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HYDROLOGIC INVESTIGATION OF THE HIGHLAND SILVER LAKE WATERSHED: 1985 PROGRESS REPORT

by
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**Prepared for the
Illinois State Rural Clean Water
Coordinating Committee**

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INTRODUCTION

Background

The Illinois State Water Plan (Illinois State Water Plan Task Force, 1984) ranked soil erosion and sediment control as the first priority of water resource management in the state. Soil is recognized as the primary agricultural nonpoint source pollutant of surface water. It is considered a pollutant because as sediment its volume reduces stream and lake capacities; it can cause high turbidity; and other pollutants can be absorbed or attached to the soil particles and so can be transported along with the sediment (North Carolina Agricultural Extension Service, 1982).

The 1972 Federal Water Pollution Control Act Amendments (PL 92-500), Section 208, required that agricultural nonpoint source pollutants be identified and assessed. The Highland Silver Lake watershed was identified in the 208 Water Quality Management Plan as a high priority area for land treatment. The 1980 Agricultural, Rural Development, and Related Agencies Appropriation Act (PL 96-100) authorized the Rural Clean Water Program. Of the thirteen projects authorized under this act the Highland Silver Lake project was one of five selected to include comprehensive monitoring and evaluation. This report summarizes the research and data collection performed for this project through 1985.

Objectives

The purpose of this study is to evaluate the water quality to determine if a reduction in turbidity and total suspended solids can be achieved by the implementation of Best Management Practices (BMPs). The specific project water quality goals are to reduce turbidity and increase secchi visibility in the lake to greater than 2 feet, and to reduce total suspended solids concentrations to an average of less than 25 mg/l. Goals for nutrient concentrations will be established if a reduction in suspended solids leads to a eutrophication problem.

To reach the project water quality goals the project calls for a reduction of the detachment and transport of soil particles by an increase in ground cover; maximization of the opportunity for settling of the suspended particles before they reach a watercourse; and a reduction of the nutrient input through better management of livestock wastes.

To assess the changes in water quality that may have occurred due to implementation of Best Management Practices (BMPs), the watershed was intensively monitored. The objectives of this report are to present and interpret the hydrologic data that were collected as part of this project.

The format and much of the content of this report are taken from an earlier progress report (Makowski and Lee, 1985).

Acknowledgments

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Many Water Survey staff helped in this project. The lake sedimentation surveys were performed under the direction of William Bogner. William Fitzpatrick designed and aided in the location and installation of the monitoring system. Sandra Graese worked for the Water Survey while an undergraduate student, and assisted in compiling the field data. Kathleen Brown typed the manuscript and camera-ready copy; John Brother, Jr., and Linda Riggin prepared the illustrations; and Gail Taylor edited the manuscript.

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DESCRIPTION OF THE STUDY AREA

Location

The Highland Silver Lake watershed is located in southwestern Illinois approximately 30 miles east-northeast of St. Louis (figure 1). Most of the watershed is in the eastern portion of Madison County, with a small part in Bond County. The watershed has an area of 49.32 square miles (31,564 acres).

Highland Silver Lake is an impoundment of East Fork Silver Creek, a tributary of the Kaskaskia River. The lake lies entirely in Madison County. The dam for the lake is about one mile northwest of the City of Highland in Section 30, Township 4N, Range 5W.

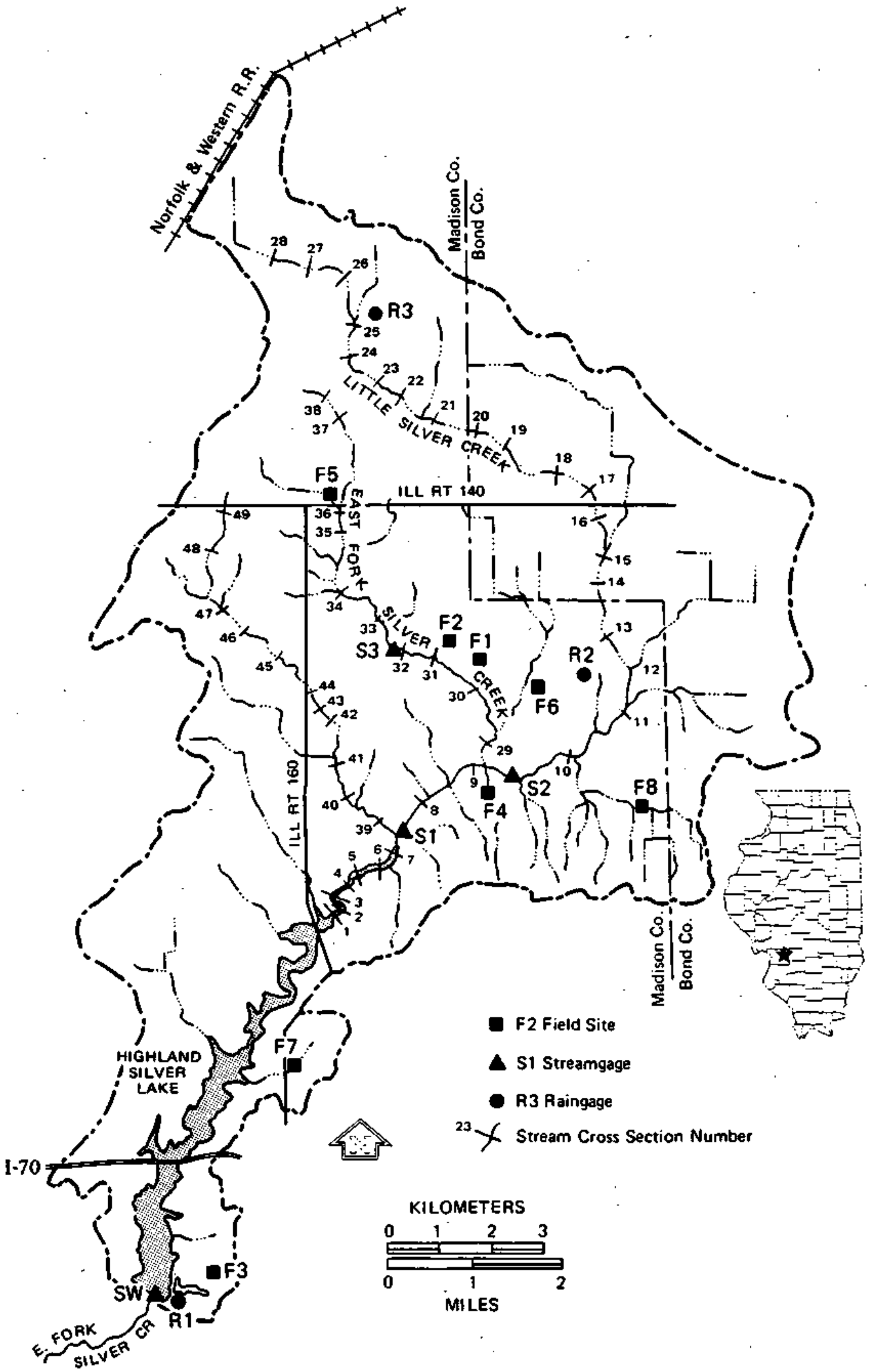

Figure 1. General watershed location map of Highland Silver Lake, with distribution of the field monitoring sites shown

The dam is a 2668-foot-long earthfill structure with an "L" shaped spillway. The spillway has a combined length of 214.08 feet, a crest elevation of 500.0 feet above mean sea level (msl), and a design discharge capacity of 9700 cubic feet per second (cfs) (Backus and Associates, 1959). A 1981 lake sedimentation survey indicated that at normal pool (spillway elevation) the lake has a storage capacity of 6336 acre-feet, a mean depth of 10.6 feet, and a maximum depth of approximately 28 feet (Bogner, 1982). Values from the 1984 lake sedimentation survey may be found later in this report.

Highland Silver Lake was completed in 1961 by the City of Highland as a public water supply. The lake's first year of use as a public water supply was 1962. The lake is also used for recreation, mainly boating and fishing, with picnicking on the adjacent park grounds. Prior to the construction of Highland Silver Lake, the old city lake, which had a capacity of about 120 million gallons, was the city's primary source of water.

Public water supply use grew from 125.9 million gallons per year in 1954 to 177.0 million gallons per year in 1964 to 307.4 million gallons per year in 1974. Since 1974 the consumption rate has remained fairly constant; the 1983 rate was 294.8 million gallons per year.

The uses of the lake are currently impaired by high levels of suspended sediment and turbidity. Suspended sediment in the lake reduces light penetration and impairs vital biological functions of aquatic life. Turbid waters affect water treatment costs. Phosphorus and nitrogen concentrations in the lake are high but do not presently impair the lake use. If turbidity levels are reduced, the increased light penetration might result in increased algal production, which could cause eutrophic-related problems that might impair lake uses (SIMRPC, 1984).

Climate

During the period 1901-1980, the maximum and minimum temperatures at Belleville (approximately 25 miles southwest of Highland Silver Lake) were 110°F above and 16°F below zero. The mean temperature for this period was 55.3°F. Other climatic variables at Belleville are as follows (ISWS, 1984):

Coldest month	January
Warmest month	July
Length of growing season	192 days
Average no. of heating degree days	4818
Average no. of cooling degree days	1320
Average annual precipitation	36.75 inches
Average annual snowfall	14.3 inches
Wettest month	June
Driest month	January

Geology

The Highland Silver Lake watershed is in the south-central region of Illinois. The land surface of this region has been shaped principally by running water and glacial ice. Several times glaciers advanced across Illinois and then melted, leaving behind glacial debris. Till, outwash, loess, and the sediment of modern streams cover the bedrock surface in this region, resulting in a relatively level plain. The bedrock surface is exposed in several areas in the Highland Silver Lake watershed. The latest period of glaciation to affect the Highland Silver Lake watershed was the Illinoian.

The underlying bedrock has an irregular surface which was formed by erosion prior to glaciation. Some of the bedrock valleys coincide with present stream valleys but they are partly or completely buried, leaving little evidence of their presence at the surface.

The bedrock beneath the glacial deposits in this region consists of beds of sedimentary shales, sandstone, limestone, and dolomite arranged one upon the other. The bedrock systems are layered, with the younger systems closer to the land surface. These systems from the surface down are Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, Cambrian, and Pre-Cambrian. The bedrock strata rest on a basement of ancient crystalline rocks composed mainly of granite. These beds were originally deposited as sediments in shallow seas or bordering marshlands and later were buried and hardened into solid rock. The rock systems were later warped and in some places fractured (Selkregg et al., 1957).

Basin Physiology

The Highland Silver Lake watershed lies entirely in the Springfield Plain of the Till Plains Section of the Central Lowland Province. A physiographic province is a region in which all parts are similar in geologic structure and which has a unified geomorphic history.

The physiographic contrasts between various parts of Illinois are due to the topography of the bedrock surface, extent of glaciation, differences in age of the uppermost drift, height of the glacial plain above main lines of drainage, glaciofluvial aggradation of basin areas, and glaciolacustrine action.

The Springfield Plain is distinguished mainly by its flatness and by the shallow entrenchment of its drainage. The southern border of the Springfield Plain is located where the drift thins and the bedrock topography becomes a controlling factor, while the western boundary follows the edge of Illinoian drift. Although most of the district is a flat till plain, the morainic features are conspicuous in the area of the Highland Silver Lake watershed. The moraines are a low and broad irregular assemblage of gravelly ridges and hills (Leighton et al., 1948).

Topography and Drainage

The Highland Silver Lake watershed has an elevation range of from 630 feet msl in the northernmost portion to a lake elevation of 500 feet msl. The greatest local relief is east of the lake where elevations of 600 feet msl may be found within 1500 feet of the lake. This steep relief provides a contrast to the relatively flat upper portion of the watershed.

The valleys are relatively shallow, and the streams have low gradients. The major tributary to the lake is East Fork Silver Creek, which may be seen in figure 1. It is joined by Little Silver Creek and two unnamed tributaries above the lake, and many minor streams also are part of the drainage system. East Fork Silver Creek is a fourth-order stream. Many first-order streams with moderate to steep slopes contribute directly to the lake.

Watershed Management

As pollutant inputs to the lake from point sources have been reduced, land activities, particularly agriculture, have continued their nonpoint source pollution input. Soil is considered a pollutant because 1) as sediment, its volume reduces stream and lake capacities; 2) sediment can cause high turbidity, which inhibits respiration and photosynthesis and can upset stream and lake ecosystems by settling out, thereby destroying benthic habitats; and 3) other pollutants such as fertilizer, pesticides, metals, toxic waste, nutrients, and bacteria can be absorbed by or attached to soil particles and thereby be transported along with the sediment. Soil loss from fields has severe negative impacts on agricultural production capacity (North Carolina Agricultural Extension Service, 1982).

Critical areas for this project (those with potential for severe erosion) have been defined as agricultural land with natric soils with slopes exceeding 2 percent or alfic soils with slopes greater than 5 percent (SIMRPC, 1983).

In addition to runoff from fields, runoff from feedlots can degrade water quality in the receiving streams. Feedlot runoff contains high concentrations of soluble nutrients and organic particulates.

The following listing identifies the Best Management Practices (BMPs) used for the Highland Silver Lake project and indicates how they contribute to improvement of water quality.

A) Permanent Vegetative Cover
Water quality is improved when permanent vegetative cover is established on farmland to prevent excessive runoff.

B) Animal Waste Control System
Facilities are provided for the storage and handling of livestock waste to prevent or abate pollution.

C) Terrace System
The installation of terrace systems can prevent or abate pollution by decreasing the slope length and steepness.

D) Diversion System
Diversions are installed where excess surface or subsurface water runoff contributes to water pollution problems.

E) Waterways
Waterways are installed to safely convey excess surface runoff across fields at non-erosive velocities.

F) Cropland Protective Cover
This measure improves water quality by providing needed protection from severe erosion on cropland between crops.

