.345	9.372	0.1	0.97	1.07	0.97	103	0.461	1.103093
08/26/92	1115	9	GRAB	0.5	19.8	18.5	23	0.5	7.6	7	8.53	10	223	403	382	21	9	12	0.02	0.00234	11.711	9.407	0.1	0.59	0.69	0.571	96	0.551	1.208406
09/10/92	1030	9	GRAB	0.5	15	15.1	12.2	0.4	9.3	9	8.43	10	217	407	369	38	16	22	0.02	0.00137	6.865	9.562	0.2	0.57	0.77	0.624	97	0.538	1.233974
09/22/92	1315	9	GRAB	0.5	16.5	14.7	14	0.4	8.2	6.2	8.42	40	218	382	364	18	3	15	0.02	0.00149	7.462	9.513	0.1	0.2	0.3	0.618	97	0.568	0.485437
10/06/92	830	9	GRAB	0.5	14.5	14.5	7	0.5	8.61	6.5	8.4	10	220.6	406	385	21	14	7	0.02	0.00124	6.212	9.579	0.1	0.8	0.9	0.654	98	0.574	1.376147
12/30/92	1000	9	GRAB	0.5	0	4	-23	0.914	13.2	12.2	8.18	2	240.8	377	365	12	3	9	0.02	0.00025	1.236	10.083	0.1	0.61	0.71	0.637	97	0.601	1.1146
01/14/93	1100	9	GRAB	0.5	0.5	4	-13	0.945	11.1	8.4	7.96	10	247.2	431	421	10	2	8	0.02	0.00016	0.780	10.064	0.1	0.99	1.09	0.671	98	0.671	1.624441
03/04/93	1400	9	GRAB	0.5	0.8	4.5	4.1	1.524	11.1	7	8.31	10	282	470	464	6	6	0	0.02	0.00035	1.774	10.053	0.1	0.74	0.84	0.682	98	0.659	1.231672
05/03/93	1630	9	GRAB	0.5	14.8	9.2	14	1.066	9.1	7.8	8.53	2	195	345	335	10			0.02	0.00167	8.374	9.569	0.1	0.81	0.91	0.471	93	0.475	1.932059

Appendix E-2

SITE 9 (SOUTH BOTTOM

DATE	TIME	SIT	SAMP	DEPTH Feet	WTEMP SURF C	WTEMP BOTT C	ATEMP C	SDISK M	DISOX SURF mg/L	DISOX BOTT mg/L	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSO mg/L	VOLSOL mg/L	FIXSO mg/L	AMMONIA mg/L	UNIONIZE AMMONIA mg/L	PERCENT UNIONAM mg/L	PKA	NO3+2 mg/L	TKN-N mg/L	TOTAL-N mg/L	TPO4 mg/L	TPO4 TSI	TDPO4 mg/L	NITR. PHOS. RATIO
10/07/91	900	9	GRAB	14	9.8	9.9	5.5	0.3	9.2	9.1	7.84	10	213	377	359	18			0.03	0.00038	1.263	9.733	0.1	0.47	0.57	0.532	95	0.441	1.071429
02/19/92	1200	9	GRAB	14	0.5	4	0	1.0	11.6	2.4	7.99	2	239	397	390	7	6	1	0.02	0.00022	1.114	9.938	0.1	0.57	0.67	0.501	94	0.481	1.337325
03/24/92	1200	9	GRAB	13.5	3	2.9	4.1	0.6	13.7	13.4	8.29	2	214	364	358	6			0.02	0.00040	2.012	9.978	0.1	0.49	0.59	0.465	93	0.395	1.268817
04/15/92	1100	9	GRAB	12.5	5.5	5.3	5.5	0.5	11.65	11.62	7.93	2	214	377	359	16	6	12	0.02	0.00022	1.079	9.892	0.1	0.43	0.53	0.395	90	0.272	1.341772
04/29/92	1000	9	GRAB	14.3	8	7.1	16	0.3	11.8	11.2	8.63	10	212	377	348	29	11	18	0.02	0.00119	5.942	9.829	0.1	0.27	0.37	0.485	93	0.392	0.762887
05/12/92	1000	9	GRAB	14	15.7	15.6	14.9	0.3	8.2	8.05	8.49	10	214	425	392	33	5	28	0.02	0.00163	8.135	9.543	0.1	0.55	0.65	0.511	94	0.395	1.272016
05/26/92	1215	9	GRAB	13	15.8	12.8	20.5	0.5	9.2	8.5	8.47	10	217	395	378	17	8	9	0.02	0.00128	6.396	9.635	0.1	0.57	0.67	0.508	94	0.402	1.318898
06/09/92	1130	9	GRAB	13	17.1	16	19.9	0.4	8.9	7.5	8.33	10	220	410	381	29	11	18	0.02	0.00119	5.938	9.530	0.1	0.37	0.47	0.531	95	0.455	0.885122
06/23/92	800	9	GRAB	14	19	19	17.5	0.5	8	7.2	8.52	10	220	385	366	19	5	14	0.03	0.00327	10.892	9.433	0.1	0.46	0.56	0.505	94	0.442	1.108911
07/09/92	830	9	GRAB	14	19.5	19.5	17.5	0.4	7.5	5	8.4	10	217	403	383	20	2	18	0.02	0.00176	8.775	9.417	0.1	0.44	0.54	0.515	94	0.435	1.048544
07/21/92	1245	9	GRAB	14	20.1	19.1	20.1	0.6	7.8	6.7	8.22	10	217	407	385	22	4	18	0.02	0.00116	5.813	9.430	0.1	0.66	0.76	0.591	96	0.455	1.285956
08/04/92	1145	9	GRAB	14	20.9	20.9	15.5	0.5	8.3	7.9	8.61	10	221	433	387	46	18	28	0.02	0.00295	14.734	9.372	0.1	0.55	0.65	0.588	96	0.461	1.105442
08/26/92	1115	9	GRAB	14	19.8	18.5	18.5	0.5	7.6	7	8.44	20	220	402	377	25	10	15	0.02	0.00178	8.924	9.449	0.1	0.87	0.97	0.571	96	0.518	1.698774
09/10/92	1030	9	GRAB	14	15	15.1	12.2	0.4	9.3	9	8.53	10	219	417	384	33	16	17	0.02	0.00171	8.550	9.559	0.1	0.49	0.59	0.614	97	0.544	0.960912
09/22/92	1315	9	GRAB	14.4	16.5	14.7	14	0.4	8.2	6.2	8.4	10	218	386	371	15	1	14	0.02	0.00126	6.301	9.572	0.1	0.65	0.75	0.618	97	0.571	1.213592
10/06/92	830	9	GRAB	13	14.5	14.5	7	0.5	8.61	6.5	8.41	20	220.2	403	383	20	12	8	0.02	0.00042	2.081	10.083	0.1	0.43	0.53	0.647	98	0.564	0.819165
12/30/92	1011	9	GRAB	13	0	4	-23	0.914	13.2	12.2	8.56	2	229.8	362	348	14	2	12	0.02	0.00058	2.915	10.083	0.1	0.42	0.52	0.651	98	0.797	0.798771
01/14/93	1100	9	GRAB	13.4	0.5	4	-13	0.945	11.1	8.4	8.06	10	239.8	403	391	12	1	11	0.02	0.00019	0.940	10.083	0.1	0.64	0.74	0.671	98	0.664	1.102832
03/04/93	1400	9	GRAB	13.8	0.8	4.5	4.1	1.524	11.1	7	8.31	10	281	3229	3223	6	6	0	0.02	0.00033	1.660	10.083	0.1	0.64	0.74	0.694	99	0.659	1.066282
05/03/93	1630	9	GRAB	15.2	14.8	9.2	14	1.066	9.1	7.8	8.66	2	193	342	328	14			0.02	0.00073	3.642	10.083	0.1	0.9	1	0.491	94	0.448	2.03666