G) Conservation Tillage System
Use of reduced tillage operations in producing a crop, as well as residue management, are involved in this measure.

H) Stream Protection
Streams may be protected from sediment and chemicals through installation of field border strips, protective fencing, livestock crossings, and livestock water facilities.

I) Permanent Vegetative Cover on Critical Areas
This measure is used to stabilize a source of sediment such as gullies, banks, private roadsides, and field borders.

J) Sediment Retention, Erosion, or Water Control Structures
Structures may be built to control erosion and also to control sediment and chemical runoff to prevent water pollution.

K) Tree Planting
Water quality may be improved by planting trees in critical areas.

L) Fertilizer Management
Water quality may be improved through needed changes in fertilizer rate, time, and/or method of application to achieve the desired degree of control of nutrient movement in critical areas.

DATA COLLECTION

Data collection began in January 1982 and continued through October 1984, which amounts to 2.8 years.

Gross Erosion Assessment

Gross erosion assessment is a part of the erosion-sedimentation study. The Universal Soil Loss Equation (USLE) was used to compute the soil loss rates (SCS, 1974). An inventory of soils, land use, and land management practices was conducted for the watershed and then entered into a geographic information system (ARC/INFO). Detailed information on the gross erosion assessment will be found in the modeling report which will be prepared in 1986.

Precipitation

Precipitation was monitored at three locations within the Highland Silver Lake watershed, as shown in figure 1. The sites were located so that both the temporal and spatial variations of precipitation could be obtained. The criteria for site selection were: a location away from objects that might interfere with precipitation collection, landowner cooperation, and ready accessibility of the site.

Belfort Universal Recording Rain Gages (weighing type), as seen in figure 2, provided a continuous time distribution graph of precipitation. From graphs of precipitation (rain and/or snow), the total amount and rate of precipitation could be obtained. Comparison of hydrographs from all the stations allowed the calculation of spatial and temporal distribution of the storm events.

The charts were collected on a weekly basis and sent to the Illinois State Water Survey for digitizing. The records were then used to calculate daily and monthly precipitation, and storm frequency.

Runoff

Runoff was monitored on both a field and sub-basin level. On the field level six sites were originally planned, although eight sites were eventually installed. On the sub-basin level three stations were installed on the major tributaries to the lake and one was installed at the spillway of the lake. The locations of these gaging stations are shown in figure 1.

Field Sites

To monitor the runoff at the field sites, 2-foot and 4.5-foot H-flumes were used. These flumes act as open channel flow nozzles where a known flow rate is passed for a given height of water. They are designed to provide a fixed stage-discharge rating relationship, which is necessary to measure flow. Detailed information on the H-flume specifications can be found in a USDA publication (Brakensiek et al., 1979). These flumes were selected because they are able to pass debris and heavy sediment loads while still maintaining accuracy over a wide range of flow conditions.

Final site selection was determined by the comprehensive monitoring and evaluation team, and installation was performed by ISWS personnel. The selection criteria used specified that the sites must have:

1) Representative slopes, soils, and land use
2) Outlet into a defined watercourse
3) Landowner cooperation
4) Rural Clean Water Program (RCWP) funding to ensure BMP implementation (if not a control site)
5) Accessibility
6) Expected peak flow of less than 80 cfs, with approximately 100 acres of area when possible
7) Suitability for equipment installation and operation

Figure 2. Precipitation gage

Six 4.5-foot H-flumes were installed at FS1, FS3, FS4, FS5, FS6, and FS7 (figure 1). One 2-foot H-flume was installed at a feedlot operation, FS8. A typical flume installation is shown in figure 3. In addition, a stilling well was used at one site (FS2) where a culvert was installed as part of a BMP (figure 4). After the field installation was surveyed and the hydraulic parameters were determined, a stage-discharge relationship was obtained for the culvert. Table 1 gives information on the drainage areas, soil types, and BMPs for the field sites and streamgaging stations.

At all seven H-flume sites and at the one culvert site, stages were monitored during event runoff. There was no flow between events at the field sites. A stilling well was attached to the flume or culvert and stage monitored with a Leupold and Stevens Type F recorder, Model 68. The recorder would start automatically when a predetermined stage was reached which activated a "watchdog." The recorder also could be hand activated.

Since the field sites were located in such widely varying watersheds, the recorder gearing ranged from 12 to 48 hours in order to capture the entire hydrograph with adequate definition. Due to the wide spacing between the field sites, which prevented all sites from being visited during storm events, an instrument was developed to record the time when the recorder tripped. This was handled inexpensively with a mercury switch and a modified digital quartz clock. When the recorder tripped, the mercury switch was closed, which stopped the clock. Afterwards the clock was read for the time and date that the recorder tripped.

Streamgaging Stations

Streamgaging stations were used to monitor the flow in the streams at three locations. Two of these sites are on East Fork Silver Creek and one is on Little Silver Creek (for locations refer to figure 1; for drainage areas refer to table 1).

Each streamgaging station had a continuous water level recorder (Leupold and Stevens, Type A, Model 71) installed on top of a stilling well constructed of 24-inch corrugated metal pipe. The pipe, with its longitudinal axis oriented vertically, was either bolted to a bridge or buried in the streambank and was placed with the bottom 2 to 3 feet below the normal water surface so that low flow stages could be obtained. When the pipe was buried in the streambank, the water level within the stilling well was connected to the stream by two 2-inch horizontal pipes. The instruments were placed above anticipated high water level and were readily accessible. A typical gaging station may be seen in figure 5.

The stage-discharge relationship was obtained for the gaging station sites by discharge measurement. Data were extrapolated by using the stream cross-sectional data to calculate a backwater profile utilizing WSP2, a computer program developed by the Soil Conservation Service (1976). Both sets of data were plotted and the curve with the best fit was utilized as the stage-discharge relationship. Streamflow was then calculated by using the recorded stage levels and the stage-discharge relationship.

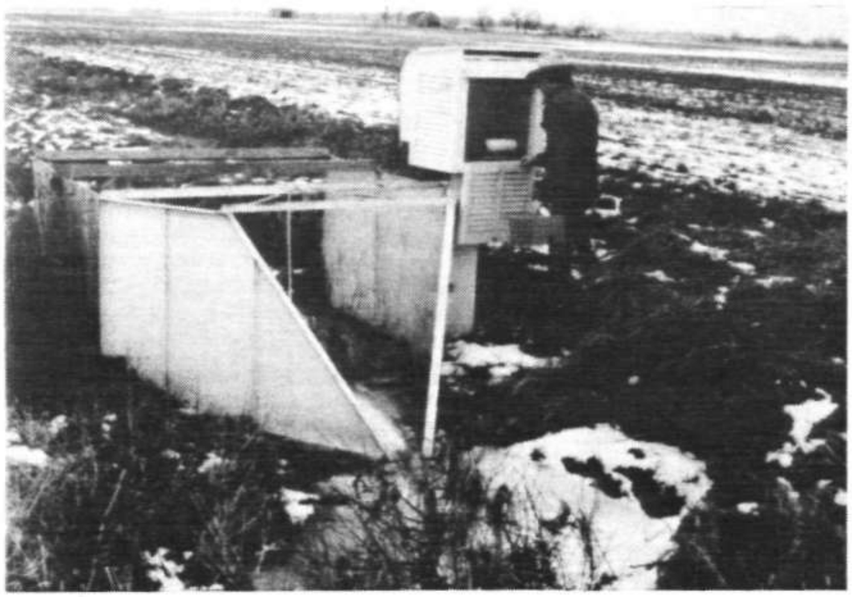

Figure 3. Typical flume installation, showing stage recorder

Figure 4. Installation at Field Site 2

Table 1. Drainage Areas, Soil Types, and Best Management Practices above the Monitoring Sites

Monitoring site	Drainage area (acres)	Soils	BMP
FS1	47[1]	Natric	Conventional tillage (no BMPs)
FS2	43[1]	Natric	Grassed waterway and sediment retention basin
FS3	29[1]	Mollic/Alfic	Grassed waterway, diversion, and no till
FS4	115[1]	Natric	Minimum tillage (partial acreage) and small terrace with diversion
FS5	332[1]	Natric	Conventional tillage (no BMPs)
FS6	58[1]	Natric	Reduced tillage
FS7	180[1]	Natric/Alfic/Mollic	Conventional tillage (no BMPs)
FS8	3[1]	Natric	Vegetative filter strip
GS1	19,916	Natric/Alfic/Mollic	(See footnote 2)
GS2	13,080	"	(See footnote 2)
GS3	3,037	"	(See footnote 2)
SW	31,564	"	(See footnote 2)

[1] Based on field measurement
[2] BMPs were applied in a portion of the subwatershed. Details may be found in the 1985 Summary Report (SIMRPC, 1985)

FS = field site
GS = gaging station
SW = spillway site

Figure 5. Typical streamgaging station installation with stage recorder on top of the stilling well and automated sampler in the foreground (Note that the creek is at bankfull flow)

Water level records from the streamgaging stations and flume sites were digitized and entered into the University of Illinois CYBER computer by ISWS personnel.

Spillway

In addition to the monitoring stations already mentioned, the amount of flow leaving the watershed was monitored at the spillway of the lake. The height of water in the lake was monitored daily by water treatment plant personnel. Daily stage readings were obtained from a porcelain enamel staff gage located near the water treatment plant. From the relative elevations of the spillway and staff gage, the lake level with respect to the spillway was obtained.

The stage-discharge relationship was obtained by performing hydraulic calculations from the spillway geometry. The daily stage readings could then be transformed into daily discharge.

Water Quality

Water quality sampling was performed at each of the stations that monitored runoff (eight field sites, three gaging stations, and the lake spillway).

Methods of Sampling

Water samples were obtained by three methods:

1) Hand dipped bottle -- The sample bottle is used to grab a water sample. This method is usually used for periodic sampling during low flows.

2) Weighted bottle -- A metal bottle holder attached to a rope is used to immerse the sample bottle into the stream or lake. This method is used for routine samples during medium to high flows.

3) Automated sampler -- The ISCO model 1680 was used in this project. The sampler was self-starting, activated by an electronic water level sensor. Samples were obtained by an internal pump which withdrew a specified amount of water at specified time intervals. Samples were stored in separate bottles within the sampler. This method of sampling was used for sampling storm runoff events to provide information as to the variation of the water quality parameters during elevated flow conditions. A typical installation is seen in figure 6.

Sampling Schedule

Four sampling frequencies were used for water quality monitoring: three per week (Monday, Wednesday, and Friday), biweekly, monthly, and event basis. Table 2 lists the sampling schedule and the parameters analyzed for each type of site.

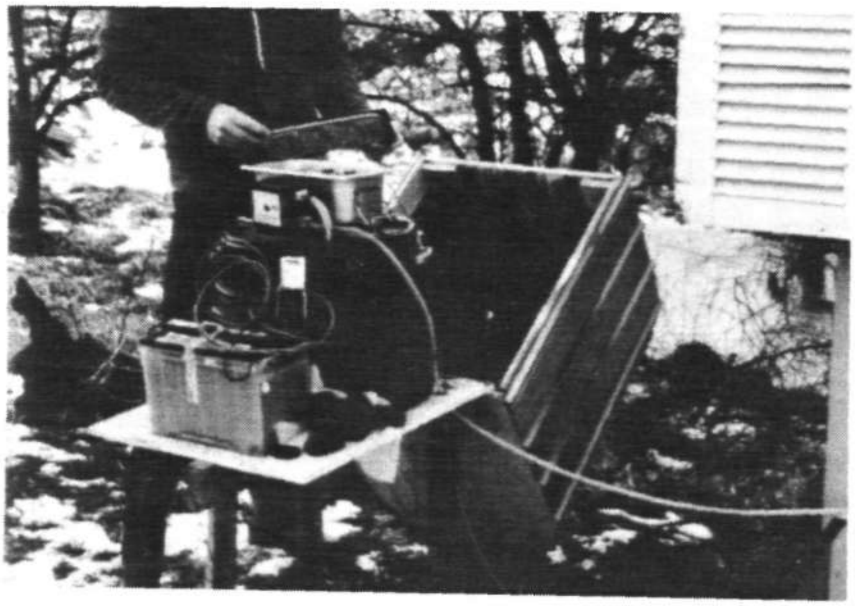

Figure 6. Typical installation of the automated sampler at a field site

Table 2. Sampling Frequency and Sampled Parameters at the Monitoring Sites

	Sampling frequency			
	Three per week	Biweekly	Monthly	Event basis
Spillway	1	2	3	-
Gaging stations	1	2	3	4
Field sites	-	-	-	4

1 - Total suspended solids, total volatile suspended solids, turbidity, dissolved oxygen, pH, temperature, and conductivity

2 - Same parameters as in 1 plus total phosphorus, total Kjeldahl nitrogen, dissolved phosphorus, ammonia, nitrate-nitrite, and chemical oxygen demand

3 - Same parameters as in 1 and 2 plus calcium, magnesium, sodium, potassium, barium, boron, beryllium, cadmium, chromium, copper, cobalt, iron, lead, manganese, nickel, strontium, zinc, and mercury

4 - Total suspended solids, total volatile suspended solids, turbidity, total Kjeldahl nitrogen, total phosphorus, and chemical oxygen demand

Lake Sedimentation

Sediment surveys were conducted on Highland Silver Lake in July 1981 (Bogner, 1982) and September 1984. For the surveys, 15 primary range lines were laid out for determining the sedimentation rate of the lake as a whole. In addition, 8 secondary range lines were laid out for study of the small bay immediately upstream of the I-70 bridge.

In the surveys, sounding data were collected at regular intervals along each range line to determine both the original and current depths of the reservoir. All depth measurements were made with a 2-inch-diameter aluminum pole marked in tenths of feet. The pole was first lowered until it touched the current lake bottom, and a depth measurement was made. The pole was then pushed through the accumulated sediment until it hit the solid original lake bed, where another depth measurement was made. Horizontal control on each cross section was maintained either by a marked cable or by a cable with a meter (Bogner, 1982).