Appendix E-3

SITE 10 (MIDDLE) SURFACE

DATE	TIME	SIT	SAMP	DEPTH Feet	WTEMP SURF C	WTEMP BOTT C	ATEMP C	SDISK M	DISOX SURF mg/L	DISOX BOTT mg/L	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSO mg/L	VOLSOL mg/L	FIXSO mg/L	AMMONIA mg/L	UNIONIZE AMMONIA mg/L	PERCENT UNIONAM mg/L	PKA	NO3+2 mg/L	TKN-N mg/L	TOTAL-N mg/L	TPO4 mg/L	TPO4 TSI	TDPO4 mg/L	NITR. PHOS. RATIO
10/07/91	1030	10	GRAB	0.5	9.8	9.8	6	0.3	9.6	9.5	8.08	20	211	382	370	12			0.02	0.00043	2.158	9.737	0.1	0.64	0.74	0.539	95	0.444	1.372913
02/19/92	1100	10	GRAB	0.5	0.5	4	-1	1.2	13.1	7.6	8.5	2	105	182	175	7	6	1	0.16	0.00425	2.655	10.064	0.2	0.52	0.72	0.139	75	0.299	5.179856
03/24/92	1300	10	GRAB	0.5	2.3	3	5.4	0.6	13.5	13.3	8.52	2	209	355	345	10			0.02	0.00064	3.211	9.999	0.1	0.73	0.83	0.422	91	0.388	1.966825
04/15/92	1145	10	GRAB	0.5	5.5	5.5	5.3	0.5	11.65	11.78	8.15	16	211	365	342	23	9	14	0.02	0.00036	1.806	9.885	0.1	0.36	0.46	0.485	93	0.398	0.948454
04/29/92	1045	10	GRAB	0.5	8	7	15.8	0.3	11.9	11.75	8.66	10	208	379	353	26	9	17	0.02	0.00136	6.780	9.798	0.1	0.33	0.43	0.498	94	0.398	0.863454
05/12/92	1045	10	GRAB	0.5	15.2	15.2	15.2	0.2	8.6	8.55	8.49	10	213	415	389	26	2	24	0.02	0.00158	7.912	9.556	0.1	0.42	0.52	0.491	94	0.398	1.059063
05/26/92	1245	10	GRAB	0.5	16.8	13	18	0.4	8.4	5	8.53	10	218	389	376	13	4	9	0.02	0.00192	9.604	9.504	0.1	0.52	0.62	0.485	93	0.426	1.278351
06/09/92	1230	10	GRAB	0.5	17.1	16	16.1	0.4	8.4	7.7	8.3	10	222	402	377	25	15	10	0.02	0.00120	6.013	9.494	0.1	0.46	0.56	0.508	94	0.438	1.102362
06/23/92	830	10	GRAB	0.5	19	18.8	18.2	0.5	8.2	4	8.53	10	219	397	381	16	7	9	0.02	0.00222	11.117	9.433	0.1	0.47	0.57	0.485	93	0.445	1.175258
07/09/92	900	10	GRAB	0.5	19.5	19.4	18	0.5	7.8	7.5	8.42	10	216	399	384	15	1	14	0.02	0.00183	9.151	9.417	0.2	0.39	0.59	0.498	94	0.422	1.184739
07/21/92	1315	10	GRAB	0.5	20	19.8	15.1	0.6	7.9	7.1	8.26	20	215	397	382	15	4	11	0.02	0.00135	6.741	9.401	0.1	0.58	0.68	0.505	94	0.445	1.346535
08/04/92	1110	10	GRAB	0.5	20.5	20.5	15	0.5	8.4	8	8.58	10	215	405	392	13	6	7	0.02	0.00271	13.542	9.385	0.1	0.67	0.77	0.538	95	0.465	1.431227
08/26/92	1215	10	GRAB	0.5	19.5	18.5	18.5	0.5	8.2	7.8	8.53	10	221	395	373	22	10	12	0.02	0.00230	11.486	9.417	0.1	0.6	0.7	0.571	96	0.515	1.225919
09/10/92	1100	10	GRAB	0.5	14.9	14.9	12	0.4	9.4	9.3	8.56	30	215	404	373	31	16	15	0.02	0.00180	8.982	9.566	0.1	0.53	0.63	0.614	97	0.535	1.026059
09/22/92	1345	10	GRAB	0.5	17.3	14.8	13	0.5	8.5	5.8	8.42	20	218	393	377	16	3	13	0.02	0.00158	7.886	9.487	0.1	0.18	0.28	0.611	97	0.544	0.458265
10/06/92	900	10	GRAB	0.5	14	13.9	8.2	0.5	8.3	8.39	8.41	120	218	418	395	23	15	8	0.02	0.00122	6.125	9.595	0.1	0.92	0.1	0.654	98	0.594	0.152905
12/30/92	110	10	GRAB	0.5	0	4	-23	3.5	13.1	11.4	8.55	2	245.4	378	363	15	2	13	0.02	0.00057	2.850	10.083	0.1	0.51	0.61	0.644	97	0.608	0.947205
01/14/93	1300	10	GRAB	0.5	0.2	4	-13	0.914	11.6	9.2	8.18	10	251.4	417	407	10			0.02	0.00024	1.201	10.075	0.1	0.74	0.84	0.671	98	0.664	1.251863
03/04/93	1430	10	GRAB	0.5	0.9	4.3	4.1	1.219	11	7.8	8.27	10	280	2824	2818	6			0.02	0.00033	1.633	10.050	0.1	1.08	1.18	0.707	99	0.652	1.669024
05/03/93	1545	10	GRAB	0.5	15.4	9.2	16	1.066	9	8.4	8.59	10	195	348	338	10			0.02	0.00198	9.894	9.549	0.1	0.77	0.87	0.481	93	0.422	1.887202

SITE 10 (MIDDLE) BOTTOM

Appendix E-4

DATE	TIME	SIT	SAMP	DEPTH Feet	WTEMP SURF C	WTEMP BOTT C	ATEMP C	SDISK M	DISOX SURF mg/L	DISOX BOTT mg/L	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSO mg/L	VOLSOL mg/L	FIXSO mg/L	AMMONIA mg/L	UNIONIZE AMMONIA mg/L	PERCENT UNIONAM mg/L	PKA	NO3+2 mg/L	TKN-N mg/L	TOTAL-N mg/L	TPO4 mg/L	TPO4 TSI	TDPO4 mg/L	NITR. PHOS. RATIO
10/07/91	1030	10	GRAB	13	9.8	9.8	6	0.3	9.6	9.5	8.13	20	211	377	361	16			0.02	0.00048	2.415	9.737	0.1	0.63	0.73	0.559	95	0.444	1.305903
02/19/92	1100	10	GRAB	13.5	0.5	4	-1	1.2	13.1	7.6	8.13	2	238	399	388	11	9	2	0.02	0.00031	1.531	9.938	0.1	0.49	0.59	0.495	94	0.495	1.191919
03/24/92	1300	10	GRAB	13.5	2.3	3	5.4	0.6	13.5	13.3	8.31	2	210	354	344	10			0.02	0.00042	2.122	9.974	0.1	0.49	0.59	0.657	98	0.564	0.898021
04/15/92	1145	10	GRAB	13.5	5.5	5.5	5.3	0.5	11.65	11.78	8.18	8	212	371	350	21	7	14	0.02	0.00039	1.933	9.885	0.1	0.5	0.6	0.491	94	0.392	1.221996
04/29/92	1045	10	GRAB	14.2	8	7	15.8	0.3	11.9	11.75	8.6	10	214	381	355	26	8	18	0.02	0.00111	5.526	9.833	0.1	0.24	0.34	0.485	93	0.388	0.701031
05/12/92	1045	10	GRAB	14	15.2	15.2	15.5	0.2	8.6	8.55	8.49	10	215	424	394	30	1	29	0.02	0.00158	7.912	9.556	0.1	0.67	0.77	0.475	93	0.392	1.621053
05/26/92	1245	10	GRAB	13.5	16.8	13	18	0.4	8.4	5	8.51	10	214	395	373	22	6	16	0.02	0.00141	7.071	9.629	0.1	0.94	1.04	0.505	94	0.425	2.059406
06/09/92	1230	10	GRAB	12.5	17.1	16	19.9	0.4	8.4	7.7	8.35	10	222	412	381	31	14	17	0.02	0.00124	6.201	9.530	0.1	0.81	0.91	0.518	94	0.435	1.756757
06/23/92	830	10	GRAB	14.5	19	18.8	18.2	0.5	8.2	4	8.54	20	219	388	374	14	4	10	0.02	0.00224	11.199	9.439	0.1	0.46	0.56	0.485	93	0.428	1.154639
07/09/92	930	10	GRAB	14	19.5	19.4	18	0.5	7.8	7.5	8.4	30	219	393	377	16	2	14	0.02	0.00174	8.717	9.420	0.1	0.39	0.49	0.491	94	0.432	0.997963
07/21/92	1315	10	GRAB	14	20	19.8	15.1	0.6	7.9	7.1	8.24	2	217	398	377	21	6	15	0.02	0.00127	6.369	9.407	0.1	0.66	0.76	0.578	96	0.452	1.314879
08/04/92	1110	10	GRAB	14	20.5	20.5	15	0.5	8.4	8	8.6	10	218	446	405	41	8	33	0.02	0.00282	14.091	9.385	0.1	0.67	0.77	0.571	96	0.458	1.348511
08/26/92	1215	10	GRAB	14	19.5	18.5	18.5	0.5	8.2	7.8	8.5	10	221	406	374	32	10	22	0.02	0.00202	10.113	9.449	0.1	0.49	0.59	0.594	96	0.508	0.993266
09/10/92	1100	10	GRAB	14	14.9	14.9	12	0.4	9.4	9.3	8.55	10	231	523	335	188	44	144	0.02	0.00176	8.795	9.566	0.1	0.69	0.79	0.637	97	0.548	1.240188
09/22/92	1345	10	GRAB	13.2	17.3	14.8	13	0.5	8.5	5.8	8.4	10	220	382	359	23	4	19	0.02	0.00127	6.345	9.569	0.1	0.25	0.35	0.614	97	0.561	0.570033
10/06/92	900	10	GRAB	13	14	13.9	8.2	0.5	8.3	8.39	8.41	120	219.6	408	387	21	15	6	0.02	0.00042	2.081	10.083	0.1	0.84	0.94	0.657	98	0.581	1.430746
12/30/92	1100	10	GRAB	13	0	4	-23	3.5	13.1	11.4	8.61	2	237.2	361	346	15	1	14	0.02	0.00065	3.259	10.083	0.1	0.46	0.56	0.618	97	0.608	0.906149
01/14/93	1300	10	GRAB	13.4	0.2	4	-13	0.914	11.6	9.2	8.05	10	243	415	401	14	4	10	0.02	0.00018	0.919	10.083	0.1	0.64	0.74	0.667	98	0.794	1.109445
03/04/93	1430	10	GRAB	14.8	0.9	4.3	4.1	1.219	11	7.8	8.11	10	272	462	455	7	5	2	0.02	0.00021	1.054	10.083	0.1	0.81	0.91	0.707	99	0.662	1.287129
05/03/93	1545	10	GRAB	14.5	15.4	9.2	16	1.066	9	8.4	8.46	10	195	347	336	11			0.02	0.00047	2.329	10.083	0.1	0.81	0.91	0.498	94	0.561	1.827309