Samples of the accumulated sediments were collected during the survey to determine particle size distribution and unit weight of the sediments. Multiple measurements and interpolation between data points allow the calculation of total accumulated sediment and lost reservoir capacity.

DATA ANALYSES

Precipitation

As shown in figure 1, there were three recording raingages used in the Highland Silver Lake study. The raingages were installed in September 1981. The results of the monthly precipitation data recorded from January 1982 through October 1984 are presented in table 3. Included in this table are the results from a National Oceanic and Atmospheric Administration (NOAA) raingage located in Belleville, Illinois, which was used for comparison purposes. The departure from normal at Belleville indicates whether the monthly precipitation was above normal, below normal, or normal in the Highland Silver Lake study area.

An average of the precipitation recorded at the three raingages on the Highland Silver Lake watershed is used for the discussion. Monthly precipitation amounts with no missing data were used to compute the average. The average precipitation was obtained by arithmetically averaging the gaged precipitation amounts in the study area.

The amount of precipitation recorded during the period of data collection was 17.78 inches (14.5 percent) above normal as indicated by the Belleville station. There was one extended dry period that occurred from May - 1983 through September 1983. The two months following this dry period experienced precipitation almost 10 inches above normal. In December 1982 the precipitation was significantly above normal.

In addition to the computation of monthly precipitation, the continuous precipitation records were used to determine the recurrence interval for individual events. The recurrence interval signifies the average number of years within which a given event will be equaled or exceeded. The frequency values are based on statistical relations based on observed data (ISWS, 1970; Huff, 1974). Those relations are dependent on the location within the state, length of storm, precipitation depth, and season. The results are presented in appendix A. In addition to the recurrence interval for the entire event, appendix A also shows the maximum 5-minute, 30-minute, and 60-minute precipitation amounts and the associated recurrence intervals. The maximum recurrence interval, 19.2 years, was recorded on June 2, 1983, at raingage 1. The maximum 5-minute recurrence interval (15.0 years) was recorded on June 28, 1983 at raingage 2, the maximum 30-minute recurrence interval (12.0 years) on March 18, 1982 at raingage 1, and the maximum 60-minute recurrence interval (4.7 years) on March 18, 1982 at raingage 1.

Runoff

Runoff data were collected at eight field sites, at three gaging stations, and at the spillway of the lake. Figure 1 shows the locations of these data collection sites within the watershed. Continuous discharge at the gaging stations, daily discharge at the spillway, and event data at the field sites were collected. Since a complete set of runoff data could not be obtained at the field sites due to equipment failure, these data could not be used to obtain monthly values. The occurrences of storm events are presented in table 4. No event data were collected at the spillway.

Table 3. Monthly Precipitation for the Highland Silver Lake Watershed, Highland, Illinois

				Highland Silver Lake Watershed			
Year	Month	NOAA Belleville raingage (inches)	Departure from normal (inches)	Raingage No. 1 (inches)	Raingage No. 2 (inches)	Raingage No. 3 (inches)	Precip. based on 3 gages (inches)
1982	Jan	4.41	2.50	3.47[2]	3.26[2]	2.52[2]	3.47
	Feb	1.10	-1.10	2.02[3]	.54[2]	.82[2]	2.02
	Mar	2.19	-1.25	4.19	4.33	2.89	3.80
	Apr	2.68[1]	-1.06	3.89	3.40	2.22	3.17
	May	4.91	1.06	5.38	5.86	5.58	5.61
	Jun	2.67	-1.31	4.44	4.66	4.27	4.46
	Jul	4.56	1.20	4.95	4.88	3.53[3]	4.45
	Aug	3.59	.30	2.96	3.30	3.11	3.12
	Sep	3.95	.77	4.20	3.17	4.01	3.79
	Oct	2.97	.60	5.34	5.08	1 .05[2]	5.21
	Nov	2.56	-.36	3.40	2.81	2.14[2]	3.10
	Dec	9.35	6.84	7.91[3]	7.43	6.94	7.43
Subtotal		44.94	8.19	52.15	48.72	39.08	49.63
1983	Jan	.86	-1.05	.80[3]	.36	.51	.56
	Feb	.89	-1.31	.85[2]	.81	.91	.86
	Mar	3.82	.38	3.37	2.58[3]	3.45[3]	3.13
	Apr	5.44	1.70	7.67	6.98	5.73[2]	7.32
	May	3.82	-.03	4.01	4.04	2.59[2]	4.02
	Jun	3.53	-.45	7.46	8.19	2.79[2]	7.82
	Jul	.96	-2.40	.47	.52	.46	.48
	Aug	1.98	-1.31	1.23	.82	.60	.88
	Sep	2.16	-1.02	1.29	1.59	1.04	1.31
	Oct	7.70	5.33	6.93	6.00	6.18	6.37
	Nov	7.55	4.63	5.68[3]	7.32	8.74	7.25
	Dec	4.00	1.49	.17[2]	3.75[2]	4.73[3]	4.73
Subtotal		42.71	5.96	39.93	42.96	37.73	44.73
1984	Jan	.58	-1.33	.13[2]	.37[2]	.63[3]	.63
	Feb	2.27	.07	0.00[2]	1.81[3]	.69[2]	1.81
	Mar	4.85	1.41	5.44[3]	2.26[2]	3.98[2]	5.44
	Apr	4.80	1.06	4.63*	6.02*	5.50	5.38
	May	3.64	-.21	3.15	3.53	3.46	3.38
	Jun	1.65	-2.33	1.39	.93	1.18	1.17
	Jul	1.56	-1.80	.76	1.07	1.05	.96
	Aug	3.53	.24	2.62**	2.48	1.79	2.30
	Sep	7.32	4.14	6.24	8.63	7.70	7.52
	Oct	4.75	2.38	4.66	4.71	4.93	4.76
Subtotal		34.95	3.63	29.02	31.81	30.91	33.35
Totals		122.60	17.78	121.10	123.49	107.72	127.71

[1]Belleville data missing; used Cahokia data
[2]Missing data
[3]Missing data -- no significant effect on the amount of precipitation recorded

Table 4. Occurrences of Recorded Storm Events

Date	FS1	FS2	FS3	FS4	FS5	FS6	FS7	FS8	GS1	GS2	GS3
1982											
Jan	1			3	1	3	1		2		
Feb				1			1		2	1	
Mar	2			2	2	3	3		3	4	2
Apr	2				2	3	1		3	1	1
May	3			2	3	4	21		7		6
June	3			2	3	4	2		7		6
July	1				1	1			2	1	2
Aug						1			1	1	
Sept	1	2	2	1	2	2	3	2	3	4	3
Oct	2		2	2	3	1	2	2	1	2	2
Nov	1		3	1	1		2		3	2	2
Dec	3		1	2	2	2	3	3	4	3	3
1983											
Jan											
Feb	1		1	1	1	1	1	1	1	1	1
Mar	2	1	2	2	2	2	3	2	2	3	2
Apr		1	3	2	3	3	2	3	6	7	6
May				1	1		1	2	1	3	1
June	2		1	1	2	1		2	4	4	3
July											
Aug											
Sept											
Oct	1		1	2	1	2	2	2	1		1
Nov	4	3	3	4	4	4	3	3	5	4	5
Dec	1	1	1	1	1	1	1	1	3	2	2
1984											
Jan									4	3	
Feb									4	3	
Mar					1	1	1	1	5	7	8
Apr	2	1	1	1	1	2	1	1	2	1	1
May									3		
June											
July											
Aug							1				
Sept	1	1			1	1			3	2	2
Oct									4	1	3
Total	33	10	21	31	39	40	36	25	80	60	59

Table 5. Field Site Installation Dates, Dates of First Recorded Event, and Number of Events

Field site number	Flume size	Installation date	First event date
1	4.5 ft	November 1981	January 1982
2	*	September 1982	September 1982
3	4.5 ft	August 1982	September 1982
4	4.5 ft	October 1981	January 1982
5	4.5 ft	October 1981	January 1982
6	4.5 ft	October 1981	January 1982
7	4.5 ft	November 1981	January 1982
8	2 ft	September 1982	September 1982

* 2-ft-diameter culvert (no flume)

Field Sites

In table 5 the installation dates and dates on which the first event was recorded at each field site are presented. The field sites that were installed in 1981 were instrumented in January 1982. Field sites 2, 3» and 8 were installed after the implementation of land management techniques and were instrumented during the installation. Differences in the number of events recorded at each field site occurred because of the time of installation, insufficient runoff, spatial distribution of precipitation, or equipment malfunctions.

Since the watersheds above the field monitoring sites are comparatively small, the watercourses respond directly to precipitation and thus are classified as ephemeral. The flow patterns at a flume site during a storm event are shown in figure 7. The time scale of the hydrograph was selected for each site so that enough definition would be obtained without sacrificing the tail end of the hydrograph. Due to the watchdog nature of the instruments used to record the hydrograph, an insignificant portion of the initial part of the hydrograph is not obtained. When an event was anticipated, the instruments were activated so that the total hydrograph was captured.

Runoff ratios (precipitation divided by runoff) were computed for the field sites and are presented in appendix B. The precipitation amounts were not averaged for analysis, and precipitation amounts were obtained from the nearest raingage. Complex storms, which are periods of precipitation interspersed with periods of little or no precipitation, were accounted for in either of two ways. When the runoff hydrograph contained the number of peaks which corresponded to the peaks in the precipitation, the whole precipitation amount was used. Otherwise, if only one peak was captured on the hydrograph, the precipitation causing that peak was subtracted from the entire precipitation amount, which makes the procedure somewhat subjective.

Figure 7. Flow patterns at a flume site during a storm event

Some events occurring in the winter months were caused by runoff from melting snow and could not have a runoff ratio computed on an event basis.

Runoff ratios vary with the conditions of the watershed such as the antecedent moisture conditions, average and peak intensities of precipitation, and condition of the ground (tilled, frozen, etc). These conditions vary within a watershed over time. Watershed basin characteristics such as differences in slope, soils, and land use come into Play with interwatershed comparisons.

Streamgaging Stations

Discharge data were collected on a continuous basis at the gaging stations, so both event and daily data are available. An event at a field site is defined by the occurrence of flow. At the streamgaging stations an event is not so clearly defined. The onset of an event at a streamgaging station occurred when the flow rate above 1 cubic foot per second (cfs) doubled within an hour. This initial criterion reflects the rapidly varying flow rate of the rising portion of a hydrograph. The peak flow rate must be above 25 cfs to be considered an event. The end of the event was taken to be when the difference between successive hourly flow rates was less than 1 cfs, which reflects the tails of the hydrograph. So that inflection points in complex events are not taken to be cutoff points, the successive flow rates must be less than 10 cfs. With these criteria, the runoff ratios for the gaging stations were calculated. They are presented in appendix C. As with the field sites, the precipitation amounts were obtained from the nearest raingage.

The total monthly discharges and monthly runoff ratios are presented in appendix D. The precipitation amounts used were an average of the available precipitation data recorded on the watershed. Major differences between the stations are caused, in part, by incomplete records. The greatest volume of water, which was obtained by normalizing the drainage area, was recorded at gaging station 1 . It is felt that this was caused by subsurface flow entering the channel. This subsurface flow became increasingly important with an increasing drainage area and was observed at the gaging stations. A sustained period of no flow was observed at all the monitoring stations during the drought of summer 1983. The highest runoff and runoff ratios were observed in late autumn, winter, and early spring. Causes of the elevated runoff were: 1) heavy rainfall causing saturated conditions, and 2) frozen soil which allowed little infiltration.

Spillway

Stage data were collected at the spillway on a daily basis. There were no intensive stage data taken during events. Therefore, no event runoff ratios were computed. Appendix E presents the monthly discharge and runoff ratios for the spillway. It also shows the water used at the municipal water treatment plant. The municipal use is small, about 2 percent of the flow that discharges over the spillway.

The lake system is somewhat different from both the field and stream sites. The lake attenuates flow significantly, and it receives direct precipitation on its surface that is not subject to losses such as interception, evapotranspiration, and infiltration, as is the case with precipitation on land. On an average annual basis, lake evaporation is somewhat less than the precipitation. On an event basis, direct precipitation on the surface of the lake can contribute a significant portion of the flow measured at the spillway.

Gross Erosion

The gross erosion was calculated using the Universal Soil Loss Equation (USLE). A geographic information system (ARC/INFO) was used to handle the computation. The annual gross erosion rates at the field sites and gaging stations, in tons per acre, are shown below. The annual gross erosion for the entire watershed was estimated at 2.9 tons per acre and individual values ranged from 0 to 50 tons per acre. No gross erosion was calculated for the feedlot site (FS8).

FS1	FS2	FS3	FS4	FS5	FS6	FS7	G1	G2	G3	Entire watershed
2.7	1.1	11.9	2.5	2.6	3.9	6.6	2.6	2.5	2.4	2.9

Lake Sedimentation

The results of the 1984 lake sedimentation survey are presented in table 6. The survey indicated that the lake has lost 0.67 percent of its capacity per year since its construction in 1961. However, the sedimentation rate between 1981 and 1984 decreased to 0.57 percent per year. The loss of storage is greatest in the upstream end of the lake and decreases in the downstream direction. The coarsest material was found in the upstream end of the lake. As the velocity decreases due to the larger cross-sectional area of the lake, the larger sediment drops out of suspension, which results in elevated sedimentation rates at the upstream end of the lake. The average annual sediment deposition in the lake since its construction is 1.35 tons per acre of watershed. The average annual lake sedimentation between 1981 and 1984 was 0.90 tons per acre.

Sediment and Nutrient Loads

Water quality data were collected at the same locations as runoff data (refer to figure 1 for locations). For the sampling frequency and parameter coverage refer to table 2.