LAKE KAMPESKA IN-LAKE SAMPLE DATA, 1991-1993

SITE 11 (NORTHEAST) SURFACE

Appendix E-5

DATE	TIME	SIT	SAMP	DEPTH Feet	WTEMP SURF C	WTEMP BOTT C	ATEMP C	SDISK M	DISOX SURF mg/L	DISOX BOTT mg/L	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSO mg/L	VOLSOL mg/L	FIXSO mg/L	AMMONIA mg/L	UNIONIZE AMMONIA mg/L	PERCENT UNIONAM mg/L	PKA	NO3+2 mg/L	TKN-N mg/L	TOTAL-N mg/L	TPO4 mg/L	TPO4 TSI	TDPO4 mg/L	NITR. PHOS. RATIO
10/07/91	1030	11	GRAB	0.5	9.4	9.5	8	0.3	9.9	9.8	8.06	10	213	360	348	12			0.02	0.00040	2.000	9.750	0.1	0.41	0.51	0.529	95	0.441	0.964083
02/19/92	1000	11	GRAB	0.5	0	4	-4	1.1	13.4	2	8.14	2	146	251	244	7	7	0	0.06	0.00068	1.129	10.083	0.1	0.74	0.84	0.315	87	0.295	2.666667
03/24/92	1400	11	GRAB	0.5	3.5	3	4.5	0.9	13.8	12	8.28	2	209	358	348	10			0.02	0.00041	2.064	9.956	0.1	0.42	0.52	0.475	93	0.385	1.094737
04/15/92	1215	11	GRAB	0.5	5.5	5.2	5.6	0.5	11.9	11.78	8.37	6	210	377	357	20	7	13	0.02	0.00059	2.962	9.885	0.1	0.43	0.53	0.485	93	0.402	1.092784
04/29/92	1115	11	GRAB	0.5	8	7	15.5	0.3	11.8	11	8.64	10	212	387	361	26	10	16	0.02	0.00130	6.495	9.798	0.1	0.16	0.26	0.478	93	0.382	0.543933
05/12/92	1115	11	GRAB	0.5	15.8	15.8	16.1	0.2	8.4	8.25	8.48	10	211	420	387	33	6	27	0.02	0.00162	8.075	9.536	0.1	0.53	0.63	0.455	92	0.392	1.384615
05/26/92	1315	11	GRAB	0.5	16.5	13.4	12	0.5	8.7	8.2	8.52	10	216	383	374	9	3	6	0.02	0.00184	9.216	9.513	0.1	0.53	0.63	0.485	93	0.455	1.298969
06/09/92	1330	11	GRAB	0.5	17	16	16.1	0.4	8.7	7.6	8.36	10	221	406	382	24	12	12	0.02	0.00136	6.796	9.497	0.1	0.57	0.67	0.515	94	0.428	1.300971
06/23/92	900	11	GRAB	0.5	18.9	18.7	17.5	0.5	8.2	5	8.47	10	218	381	366	15	6	9	0.02	0.00195	9.759	9.436	0.1	0.66	0.76	0.478	93	0.432	1.589958
07/09/92	930	11	GRAB	0.5	19.1	19.1	18.5	0.5	7.5	5.4	8.42	10	217	395	378	17	1	16	0.02	0.00178	8.909	9.430	0.1	0.61	0.71	0.478	93	0.418	1.485356
07/21/92	1330	11	GRAB	0.5	19.9	19.8	17.9	0.6	8	7.5	8.22	10	216	387	370	17	5	12	0.02	0.00123	6.142	9.404	0.1	0.55	0.65	0.525	95	0.455	1.238095
08/04/92	1035	11	GRAB	0.5	19.9	19.9	16.5	0.3	7.6	7.4	8.44	10	216	402	393	9	5	4	0.02	0.00196	9.797	9.404	0.1	0.78	0.88	0.535	95	0.465	1.64486
08/26/92	1215	11	GRAB	0.5	19.5	19	18.8	0.5	8.2	7.6	8.5		221	377	355	22	9	13	0.02	0.00216	10.802	9.417	0.1	0.43	0.53	0.561	95	0.505	0.944742
09/10/92	1120	11	GRAB	0.5	15	14.9	11	0.3	9.4	9.1	8.55	10	216	410	370	40	19	21	0.02	0.00177	8.856	9.562	0.1	0.69	0.79	0.581	96	0.548	1.359725
09/22/92	1415	11	GRAB	0.5	18	15	14	0.5	8.4	6	8.44	40	217	389	374	15	3	12	0.02	0.00173	8.628	9.465	0.1	0.17	0.27	0.611	97	0.588	0.441899
10/08/92	930	11	GRAB	0.5	13.1	13.1	7.8	0.457	8.61	5.8	8.37	20	219	403	382	21	15	6	0.02	0.00105	5.262	9.625	0.1	0.95	1.05	0.644	97	0.588	1.630435
12/30/92	12	11	GRAB	0.5	0	4	-25	0.914	13.2	12.2	8.62	2	242.2	376	365	11	1	10	0.02	0.00067	3.332	10.083	0.1	0.5	0.6	0.664	98	0.621	0.903614
01/14/93	1400	11	GRAB	0.5	0.5	4.5	-12	0.61	11.8	8.2	8.12	10	244.4	432	422	10	2	8	0.02	0.00022	1.124	10.064	0.1	0.81	0.91	0.691	98	0.647	1.316932
03/04/93	1530	11	GRAB	0.5	0.8	5	4.1	1.372	9.2	7.3	8.27	10	275	465	459	6	6	0	0.02	0.00032	1.620	10.053	0.1	1.01	1.11	0.672	98	0.661	1.651786
05/03/93	1445	11	GRAB	0.5	15.5	9.2	20.3	1.219	9.4	8.6	8.75	10	191	334	322	12			0.02	0.00276	13.787	9.546	0.1	0.86	0.96	0.468	93	0.425	2.051282