Event Basis

In the case of storm events which were discrete activities, the concept of the event mean concentration (EMC) was used. The EMC is the flow-weighted average value of each sampled water quality constituent for the entire storm

Table 6. Summary of Sedimentation Data
Highland Silver Lake 1984

Age	Years	
Built November, 1961		
Survey July, 1981	19.7	
Survey September, 1984	22.8	
Watershed	Sq ml	Acres
Total area	49.3	31,564
Area excluding lake	48.4	30,966
Reservoir		
	Sq mi	Acres
Surface area at spillway level	0.94	598.1
Storage capacity at spillway level	Acre-feet	Mil gal
1961	7340	2390
1981	6350	2070
1981	6220	2030
Capacity per square mile of drainage area*	Acre-feet	
1961	149	
1981	129	
1984	126	
Sedimentation	Acre-feet	
1961-1981	990	
1961-1984	1120	

Average annual accumulation of sediment**	
	Acre-feet from entire watershed
1961-1981	50.35
1981-1984	41.94
1961-1984	49.12
	Acre-feet per square mile
1961-1981	1.04
1981-1984	0.87
1961-1984	1.02
	Cubic feet per acre
1961-1981	70.8
1981-1984	59.2
1961-1984	69.4
	Tons per acre
1961-1981	1.42
1981-1984	0.90
1961-1984	1.35

Depletion of original storage	Percent of original storage	Percent per year
1961-1981	13.5	0.68
1981-1984	1.8	0.57
1961-1984	15.3	0.67

* Includes area of lake
** Excludes area of lake

event (Bender et al., 1983). EMC values were calculated according to the following equation:

$$EMC_j = \frac{\sum_{i=1}^{n-1} [C_{j,i}\, Q_i + C_{j,i+1}\, Q_{i+1}]\ \Delta t_i/2}{\sum_{i=1}^{n-1} [Q_i + Q_{i+1}]\ \Delta t_i/2} \qquad (1)$$

where

EMC_j = event mean concentration of parameter j
$C_{j,i}$ = instantaneous sample concentration for time i, and parameter j
Q_i = instantaneous discharge at time i
Δt_i = time between samples

For computing the EMC, the units within the equation must be consistent. EMCs were computed for both the field sites and the gaging stations. To ensure that the calculated EMC is representative of the storm event, the time and volume of flow between the instantaneous sample concentrations must not be too great. Storm events that had a sufficient number of instantaneous samples which included at least 50 percent of the total event volume were selected for EMC and load computation. Appendix F summarizes the number of occurrences of runoff, suspended sediment loads, and nutrient loads which were calculated. Runoff data were collected more often than suspended sediment loads, which in turn were measured more often than nutrient loads. Because load is a product of discharge and concentration, no load can be computed if the discharge value is absent even though concentration data are available. Frequently concentration data are unavailable due to sampler failure or contaminated samples.

A water quality load was obtained by multiplying the EMC by the total volume of runoff for the event. In addition, multiplication by a constant was necessary for the units to be consistent. Load which is normalized by runoff is the EMC. The results of the EMC and water quality load computations are presented in appendix G.

Comparisons between stations are best made using the EMC values since using loads would bias the sites with larger drainage areas. If the available data are used, comparison of the maximum values of the parameters for the field sites suggests that field site 8 (FS8) experiences the highest concentrations of TKN, TPH, and COD. These elevated nutrient concentrations might be expected due to the fact that this entire watershed is a feedlot. The highest concentration of TSS was found at FS7, which is the steepest watershed. The site with the lowest concentration of TSS was FS8, whose entire watershed was either paved or consisted of a grass filter strip. FS2 had the lowest value of TKN while FS4 had the lowest value of TPH of the field sites.

Monthly Basis

To relate the suspended sediment and nutrient concentrations to the suspended sediment and nutrient loads, the following equation was used:

$$Qs = 0.00269 \cdot Cs \cdot Qw \qquad (2)$$

where

Qs = load in tons per day
Cs = concentration in mg/l
Qw = flow rate in cfs

There were no monthly loads computed for the field sites since not all events were monitored. Because of the missing events, monthly totals of these discrete events would not be representative without significant adjustments to the data.

There are differences in the methods used to compute the event and monthly loads of these water quality parameters. The EMC method is commonly used to calculate loads due to its simplicity. The method to compute monthly loads is more involved since it utilizes the discharge data between concentration samples and so tends to provide a more accurate representation of the actual condition. The more the hydrograph deviates from a linear trace between the concentration samples, the less accurate are the results. The EMC method was used since it is consistent with prior results (Bender et al., 1983).

The discharge and water quality concentration data that were available for the spillway were instantaneous values. Since the sampling location was on the lake, it was assumed that the instantaneous water quality concentration samples and discharge data were representative of the entire day. The suspended sediment and water quality loads were determined from both of these concentrations and the daily discharges. Missing concentrations were obtained by interpolating linearly from the data immediately prior to and following the missing data for the spillway only.

The municipal water treatment plant uses lake water and in so doing draws off a portion of the suspended sediment and nutrients. Settling ponds, which collect the backwash water from the filters, are located west of the treatment plant. The backwash water is comprised in part of suspended sediment and the other water quality parameters which were monitored in this study. These ponds have been cleaned in the past but they were at capacity during the monitoring period so the ponds were short circuited. Therefore, for all practical purposes the material removed from the lake during water treatment is returned to the lake. In comparison to the flow over the spillway, the amount of water drawn off by the treatment plant is small, and since the loads are proportional to the flow rates, the loads removed by the water treatment facility are not significant whether the loads re-entered the lake or not.

The methodology for the computation of loads at the three streamgaging stations differs from that for the spillway. The discharges at each gaging station were monitored on a continuous basis while the discharges at the spillway were collected on a daily basis. Water quality samples were collected on a routine basis at the gaging stations and spillway, while at the gaging stations additional intensive sampling was performed during storm events. The loads at the spillway were computed simply by using an average daily discharge and the corresponding water quality concentration. This is justified since the lake responds relatively slowly with respect to both discharge and water quality concentrations.

At the streamgaging stations, however, both discharge and water quality concentrations vary relatively quickly. Therefore, the temporal midpoints between sampling times of consecutive water quality concentrations are determined, and the corresponding discharge is then determined. If one entire day is encompassed by one water quality concentration, the average daily discharge is used to determine the load. If two or more water quality concentrations are sampled in one day (as can occur when an event is sampled intensively), the corresponding volume of discharge is determined and then weighted so when the two or more parts of the load are summed the daily load is obtained.

An example of the daily water quality load calculation method may be seen in figure 8. In this example there were six water quality concentration samples taken over three days. Since the temporal midpoint between samples 1 and 2 occurs within the day for which the load is to be computed, this concentration is utilized for a portion of the daily load. The temporal midpoint between samples 5 and 6 lies outside the day under investigation so sample 6 has no impact. The instantaneous discharge values are applied to these water quality concentrations and a load is determined. These loads are weighted and then summed to yield a daily water quality load.

The computed monthly summaries of water quality loads at the gaging stations and spillway are presented in appendix H. Caution must be exercised when comparing the monthly totals with one another because of incomplete records.

Water Quality Parameters

The results of the water quality load computations were presented in the preceding section. In this section each water quality parameter will be described and, where applicable, the concentration and loading will be discussed qualitatively.

There were six parameters sampled at the field sites: total suspended solids, total volatile solids, total Kjeldahl nitrogen, total phosphorus, turbidity, and chemical oxygen demand. In addition to these parameters, the following parameters were analyzed for samples collected at the gaging stations and spillway: ammonia, nitrate and nitrite, dissolved phosphorus, pH, dissolved oxygen, conductivity, and water temperature.

The maximum, minimum, mean and standard deviation of selected water quality parameters are presented in appendix I. The samples at the gaging stations represent both routine and event samples, whereas the samples at the spillway consisted solely of routine samples and the samples at the field sites were event samples. Comparing the maximum values of the water quality

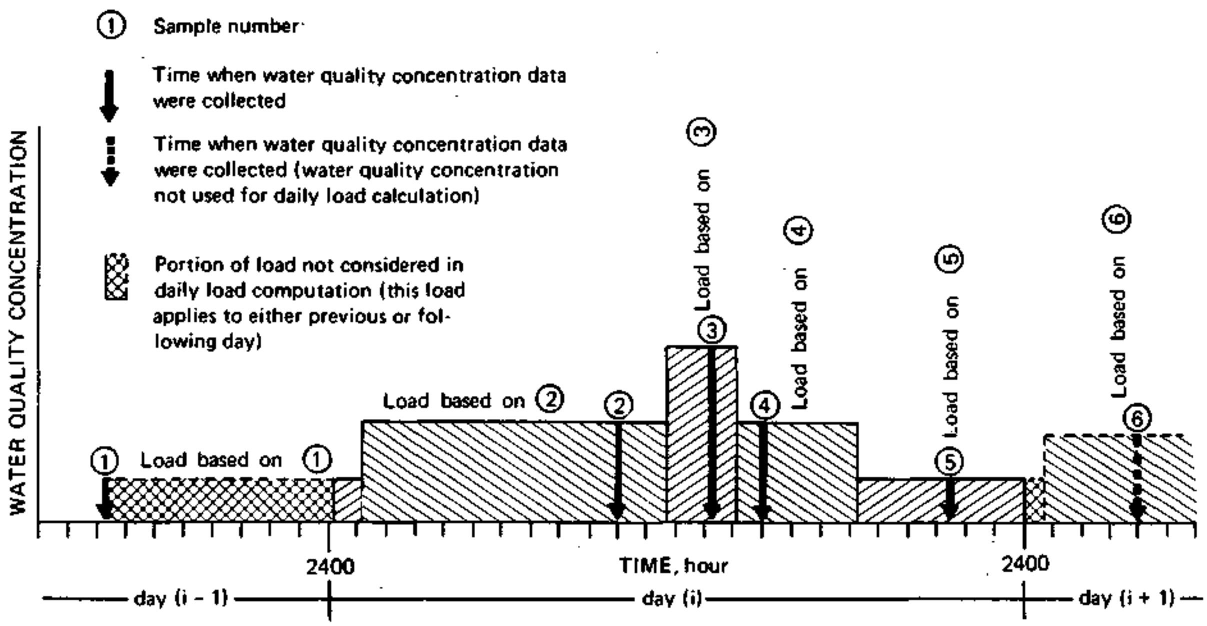

Figure 8. Daily water quality load calculation method

parameters shows that FS5 has among the worst water quality characteristics (after FS6 and FS7) though the watershed is flat and had a low gross erosion estimate. The water quality at FS2 appears better than that at either GS1 or GS3. The water quality at the spillway is the best of the sites monitored in the watershed.

The results of the regression between selected water quality parameters are presented in appendix J. In addition, selected water quality parameters were regressed with flow. A logarithmic regression equation was used where A is the y-intercept, B is the slope, and R is the correlation coefficient. The only regression relationship with a consistently high correlation coefficient is TSS against TVS. The volatile suspended solids are the organic portion of the total suspended solids, so some correlation is to be expected. A relationship between turbidity and TSS might be expected since turbidity is caused by the presence of suspended matter, but none was consistently found. No consistent relationship was found between flow and water quality parameters. A reasonable expectation is that when the flow increases so does its capacity to transport material. While this is true, transport also is dependent on the availability of material. The rising limb of the hydrograph was found to transport more material per unit discharge (the material has a higher concentration) which thereby decreased the overall correlation.

The following discussions are presented according to parameter. A brief summary accompanies the discussion of each parameter to clarify and help explain any conclusions.

Total Suspended Solids (TSS)

Total suspended solids are the materials left on the filter after the filtration and drying process. A significant portion of this material is sediment, and the term "total suspended solids" is quite often used synonymously with "suspended sediment." Sediment is of paramount importance in this study because erosion is the removal of soil particles from land. The amount of soil detached from the watershed is a function of a number of factors, including rainfall amount, rainfall intensity, antecedent moisture, ground cover, soil conservation practices utilized, land slope, and soil type.

The maximum values of TSS were found at the field sites, especially FS6 and FS7, as seen from appendix I. The highest mean values of TSS were recorded at FS7, FS2, and FS3. The maximum value of TSS at FS6 suggests an anomaly which was caused by one event (28 June 1983). The other sites on this date did not result in this extreme value. The lowest TSS (maximum and mean) at a field site was recorded at FS8. As mentioned earlier this feedlot site consists mostly of paved and grassed areas. The values recorded at the other field sites were fairly well grouped about each other.

With respect to the streamgaging stations, GS1 experienced the greatest recorded maximum and mean values of TSS. This could possibly be due to the turbulent conditions upstream of FS1 (and below GS2) that resuspended the solids that might have settled out. These turbulent conditions are caused by a rock outcropping which causes a pool at GS2. The pool may allow material to settle out of suspension and may explain the low values at GS2. The values recorded at the spillway were low as compared to those at the other sites. The maximum value is less than the means at the other sites (FS8 excluded). The mean measured at the spillway was in excess of the project goals.

Total Volatile Solids (TVS)

Total volatile suspended solids or total volatile solids are a rough approximation of the organic matter present in the total suspended solids. The result of igniting the sample may also reflect the loss of other components besides organic carbon (Standard Methods, 1975). The volatile suspended solids are the organic fraction of the total suspended solids that oxidizes and is driven off as gas at 559°C. The inorganic fraction remains behind as ash. The total volatile solids concentrations are necessarily smaller than the total suspended solids concentrations since the TVS constitute a portion of TSS.

The maximum and mean TVS concentrations were highest at FS7 followed by FS6, as seen in appendix I. The lowest mean value was recorded at FS5 and the lowest maximum at FS8. As is to be expected, TVS constituted the greatest portion of TSS at FS8 due to the organic nature of the runoff.