SITE 11 (NORTH BOTTOM

Appendix E-6

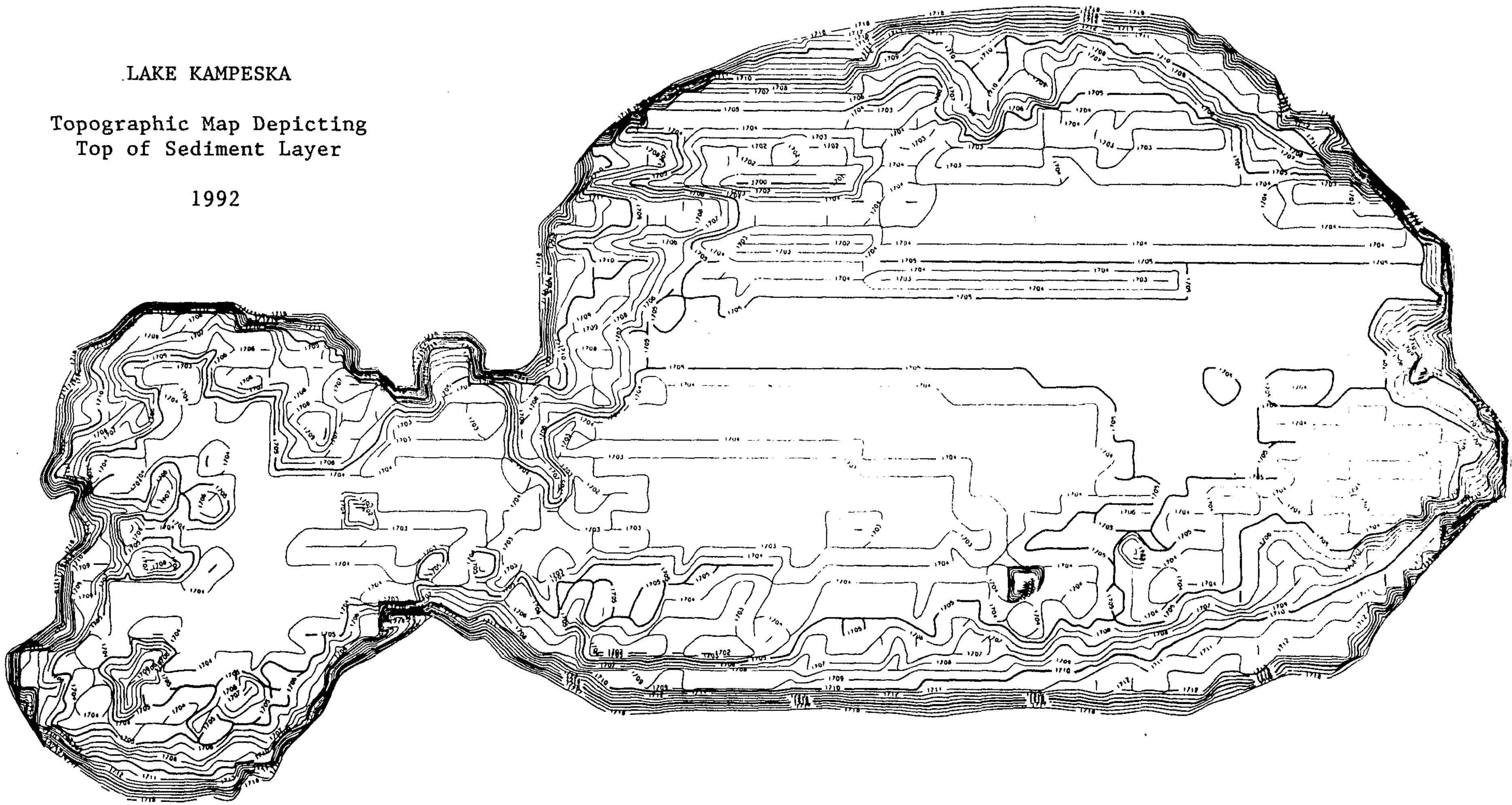
DATE	TIME	SIT	SAMP	DEPTH Feet	WTEMP SURF C	WTEMP BOTT C	ATEMP C	SDISK M	DISOX SURF mg/L	DISOX BOTT mg/L	FPH units	FECAL COLIFOR per 100mL	TALKAL mg/L	TSOL mg/L	TDSOL mg/L	TSSO mg/L	VOLSOL mg/L	FIXSO mg/L	AMMONIA mg/L	UNIONIZE AMMONIA mg/L	PERCENT UNIONAM mg/L	PKA	NO3+2 mg/L	TKN-N mg/L	TOTAL-N mg/L	TPO4 mg/L	TPO4 TSI	TDPO4 mg/L	NITR. PHOS. RATIO
10/07/91	1100	11	GRAB	13	9.4	9.5	8	0.3	9.9	9.8	8.2	40	211	372	364	8			0.02	0.00055	2.761	9.747	0.1	0.61	0.71	0.529	95	0.447	1.342155
02/19/92	1000	11	GRAB	13.5	0	4	-4	1.1	13.4	2	7.88	2	236	409	402	7	7	0	0.02	0.00017	0.867	9.938	0.1	0.65	0.75	0.491	94	0.395	1.527495
03/24/92	1400	11	GRAB	13	3.5	3	4.5	0.9	13.8	12	8.22	2	209	354	344	10			0.02	0.00035	1.731	9.974	0.1	0.36	0.46	0.458	93	0.402	1.004367
04/15/92	1215	11	GRAB	13.5	5.5	5.2	5.6	0.5	11.9	11.78	8.4	4	211	369	352	17	4	13	0.02	0.00062	3.093	9.896	0.1	0.42	0.52	0.435	92	0.286	1.195402
04/29/92	1115	11	GRAB	13	8	7	15.5	0.3	11.8	11	8.63	10	210	382	355	27	11	16	0.02	0.00118	5.897	9.833	0.1	0.19	0.29	0.495	94	0.388	0.585859
05/12/92	1115	11	GRAB	13	15.8	15.8	16.1	0.2	8.4	8.25	8.47	10	216	420	392	28	4	24	0.02	0.00158	7.906	9.536	0.1	0.5	0.6	0.445	92	0.405	1.348315
05/26/92	1315	11	GRAB	12	16.5	13.4	12	0.5	8.7	8.2	8.52	10	218	403	382	21	3	18	0.02	0.00149	7.432	9.615	0.1	0.55	0.65	0.491	94	0.442	1.323829
06/09/92	1330	11	GRAB	12	17	16	16.1	0.4	8.7	7.6	8.35	10	219	400	373	27	15	12	0.02	0.00124	6.201	9.530	0.1	0.42	0.52	0.511	94	0.445	1.017613
06/23/92	900	11	GRAB	13	18.9	18.7	17.5	0.5	8.2	5	8.47	10	218	397	381	16	5	11	0.03	0.00289	9.629	9.442	0.1	0.63	0.73	0.488	93	0.455	1.495902
07/09/92	930	11	GRAB	14	19.1	19.1	18.5	0.5	7.5	5.4	8.41	20	219	395	376	19	1	18	0.02	0.00174	8.724	9.430	0.2	0.29	0.49	0.515	94	0.425	0.951456
07/21/92	1330	11	GRAB	13.5	19.9	19.8	17.9	0.6	8	7.5	8.23	10	217	399	381	18	5	13	0.02	0.00125	6.234	9.407	0.1	0.72	0.82	0.515	94	0.465	1.592233
08/04/92	1035	11	GRAB	13.5	19.9	19.9	16.5	0.3	7.6	7.4	8.55	10	219	455	392	63	10	53	0.02	0.00245	12.274	9.404	0.1	0.92	1.02	0.521	94	0.465	1.957774
08/26/92	1245	11	GRAB	13	19.5	19	18.8	0.5	8.2	7.6	8.49	20	221	385	358	27	10	17	0.02	0.00205	10.239	9.433	0.1	0.59	0.69	0.571	96	0.515	1.208408
09/10/92	1120	11	GRAB	13	15	14.9	11	0.3	9.4	9.1	8.54	10	217	421	384	37	15	22	0.02	0.00172	8.612	9.566	0.1	0.43	0.53	0.604	97	0.548	0.877483
09/22/92	1415	11	GRAB	12.7	18	15	14	0.5	8.4	6	8.41	160	214	397	378	19	3	16	0.02	0.00132	6.576	9.562	0.1	0.8	0.9	0.621	97	0.568	1.449275
10/06/92	1200	11	GRAB	13	13.1	13.1	7.8	0.457	8.61	5.8	8.39	40	218.6	408	388	20	14	6	0.02	0.00040	1.989	10.083	0.1	0.4	0.5	0.647	98	0.608	0.772798
12/30/92	1230	11	GRAB	13	0	4	-25	0.914	13.2	12.2	8.52	2	234.2	367	366	1	1	0	0.02	0.00053	2.665	10.083	0.1	0.44	0.54	0.651	98	0.591	0.829493
01/14/93	1400	11	GRAB	12.5	0.5	4.5	-12.76	0.61	11.8	8.2	8.03	10	279.2	417	407	10	1	9	0.02	0.00018	0.878	10.083	0.1	0.65	0.75	0.674	98	0.651	1.11276
03/04/93	1530	11	GRAB	12.2	0.8	5	4.1	1.372	9.2	7.3	8.13	10	275	462	455	7	5	2	0.02	0.00022	1.103	10.083	0.1	0.87	0.97	0.698	99	0.665	1.389685
05/03/93	1445	11	GRAB	14	15.5	9.2	20.3	1.219	9.4	8.6	8.67	10	193	347	332	15			0.02	0.00074	3.7235199	10.083	0.1	1.07	1.17	0.498	94	0.468	2.348396