The values of TVS recorded at the streamgaging stations were generally below those at the field sites. The means at the three stations are similar. The ratio of TVS to TSS at the spillway was relatively high due to the low overall values of TSS and TVS.

Total Kjeldahl Nitrogen (TKN)

Total Kjeldahl nitrogen (TKN) is the sum of organic nitrogen and ammonia nitrogen. Organic nitrogen is defined as organically bound nitrogen in the oxidation trinegative state and does not include all organic nitrogen compounds (Standard Methods, 1975). Ammonia nitrogen will be discussed later.

Nitrogen is a component of the nitrogen cycle and occurs naturally. Nitrogen is also applied to agricultural land as fertilizer, which elevates nitrogen levels above those that occur naturally.

The mean value of TKN varied little among all the stations, with FS8 having the greatest value and the spillway having the least as seen in appendix I. The largest maximum value recorded was at GS3 (followed closely by FS8) and the lowest maximum was at the spillway. Since FS8 is a feedlot, TKN in high proportions should not be unexpected. The high value of TKN at GS3 occurred on 20 October 1983 after a prolonged dry period. The elevated value probably stems from a concentrated runoff from an adjacent area where cattle are pastured.

Total Phosphorus (TPHS)

Phosphorus occurs in natural waters almost solely in the form of phosphate compounds. These forms are commonly classified into orthophosphates, condensed phosphates, and organically bound phosphates. These may occur in the soluble form, in particles of detritus, or in the bodies of aquatic organisms. Orthophosphates are applied to agricultural land as fertilizer. Organic phosphates are formed primarily by biological processes. Phosphorus is essential to the growth of organisms, although in nuisance quantities it may stimulate growth in undesirable populations (Standard Methods, 1975).

With the exception of FS8, the mean values of TPH show minor variances between the sites as seen in appendix I. Since FS8 is a feedlot, it has high nutrient runoff. The spillway had the smallest mean value. FS8 also had the largest maximum value of TPH, and the spillway had the smallest value.

Turbidity (TURB)

Turbidity in water is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms. Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines (Standard Methods, 1975). In other words, turbidity is a measure of light-transmitting properties of water. The units of turbidity used here are nephelometric turbidity units (NTU).

There is a wide variation among the sites of the mean and maximum values of turbidity as seen in appendix I. FS7 had the highest mean and maximum values while the spillway had the lowest values. The turbidity values at the rest of the field sites are grouped together, with FS8 having the lowest. The values at the streamgaging stations are less than those recorded at the field sites. There is somewhat of a correlation between TSS and turbidity at the field sites (excluding FS5). The relationship between TSS and turbidity is not as strong at the gaging stations and spillway.

Chemical Oxygen Demand (COD)

The chemical oxygen demand determination is a measure of the oxygen equivalent of that portion of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. It is a rapidly measured parameter but fails to include some organic compounds that are biologically available to stream organisms, while including some biological components that are not a part of the immediate biochemical load on the oxygen assets of the water (Standard Methods, 1975).

There is consistency in the mean and maximum values of COD as seen in appendix I. This excludes FS2, which has a high organic load. The value at the spillway is quite low in comparison to those at the other field sites.

The following water quality parameters were measured only at the three streamgaging stations and at the spillway.

Ammonia (NH_3)

Ammonia or ammonia nitrogen is naturally present and is produced, for the most part, by the deamination of compounds containing organic nitrogen, by the hydrolysis of urea, and by the reduction of nitrate under anaerobic conditions (Standard Methods, 1975).

GS1 and GS2 were numerically close in the mean and maximum values of NH3, while GS3 and the spillway were numerically close as seen in appendix I. It is suspected that at GS3 the nitrates had not been reduced and by the time the water reached the spillway the ammonia had become oxidized.

Nitrate and Nitrite (N23)

Nitrate is usually found in small amounts in nature. It is an essential nutrient for many photosynthetic autotrophs and has been identified as the growth limiting nutrient in some cases. Nitrite is an intermediate state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate. Nitrite also is found in natural water.

Along with NH3 and TKN, nitrate and nitrite are part of the nitrogen cycle, and their oxidation or reduction can lead to relative elevations in a form of nitrogen. The variations in the mean values of N23 are small as seen in appendix I. There is some variation in the maximum values, with GS3 having the largest and the spillway the smallest.

Dissolved Phosphorus (DSPH)

Dissolved phosphorus is measured identically to total phosphorus except that dissolved phosphorus is the portion of the phosphorus that is not filtered out. Since dissolved phosphorus is a portion of the total phosphorus, its values are necessarily smaller than those for total phosphorus.

The maximum values of dissolved phosphorus for the sites are numerically close and the mean values are virtually identical for the gaging stations as seen in appendix I. The spillway has the highest percentage of dissolved phosphorus as compared to total phosphorus. This is due to the settling of much of the suspended material.

The following parameters were measured in the field for the streamgaging stations and the spillway during routine sampling. The discussion here is descriptive since the data file containing these values is not presented here. These parameters were measured at the location where a water quality sample was taken.

pH

The pH of a solution refers to its hydrogen ion activity and is expressed as the logarithm of the reciprocal of the hydrogen ion activity in moles per liter at a given temperature. The practical pH scale extends from 0 (very acidic) to 14 (very alkaline), with 7 corresponding to exact neutrality at 25°C. The pH of most natural waters falls between 4 and 9, with the majority of waters slightly basic (Standard Methods, 1975). In this study, all the sites had a pH that reached a minimum of 4, but the pH reached a maximum of almost 11 at GS2.

Dissolved Oxygen (DO)

Dissolved oxygen levels in natural waters are dependent on the physical, chemical, and biochemical activities prevailing in the water body (Standard Methods, 1975). It was found that time of the day was very important. The morning had lower DO concentrations than the afternoon. This is because the aquatic plants use oxygen at night and produce oxygen in the day as part of the photosynthetic process.

The maximum values of dissolved oxygen at the sites are very high. The minimum values recorded might stress certain types of aquatic life.

Conductivity (COND)

Conductivity is a numerical expression of the ability of water to carry an electric current. The conductivity value depends on the total concentration of the ionized substances dissolved in the water and the temperature at which the measurement was made. The results of conductivity are given the units of micromhos per centimeter. The conductivity of potable waters ranges from 50 to 1500 µmhos/cm. Conductivity is an indicator of the degree of mineralization or total dissolved solids (Standard Methods, 1975). The values of conductivity lie within the range given for potable waters. The conductivity reaches the maximum during low flow when ground water constitutes a principal portion of the flow. Ground water contains significant dissolved substances of which conductivity is a measure.

Water Temperature (TEMP)

Water temperature can be used to calculate viscosity and density and to aid in ecological studies. Temperature is dependent on the time of year and time of day.

The minimum values of water temperature at all the study locations are identical at 0°C. The maximum values vary widely. GS1 has the lowest maximum values due to the canopy over the streams, while GS2 has no canopy and its temperatures are higher. GS3 has a moderate amount of canopy and its values lie between those measured at GS1 and GS2. The lake has the highest temperatures because of the lack of shade and the lack of movement of the water. Since there is little current and only the wind mixes the water, the lake becomes stratified, with the less dense warm water on the surface of the lake.

Suspended Sediment Load

The relationship between flow and sediment discharge is generally-presented in the form of a sediment rating curve. The sediment rating curves for the streamgaging stations and spillway are presented in figure 9. The suspended sediment load is given as a power function of discharge. A least squares method was used to determine the linear relationship of the logarithms of the values. The suspended sediment rating curves showed that upstream stations transport more sediment per unit discharge than downstream stations. This is shown by the steeper slope of the regression line (GS2 appears to be an exception). Nevertheless, at the medium to high flows an equal discharge will produce a higher suspended sediment load. Therefore, small drainage areas are more efficient in converting hydrologic activity to geomorphic work (Makowski, 1985).

The suspended sediment load depends on a number of factors such as rainfall amount and intensity, antecedent moisture content, ground cover, soil conservation practices, land slope, and soil type. The temporal distribution and magnitude of precipitation intensity, discharge, and suspended sediment concentration may be seen in figure 10 for GS1 for an event of April 13, 1983. The sediment concentration was observed to reach its maximum at or before the peak discharge, which is consistent with previous results (Lee et al., 1983; Hamlett et al., 1984). The sediment concentration fluctuates widely during an event, while discharge is less variable. The receding limb of the hydrograph shows a closer relationship between discharge and sediment concentration than the rising limb.

Most of the suspended sediment transport occurred during storm events. The smaller watersheds monitored by the field sites have runoff only during precipitation or snowmelt, so essentially 100 percent of the sediment transport at these sites is event related. The percentage of suspended sediment load transported during monitoring is presented in table 7. From table 7 it can be seen that most of the sediment is transported in a small percentage of the time.

The larger basin has more attenuation of flow and suspended sediment load so the smaller basin transports more sediment per unit discharge. The runoff response of the smaller basin is quicker and the suspended sediment concentration of an event is greater for a small basin than for a larger basin. At gaging station 1 one 3-day event transported roughly 9.4 percent of the total measured load. The events which transported large quantities of suspended sediment load occurred throughout the year but primarily in the spring when the highest values of sediment load per unit rainfall occurred. These large suspended sediment loads occurred although precipitation was only slightly above or even below normal. The lowest values of sediment load and sediment load per unit rainfall were observed in the summer. Elevated loads in the spring can be attributed to fields that were tilled for spring planting and were susceptible to erosion. The disturbed ground surface left soil available for transport when the infiltration capacity of the soil was exceeded. The low summer loads might be a result of well-developed crop canopy that reduced raindrop impact and soil detachment.

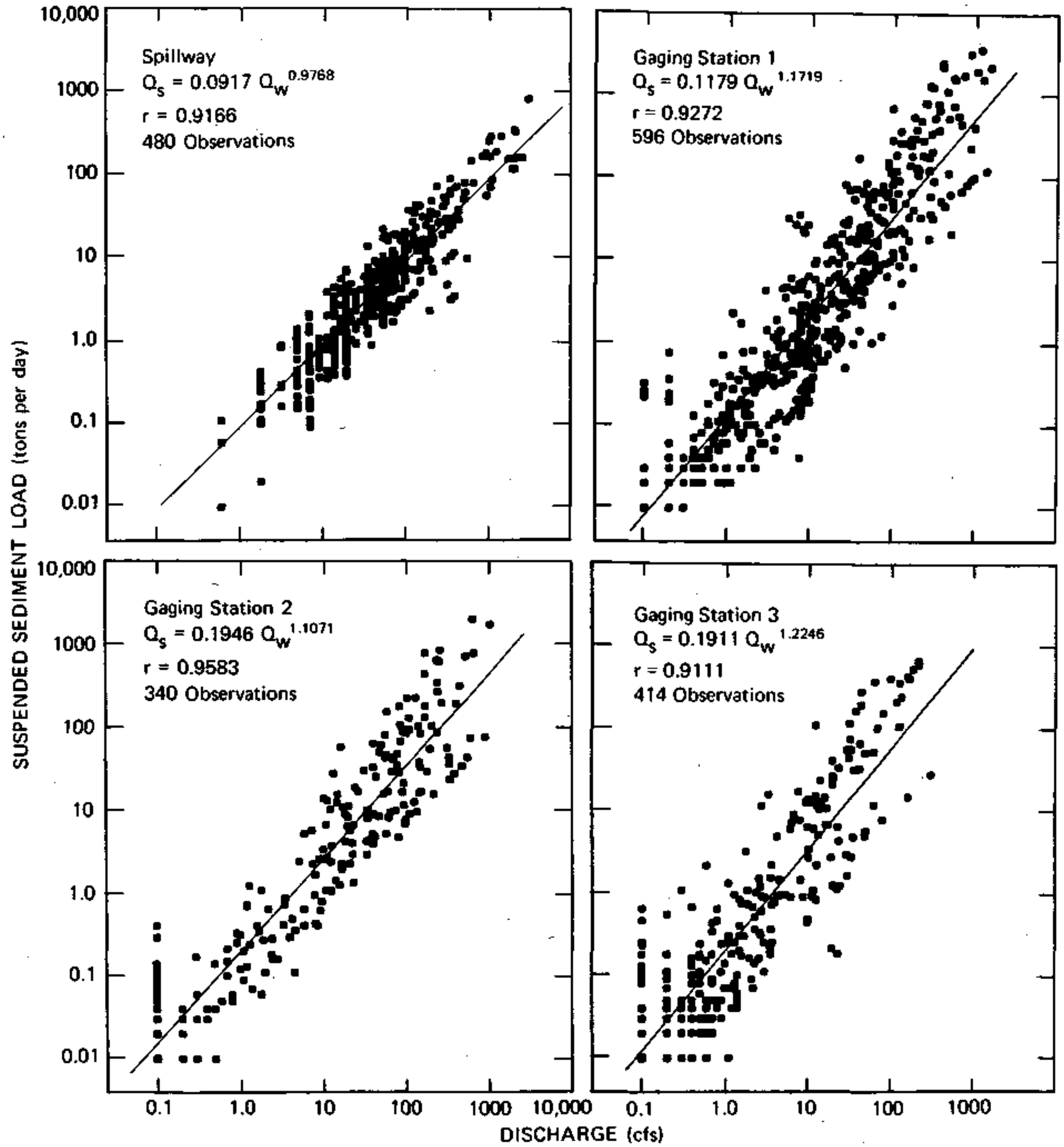

Figure 9. Sediment rating curves for the spillway and the three gaging stations

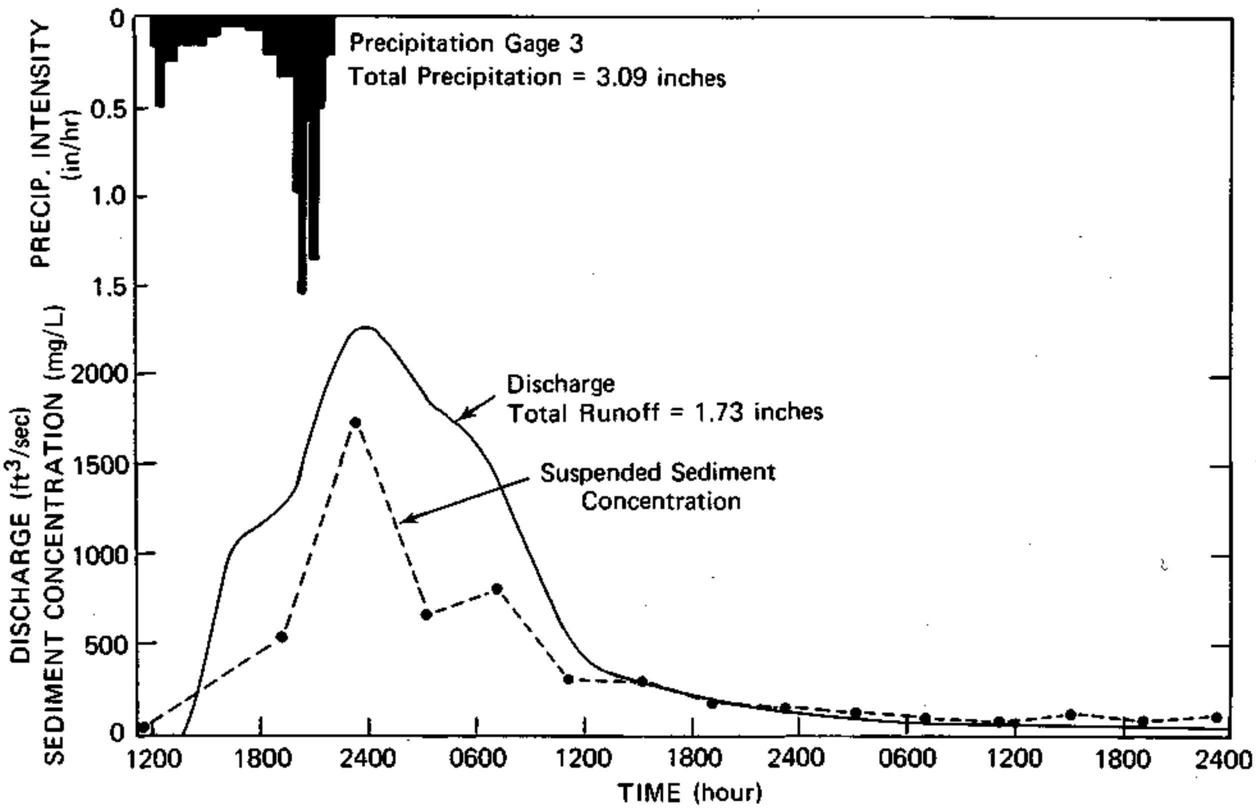

Figure 10. Precipitation, runoff, and suspended sediment for GS1 on April 13, 1983

Table 7. Percentage of Suspended Sediment Load Transported during Monitoring Period

Percentage of transported load	Station* SW	GS1	GS2	GS3
98	30.6	14.1	9.0	5.9
90	14.7	5.9	4.4	2.7
50	1.7	1.2	0.8	0.8

*Values given for each station represent the percentage of the monitoring period during which the transported load passed each station.

Table 8. Sediment Delivery Ratios for the Gaging Stations and Spillway

	Station SW	GS1	GS2	GS3
Gross erosion (tons/acre/yr)	2.9	2.6	2.5	2.4
Sediment yield (tons/acre/yr)	0.06	0.55	0.19	0.61
Sediment delivery ratio	0.02	0.21	0.08	0.25

Sediment Delivery Ratio

The sediment delivery ratio is defined as the sediment yield divided by the gross erosion. The sediment yield is the total quantity of sediment from the watershed under consideration that moves past a point. Due to the sporadic data at the field sites the sediment yield could be determined only for the streamgaging stations and the spillway site. The annual gross erosion rate and sediment yield (monthly loads) were discussed in earlier sections.

Table 8 presents the sediment delivery ratios for the three gaging stations and the spillway site. Both the gross erosion and sediment yield have the units of tons per acre per year. The latter figure was obtained from total sediment load monitored during the study period. The data were adjusted to account for missing data and to correspond to a similar time frame to allow direct comparison. The greatest sediment delivery ratio was found at GS3. However, the delivery ratio for GS2 was less than for either GS1 or GS3. GS2 is located upstream on Little Silver Creek while GS3 lies upstream of FS1 on East Fork Silver Creek. Therefore, the watershed of GS1 is comprised of both the GS2 and GS3 watersheds and the delivery ratio appears to reflect that fact.

The gross erosion from the lake watershed is higher than at the other sites and is due to the slope and proximity of numerous streams to the lake. The delivery ratio of these streams should be quite high. Excluding the area adjacent to the lake, the annual sediment yield becomes 0.55 tons/acre at the lake site and the annual amount leaving the lake is 0.06 tons/acre, so the reservoir trap efficiency is about 89 percent. The 1984 lake sedimentation survey found an average annual sediment deposition of 0.90 tons/acre. The difference between the sedimentation survey and the measured load is probably due to the unmonitored watershed adjacent to the lake.

DISCUSSION

The water quality of Highland Silver Lake has been impaired by suspended sediment and elevated nutrient values which could cause eutrophic conditions in the future. The agricultural runoff in the watershed was identified as a major source of the sediment and nutrients. The approach used in this project to solve water quality problems is: 1) reduce detachment and transport of soil particles by increasing ground cover, 2) maximize the opportunity for settling of suspended particles before they reach a watercourse, and 3) reduce nutrient input through better management of livestock wastes. The main goals of the project were to: 1) reduce turbidity and increase visibility to greater than 2 feet, and 2) reduce the average total suspended solids concentrations to less than 25 mg/l. These goals were evaluated at the spillway. Visibility, as measured by secchi readings, was under 2 feet and the mean total suspended solids was 35 mg/1.

The main questions that this watershed study was to answer were:

1) How effective are Best Management Practices (BMPs) in water quality terms?

2) Do conservation measures work in water quality areas?

3) Given the small-scale study information, what water quality projections can be made based on present implementation?

As discussed in the previous progress report (Makowski and Lee., 1985), these questions are difficult to answer. The data set which consists of event data at the field sites is small. Because of dry conditions, few event data were added after publication of the previous progress report (Makowski and Lee, 1985). Comparison between field sites is limited by not having an event which was monitored at a complete set of sites. Analysis of trends over time is hampered by sporadic data. This is further exacerbated by stratification of the data, which yields a small data set. The best way to use the field data to answer the main questions of the watershed study is to use them in calibration of a model.

The streamgaging station data are much more complete than the field site data. The streamgaging data contain both event and nonevent data. Though the spillway data are complete, they do not contain event data. The problem with the streamgaging data is not completeness but rather dilution. This diluting effect is the shrinking percentage of the "critical" areas. Whereas the "critical" area can be a significant portion of the watershed above a field site, the 37 percent "critical" area of the watershed under contract to have BMPs implemented amounted to only 8 percent of the entire watershed.

In a report by the North Carolina Agricultural Extension Service (1985) several broad questions were raised regarding the Highland Silver Lake project. Three of these have been addressed in this report. These are:

1) If suspended sediment loadings are reduced, will there be a corresponding reduction in turbidity of the lake?

2) If land treatment practices adequately reduce suspended sediment loadings and turbidity levels of the lake, will these same practices reduce nutrient loadings, or will additional animal waste and fertilizer management practices be required to avoid eutrophication of the lake?

3) Have any significant water quality changes occurred at the tributary and/or lake levels of the project?

These questions may be addressed in a discussion of GS1, the closest site upstream of the lake, and the spillway station that ought to represent conditions within the lake.

The first question can be answered by relating the loads at GS1 to the turbidity levels in the lake (see figure 11). The available data suggest that there is little correlation between the two variables. The relationship that is seen is inverse. This shows that other mechanisms besides a reduction in sediment input to the lake determine the turbidity in the lake. The other mechanisms at work in the lake to increase turbidity are resuspension of the fine sediment by currents caused by waves, boats, and fish. However, reduction of sediment, especially the finer material, would be beneficial in the reduction of future turbidity in the lake.

The next question assumes that a reduction of sediment loading to the lake takes place. With the reduction in sediment there would be a corresponding reduction in nutrient loading. Discussion will concern the loads at GS1. The nutrient loads will be represented by nitrogen (TKN) and phosphorus (TPH). There is good correlation between the sediment and nutrient loads observed from the data, as may be seen in figure 12. Therefore, the data suggest that if sediment loads could be reduced, nutrient loads should also decrease without additional animal waste and fertilizer management.

The final question deals with significant changes in water quality in the watershed due to BMPs. The monitoring began in January 1982 with 0 percent of the "critical" area under contract and ended in October 1984 with 37 percent of the "critical" area (8 percent of the watershed). There was little hydrologic activity in the last six months of the study. To evaluate the temporal trends the data at GS1 were utilized. The plots of the loads of suspended sediment, nitrogen, and phosphorus at GS1 are shown in figure 13. Treatment of 8 percent of the watershed has failed to produce significant reductions in water quality. Significant changes might not manifest themselves in such a short period of time since there might be some residual water quality parameters within the system.

To do meaningful analysis a large data set is required. To produce significant changes in the downstream water quality parameters, major areas

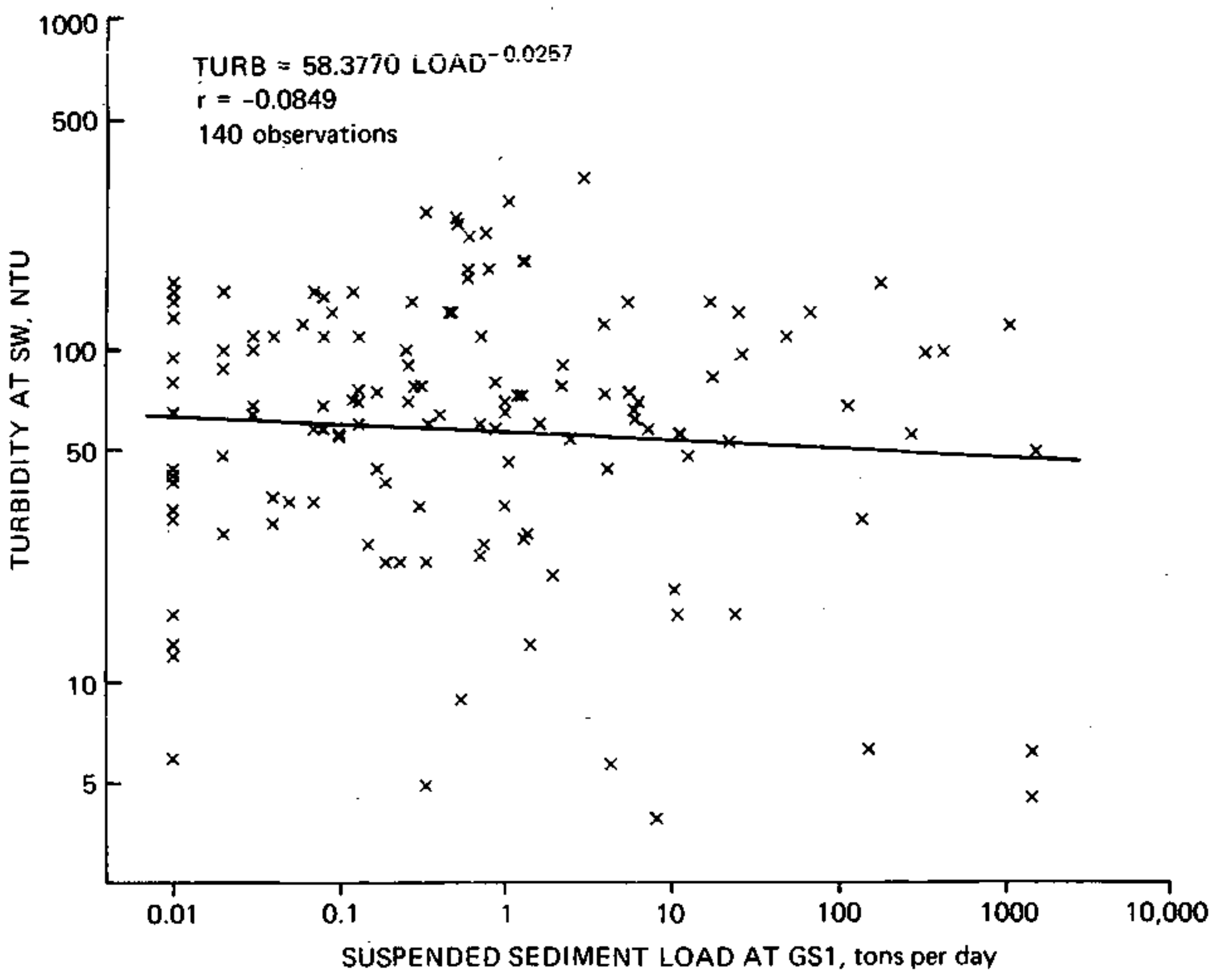

Figure 11. Relationship of the suspended sediment loads at GS1 to the turbidity at the spillway