APPENDIX F. Lake Kampeska Sediment Survey Maps

LAKE KAMPESKA

Topographic Map Depicting
Top of Sediment Layer

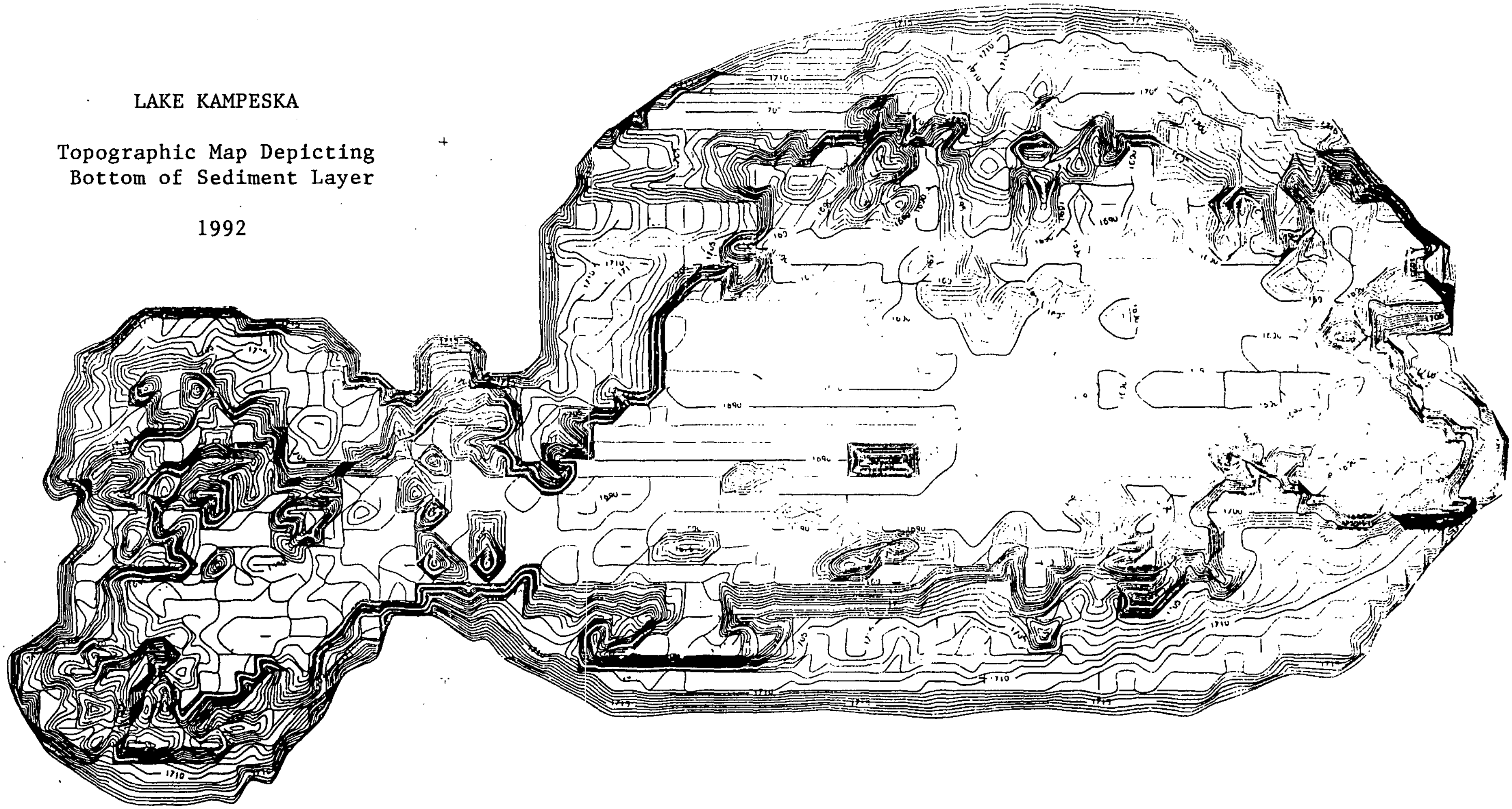
1992



LAKE KAMPESKA

Topographic Map Depicting
Bottom of Sediment Layer

1992



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

Ref: 8EPR-EP

DEC 26 1996

Mr. Steve Pirner, Director
Division of Environmental Regulations
Department of Environment and Natural Resources
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Re: Approval of TMDLs
(Section 303(d) Clean Water Act)

Dear Mr. Pirner:

Thank you for the submittal dated October 30 requesting approval of certain actions under Section 303(d) of the Clean Water Act. We have completed our review of these projects as TMDLs and wish to provide approval on some of the actions. In particular, we approve those TMDLs listed on the attached table in accordance with Section 303(d) of the Clean Water Act (33 U.S.C. 1251 et. seq.). We wish to also acknowledge that these projects submitted to us are primarily based on a voluntary approach to solving water quality problems.

In our June 26, 1996 correspondence to all of the Region VIII states, we requested that past point and nonpoint source actions be evaluated for approval as TMDLs under the Clean Water Act. We feel that each state has completed certain projects that should get acknowledgement as TMDLs. The June 26 correspondence provided a list of minimum characteristics for TMDLs. We feel that several of the actions mentioned in your October 30 letter meet these minimum characteristics.

There are several reports submitted to us regarding projects that do not qualify as TMDLs. These projects appear to have relied on a technology-based approach, using best professional judgement to develop a plan of action. Although the technology-based approach is appropriate and effective in many cases and will result in attainment of water quality goals, there were pieces missing from these particular projects that would have qualified them as TMDLs. These projects most often did not include a quantitative water quality endpoint (such as an in-lake phosphorus concentration, Secchi depth reading, or standing crop goal) or a quantitative reduction target (such as a percent reduction in either sediment or nutrient loading). Again, these projects may lead to or have resulted in attainment of water quality goals, but are considered as using a technology-based approach rather than a TMDL approach. The following are the projects that fall under the technology-based approach:

- Lake Andes (Charles Mix County)
- Beaver Lake/Beaver Creek Watershed (Yankton County)
- Burke Lake (Gregory County)
- Lake Byron (Beadle County)
- Lake Campbell/Battle Creek (Lake & Moody Counties)
- Canyon Lake/Rapid Creek
- East Lake Eureka (McPherson County)
- Lake Herman (Lake County)
- McCook Lake (Union County)
- Mina Lake (Edmunds County)
- Punished Woman's Lake (Codington County)
- Ravine Lake (Beadle County)
- Richmond Lake (Brown County)
- Swan Lake (Turner County)
- Wall Lake (Minnehaha County)

In contrast, the projects listed on the attached table fully qualify as TMDLs, meeting all the minimum requirements as provided for in our June 26 correspondence to you.

Thank you for this submittal. If you have any questions concerning this approval, feel free to contact Bruce Zander of my staff at 303/312-6846.

Sincerely,

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

cc: Tim Bjork

Attachment

Attachment

APPROVED TMDLs

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	Reference Document(s)
Big Stone Lake*	total nitrogen total phosphorus	39 μg/l area-weighted annual mean chlorophyll-*a* 105 μg/l area weighted mean total phosphorus	40% reduction in total phosphorus & total nitrogen	"Restoration of Big Stone Lake; Evaluation of the Effectiveness of Lake Management Measures; EPA Clean Lakes Phase II Final Report" (HDR Engineering; 1994)
Lake Kampeska*	total nutrients sediment	return Lake Kampeska from hypereutrophic to eutrophic condition	35% reduction in nutrient loadings 25% reduction in sediment loadings	Upper Big Sioux River Watershed Project (Section 319) Project Implementation Plan (SDDENR; June 1996) and Lake Kampeska Watershed Project (Section 319) (SDDENR; 1994)
Pelican Lake	total nutrients sediment	70 μg/l total phosphorus trophic state index (TSI) 65	55% reduction in nutrient loadings 65% reduction in sediment loadings	Upper Big Sioux River Watershed Project (Section 319) Project Implementation Plan (SDDENR: June 1996) and Lake Assessment Project; Pelican Lake; Codington County, South Dakota (SDDENR; 1995)
Lake Poinsett	total phosphorus	158 tons total lake algal biomass	40% reduction in total phosphorus	Phase I Diagnostic Feasibility Study; Final Report; Lake Poinsett; Hamlin County, South Dakota (SDDENR, 1996)

* These waterbodies are currently on or have been on the State's Section 303(d) waterbody list. The TMDLs associated with these waters are considered Section 303(d)(1) TMDLs. All others are considered Section 303(d)(3) TMDLs since the waters were not on the State's waterbody list.