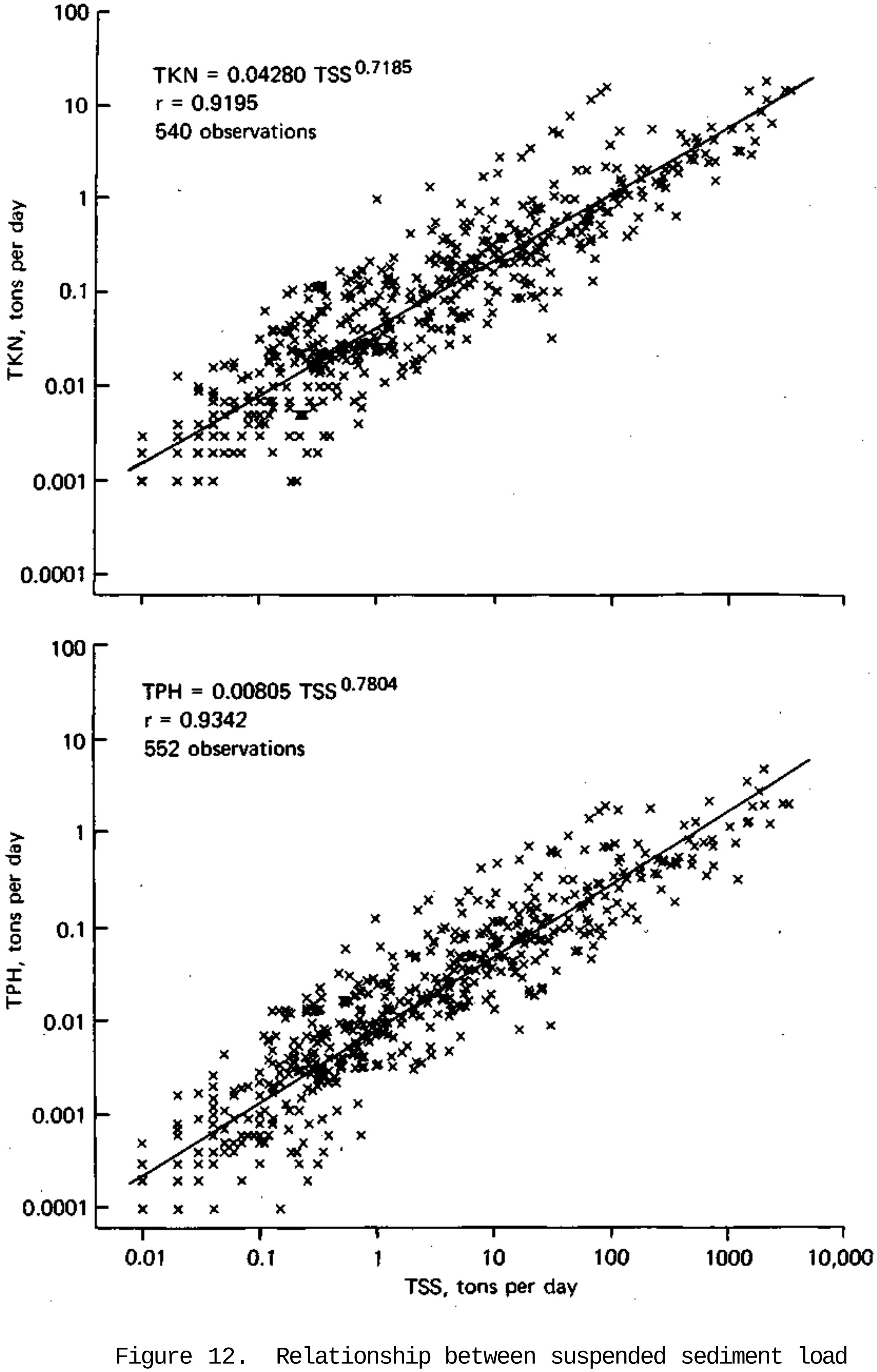

Figure 12. Relationship between suspended sediment load and nitrogen and phosphorus at GS1

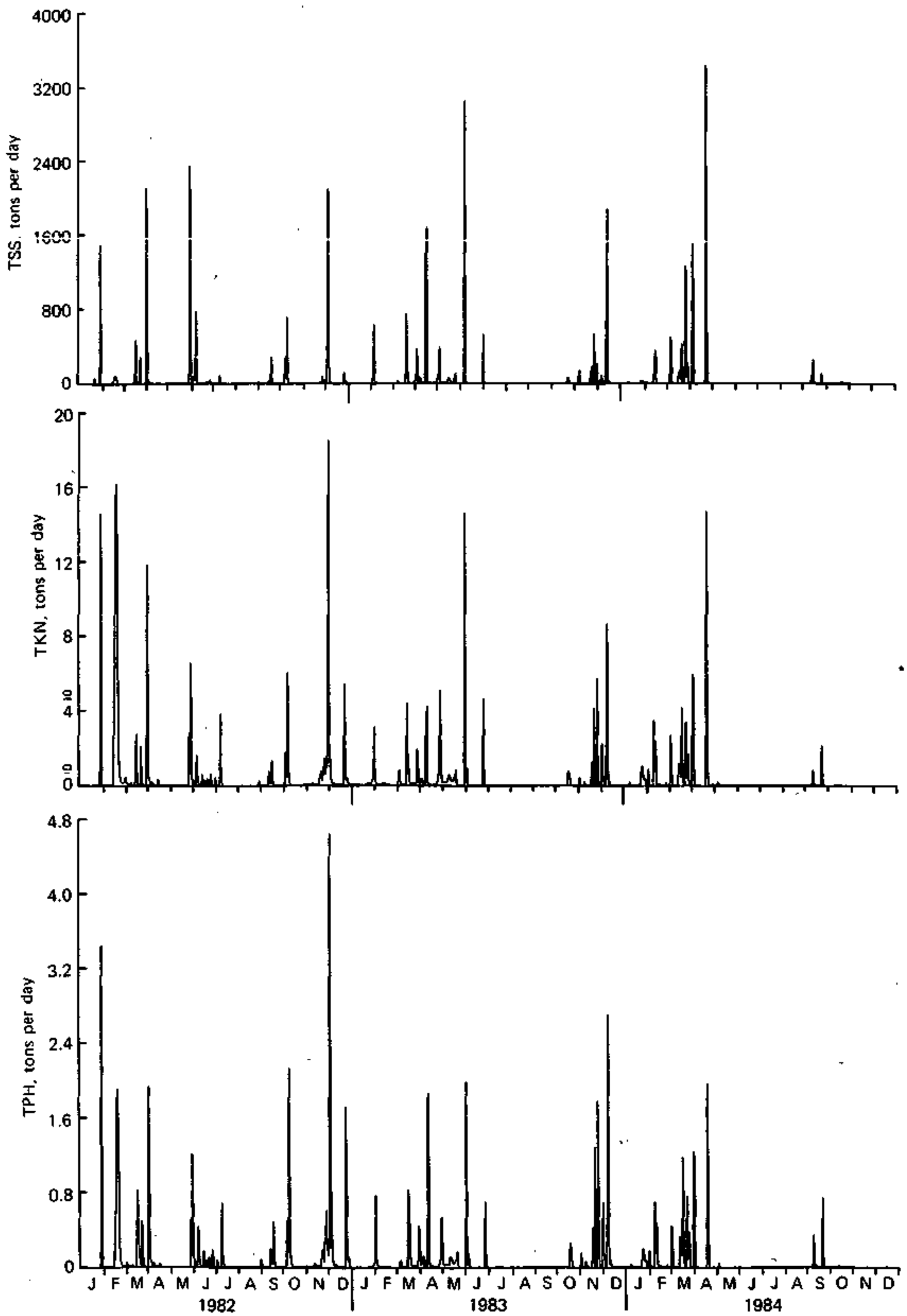

Figure 13. Trends over time of suspended sediment, nitrogen, and phosphorus loads at GS1

within the watershed must be under contract. The field data collection must continue after BMPs are implemented to ensure that any improvements in water quality have sufficient time to make their way throughout the hydrologic system and that any residual adverse water quality parameters can leave the system. Additional field data collection might resolve some of these questions.

SUMMARY

This report details the data collection methods and results from the Highland Silver Lake Rural Clean Water Program. Data were collected from January 1982 through October 1984 and resulted in 2.75 years of precipitation, runoff, and water quality data. In addition to these data two lake sedimentation studies (1981 and 1984) were done for the entire lake. These surveys provided a long-term sedimentation rate as well as the rate of sedimentation during monitoring. Data were also collected so that the streambank and streambed erosion could be assessed, the results of which are in a separate report (Makowski et al., 1986).

Water quality parameter loads were computed for all the monitoring locations (8 field sites, 3 streamgaging stations, and the spillway). Loads were computed on an event basis and/or on a continuous basis depending on the schedule of sampling.

Long-term precipitation records suggest that precipitation on the Highland Silver Lake watershed was above normal for the monitoring period. On the basis of the long-term precipitation data available for Belleville, Illinois, the monitoring period (January 1982 through October 1984) had precipitation 17.78 inches (14.5 percent) above normal. There were five occurrences of average monthly precipitation amounts on the watershed in excess of 7 inches, with the maximum recorded monthly precipitation in June 1983. An average monthly precipitation below 1 inch occurred six times, with the minimum precipitation in July 1983.

There were 235 event hydrographs collected at the eight field sites and 199 event hydrographs at the three gaging stations. The continuous streamflow records were broken down into events. Runoff ratios ranged from 0.00 (no runoff) to 1.00 (100 percent runoff) depending on when the collection of the hydrograph started and ended, time of year, field conditions, antecedent soil moisture, and snowmelt. Runoff ratios averaged roughly 0.25. No event hydrographs were computed from the spillway since data were not available. The municipal use of water from Highland Silver Lake was insignificant.

The loads of five water quality parameters (total suspended solids, total volatile solids, Kjeldahl nitrogen, total phosphorus, and chemical oxygen demand) were computed on an event basis, and three additional parameters (ammonia, nitrate and nitrite, and dissolved phosphorus) had their loads computed on a continuous basis. The majority of the loads were transported during storm events. As an example, 98 percent of the suspended sediment load monitored during data collection was transported in 14.1, 9.0, and 5.9 percent of the time at gaging stations 1, 2, and 3, respectively. The trap efficiency of the lake was about 89 percent. The lake sedimentation

survey indicated that between 1981 and 1984 (watershed monitoring) an average of 0.90 tons/acre of material was deposited in the lake each year.

No consistent relationship was found between discharge and the water quality parameters due to the fact that transport is dependent on the availability of material. There is usually more material available for transport in the beginning of an event (rising limb of the hydrograph). Peak sediment concentration was also observed to precede peak discharge. However, much better correlation may be found when correlating loads to discharge. This is because the importance of the concentration is reduced since load is a function of discharge.

The lake did not meet the stated goal of visibility of greater than 2 feet and an average total suspended solids concentration of less than 25 mg/l. From the relationship between total suspended solids at GS1 and turbidity at the spillway it was found, according to the data, that there is little correlation between the two parameters. However, a much better correlation was found between sediment and nutrients so a reduction in total suspended solids will result in a reduction in nitrogen and phosphorus. No significant changes were found in sediment, nitrogen, and phosphorus over time from the beginning of the project to the end. The reasons for the lack of significant change might be many. For instance, a small portion of the watershed is under contract, and data collection did not continue after BMPs were installed. In fact BMPs continue to be installed, so any potential positive effects cannot be assessed using this data set.

No consistent relationship was found between discharge and the water quality parameters due to the fact that transport is dependent on the availability of material. There is usually more material available for transport in the beginning of an event (rising limb of the hydrograph). Peak sediment concentration was also observed to precede peak discharge. However, much better correlation may be found when correlating loads to discharge. This is because the importance of the concentration is reduced since load is a function of discharge.

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Appendix A. Precipitation Analysis

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
26 981	1	196.0	.21	-5.00	.05	-4.00	.12	-4.00	.12	-4.00
26 981	3	152.0	.31	-5.00	.12	.29	.25	.26	.27	.21
51081	1	200.0	.69	-5.00	.15	.44	.50	1.03	.58	.92
51081	2	104.0	.58	-5.00	.12	.28	.31	.36	.36	.33
30 981	3	164.0	.14	-5.00	.04	-4.00	.02	-4.00	.09	-4.00
101081	1	739.0	.11	-5.00	.01	-4.00	.04	-4.00	.06	-4.00
101081	2	627.0	.03	-5.00	.00	-4.00	.00	-4.00	.01	-4.00
101081	3	443.0	.04	-5.00	.00	-4.00	.01	-4.00	.01	-4.00
141081	1	196.0	.45	-5.00	.02	-4.00	.11	-4.00	.18	-4.00
141081	2	174.0	.31	-5.00	.03	-4.00	.11	-4.00	.14	-4.00
161081	2	120.0	.03	-5.00	.00	-4.00	.02	-4.00	.03	-4.00
141081	3	211.0	.31	-5.00	.02	-4.00	.09	-4.00	.14	-4.00
161081	1	452.0	.84	-5.00	.10	.23	.28	.30	.37	.34
171081	1	238.0	.31	-5.00	.02	-4.00	.09	-4.00	.14	-4.00
161081	2	491.0	1.06	-5.00	.08	-4.00	.24	.24	.29	.23
171081	2	203.0	.23	-5.00	.03	-4.00	.08	-4.00	.10	-4.00
161081	3	494.0	.97	-5.00	.11	.25	.36	.48	.41	.42
171081	3	186.0	.17	-5.00	.01	-4.00	.04	-4.00	.08	-4.00
221081	1	602.0	.82	-5.00	.03	-4.00	.12	-4.00	.19	-4.00
221081	2	605.0	.93	-5.00	.04	-4.00	.11	-4.00	.20	-4.00
221081	3	598.0	.93	-5.00	.02	-4.00	.12	-4.00	.21	-4.00
251081	1	484.0	.38	-5.00	.01	-4.00	.04	-4.00	.07	-4.00
11181	1	366.0	.21	-5.00	.01	-4.00	.06	-4.00	.10	-4.00
251081	2	479.0	.32	-5.00	.02	-4.00	.05	-4.00	.08	-4.00
251081	3	484.0	.24	-5.00	.01	-4.00	.05	-4.00	.08	-4.00
41181	1	169.0	.33	-5.00	.05	-4.00	.13	-4.00	.18	-4.00
21181	2	387.0	.21	-5.00	.01	-4.00	.05	-4.00	.09	-4.00
41181	2	162.0	.23	-5.00	.02	-4.00	.07	-4.00	.12	-4.00
41181	2	38.0	.05	-4.00	.05	-4.00	.05	-4.00	-1.00	-1.00
21181	3	371.0	.25	-5.00	.01	-4.00	.06	-4.00	.10	-4.00
41181	3	225.0	.26	-5.00	.01	-4.00	.06	-4.00	.11	-4.00
111181	1	400.0	.36	-5.00	.01	-4.00	.07	-4.00	.12	-4.00
151181	1	332.0	.21	-5.00	.02	-4.00	.09	-4.00	.12	-4.00
111181	2	380.0	.21	-5.00	.01	-4.00	.04	-4.00	.07	-4.00
101181	3	877.0	.29	-5.00	.02	-4.00	.08	-4.00	.08	-4.00
191181	1	330.0	.13	-5.00	.03	-4.00	.05	-4.00	.06	-4.00
191181	2	182.0	.10	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
21 182	1	68.0	.12	-5.00	.04	-5.00	.11	-5.00	.12	-4.00
21 182	2	96.0	.11	-5.00	.03	-5.00	.06	-5.00	.10	-4.00
21 182	3	47.0	.06	-5.00	.02	-5.00	.05	-5.00	-1.00	-1.00
29 182	1	900.0	1.21	-5.00	.06	-5.00	.21	-5.00	.30	.82
30 182	1	1410.0	2.07	-5.00	.03	-5.00	.11	-5.00	.18	.30
31 182	1	336.0	.09	-5.00	.00	-5.00	.02	-5.00	.04	-4.00
1 282	1	184.0	.42	-5.00	.16	-5.00	.33	-5.00	.38	1.06
2 282	1	100.0	.09	-5.00	.04	-5.00	.03	-5.00	.08	-4.00
3 282	1	392.0	.24	-5.00	.01	-5.00	.04	-5.00	.05	-4.00

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
8 282	1	507.0	.48	-5.00	.02	-5.00	.08	-5.00	.15	.22
9 282	1	185.0	.11	-5.00	.01	-5.00	.03	-5.00	.06	-4.00
29 182	2	1008.0	1.24	-5.00	.05	-5.00	.18	-5.00	.30	.88
30 182	2	1413.0	1.72	-5.00	.02	-5.00	.11	-5.00	.19	.34
31 182	2	433.0	.19	-5.00	.03	-5.00	.03	-5.00	.05	-4.00
29 182	3	995.0	1.08	-5.00	.04	-5.00	.13	-5.00	.22	.42
30 182	3	1430.0	1.27	-5.00	.02	-5.00	.10	-5.00	.16	.24
31 182	3	197.0	.06	-5.00	.00	-5.00	.02	-5.00	.03	-4.00
1 282	3	100.0	.12	-5.00	.04	-5.00	.02	-5.00	.09	-4.00
16 282	1	99.0	.31	-5.00	.04	-5.00	.18	-5.00	.20	.35
16 282	1	24.0	.03	-5.00	.01	-5.00	-2.00	-2.00	-1.00	-1.00
16 282	1	31.0	.04	-5.00	.03	-5.00	.04	-5.00	-1.00	-1.00
16 282	1	60.0	.04	-4.00	.01	-5.00	.02	-5.00	.04	-4.00
16 282	1	122.0	.16	-5.00	.03	-5.00	.08	-5.00	.11	-4.00
18 282	1	220.0	.10	-5.00	.02	-5.00	.03	-5.00	.04	-4.00
16 282	2	253.0	.38	-5.00	.05	-5.00	.22	-5.00	.28	.71
16 282	2	152.0	.13	-5.00	.01	-5.00	.05	-5.00	.07	-4.00
18 282	2	90.0	.03	-5.00	.00	-5.00	.02	-5.00	.03	-4.00
16 282	3	197.0	.32	-5.00	.03	-5.00	.16	-5.00	.21	.39
16 282	3	171.0	.06	-5.00	.01	-5.00	.03	-5.00	.03	-4.00
16 282	3	233.0	.32	-5.00	.03	-5.00	.16	-5.00	.20	.37
3 382	1	551.0	.15	-5.00	.02	-5.00	.05	-5.00	.05	-4.00
3 382	2	80.0	.05	-5.00	.00	-5.00	.02	-5.00	.04	-4.00
3 382	2	483.0	.18	-5.00	.01	-5.00	.03	-5.00	.05	-4.00
3 382	3	739.0	.29	-5.00	.02	-5.00	.05	-5.00	.07	-4.00
9 382	1	185.0	.13	-5.00	.02	-5.00	.06	-5.00	.07	-4.00
11 382	1	80.0	.34	-5.00	.13	-5.00	.27	-5.00	.32	1.00
12 382	1	166.0	.39	-5.00	.03	-5.00	.10	-5.00	.20	.36
14 382	1	459.0	.65	-5.00	.05	-5.00	.12	-5.00	.15	.22
9 382	2	269.0	.12	-5.00	.02	-5.00	.05	-5.00	.06	-4.00
11 382	2	246.0	.24	-5.00	.11	-5.00	.14	-5.00	.16	.24
12 382	2	206.0	.52	-5.00	.04	-5.00	.14	-5.00	.26	.57
14 382	2	485.0	.54	-5.00	.03	-5.00	.09	-5.00	.11	-4.00
9 382	3	206.0	.10	-5.00	.02	-5.00	.03	-5.00	.05	-4.00
11 382	3	124.0	.20	-5.00	.05	-5.00	.11	-5.00	.16	.24
12 382	3	187.0	.35	-5.00	.05	-5.00	.09	-5.00	.15	.22
14 382	3	446.0	.45	-5.00	.03	-5.00	.07	-5.00	.13	-4.00
18 382	1	126.0	1.65	2.95	.48	9.00	1.56	12.00	1.61	4.70
19 382	1	35.0	.09	-5.00	.03	-5.00	.09	-5.00	-1.00	-1.00
24 382	1	571.0	.73	-5.00	.04	-4.00	.17	-4.00	.27	-4.00
18 382	2	449.0	1.43	-5.00	.17	-5.00	.64	-5.00	.70	1.40
19 382	2	140.0	.26	-5.00	.11	-5.00	.23	-5.00	.03	-4.00
18 382	3	452.0	.46	-5.00	.09	-5.00	.14	-5.00	.19	.33
19 382	3	31.0	.09	-5.00	.05	-5.00	.10	-5.00	-1.00	-1.00
25 382	1	116.0	.06	-5.00	.01	-4.00	.04	-4.00	.05	-4.00
24 382	2	482.0	.88	-5.00	.09	-4.00	.18	-4.00	.29	-4.00

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
26 382	2	225.0	.11	-5.00	.02	-4.00	.05	-4.00	.08	-4.00
24 382	3	515.0	.88	-5.00	.04	-4.00	.16	-4.00	.26	-4.00
25 382	3	228.0	.07	-5.00	.01	-4.00	.03	-4.00	.04	-4.00
2 482	1	97.0	.27	-5.00	.06	-4.00	.17	-4.00	.21	-4.00
2 482	1	166.0	1.70	2.29	.27	1.33	1.06	3.13	1.54	4.20
5 482	1	325.0	.40	-5.00	.07	-4.00	.18	-4.00	.31	.21
2 482	2	89.0	.31	-5.00	.10	-4.00	.26	.22	.30	.20
2 482	2	171.0	1.56	-5.00	.25	1.17	.93	1.95	1.33	2.56
1 482	3	90.0	.08	-5.00	.01	-4.00	.04	-4.00	.06	-4.00
2 482	3	49.0	.08	-4.00	.02	-4.00	.07	-4.00	-1.00	-1.00
2 482	3	124.0	.76	-5.00	.10	-4.00	.31	.28	.50	.47
7 482	1	350.0	.20	-5.00	.01	-4.00	.04	-4.00	.07	-4.00
8 482	1	520.0	.14	-5.00	.01	-4.00	.02	-4.00	.04	-4.00
5 482	2	305.0	.33	-5.00	.06	-4.00	.13	-4.00	.21	-4.00
8 482	2	294.0	.10	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
5 482	3	336.0	.37	-5.00	.08	-4.00	. .16	-4.00	.25	-4.00
8 482	3	382.0	.10	-5.00	.01	-4.00	.02	-4.00	.04	-4.00
15 482	1	93.0	.26	-5.00	.07	-4.00	.18	-4.00	.24	-4.00
16 482	1	92.0	.65	-5.00	.23	1.03	.53	.94	.63	.87
19 482	1	105.0	.23	-5.00	.03	-4.00	.14	-4.00	.21	-4.00
15 482	2	80.0	.25	-5.00	.05	-4.00	.17	-4.00	.25	-4.00
16 482	2	81.0	.64	-5.00	.15	.33	.46	.67	.60	.77
17 482	2	22.0	.03	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
19 482	2	71.0	.15	-5.00	.02	-4.00	.09	-4.00	.14	-4.00
15 482	3	69.0	.09	-5.00	.03	-4.00	.07	-4.00	.09	-4.00
16 482	3	103.0	.69	-5.00	.19	.62	.54	1.01	.64	.90
24 482	1	48.0	.04	-4.00	.01	-4.00	.04	-4.00	-1.00	-1.00
25 482	2	45.0	.03	-4.00	.01	-4.00	.02	-4.00	-1.00	-1.00
25 482	3	43.0	.05	-4.00	.01	-4.00	.02	-4.00	-1.00	-1.00
6 582	1	54.0	.31	.22	.07	-4.00	.28	.24	-1.00	-1.00
6 582	1	347.0	.53	-5.00	.02	-4.00	.11	-4.00	.20	-4.00
6 582	2	55.0	.27	-4.00	.12	.21	.23	-4.00	-1.00	-1.00
6 582	2	346.0	.49	-5.00	.02	-4.00	.12	-4.00	.19	-4.00
6 582	3	69.0	.24	-5.00	.09	-4.00	.15	-4.00	.23	-4.00
6 582	3	366.0	.45	-5.00	.02	-4.00	.11	-4.00	.20	-4.00
20 582	1	146.0	.20	-5.00	.08	-4.00	.13	-4.00	.17	-4.00
21 582	1	265.0	.21	-5.00	.05	-4.00	.07	-4.00	.05	-4.00
20 582	2	62.0	.30	-5.00	.11	-4.00	.23	-4.00	.31	.21
21 582	2	346.0	.29	-5.00	.13	.25	.20	-4.00	.02	-4.00
20 582	3	69.0	.44	-5.00	.12	.23	.35	.35	.41	.33
21 582	3	33.0	.24	-4.00	.14	.29	.24	-4.00	-1.00	-1.00
27 582	1	158.0	.62	-5.00	.06	-4.00	.23	-4.00	.35	.25
28 582	1	45.0	.90	1.55	.36	2.40	.87	1.80	-1.00	-1.00
29 582	1	71.0	.40	-5.00	.13	.26	.39	.43	.41	.32
29 582	1	202.0	.23	-5.00	.02	-4.00	.11	-4.00	.18	-4.00
30 582	1	97.0	.20	-5.00	.04	-4.00	.11	-4.00	.14	-4.00

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
31 582	1	141.0	.46	-5.00	.10	-4.00	.20	-4.00	.34	.24
27 582	2	136.0	.42	-5.00	.03	-4.00	.14	-4.00	.25	-4.00
28 582	2	51.0	1.29	2.72	.41	5.38	1.18	4.30	-1.00	-1.00
29 582	2	57.0	.20	-4.00	.08	-4.00	.20	-4.00	-1.00	-1.00
29 582	2	22.0	.05	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
29 582	2	105.0	.13	-5.00	.01	-4.00	.06	-4.00	.10	-4.00
30 582	2	123.0	.53	-5.00	.17	.44	.33	.31	.37	.28
31 582	2	125.0	.71	-5.00	.19	.63	.42	.49	.62	.85
31 582	2	203.0	1.20	-5.00	.23	1.00	.60	1.13	.84	1.30
4 682	2	668.0	.40	-5.00	.02	-4.00	.08	-4.00	.14	-4.00
26 582	3	21.0	.37	.52	.20	.71	-2.00	-2.00	-1.00	-1.00
27 582	3	169.0	.52	-5.00	.10	-4.00	.22	-4.00	.28	-4.00
28 582	3	48.0	1.25	2.62	.45	7.25	1.24	4.85	-1.00	-1.00
29 582	3	89.0	.07	-5.00	.01	-4.00	.04	-4.00	.07	-4.00
29 582	3	117.0	.17	-5.00	.02	-4.00	.06	-4.00	.11	-4.00
30 582	3	116.0	.81	-5.00	.28	1.42	.65	1.27	.69	1.04
31 582	3	101.0	.20	-5.00	.07	-4.00	.13	-4.00	.17	-4.00
31 582	3	220.0	.88	-5.00	.17	.46	.30	.27	.36	.26
4 682	3	187.0	.12	-5.00	.01	-4.00	.05	-4.00	.06	-4.00
4 682	3	78.0	.08	-5.00	.01	-4.00	.04	-4.00	.07	-4.00
31 582	1	204.0	1.33	-5.00	.27	1.33	.71	1.41	.84	1.29
4 682	1	717.0	.48	-5.00	.02	-4.00	.10	-4.00	.18	-4.00
7 682	1	35.0	.13	-4.00	.03	-4.00	.11	-4.00	-1.00	-1.00
7 682	1	24.0	.14	-4.00	.06	-4.00	-2.00	-2.00	-1.00	-1.00
8 682	1	256.0	.24	-5.00	.03	-4.00	.09	-4.00	.10	-4.00
7 682	2	14.0	.19	.21	.16	.39	-2.00	-2.00	-1.00	-1.00
7 682	2	86.0	.70	-5.00	.12	.22	.60	1.13	.67	1.00
7 682	2	40.0	.07	-4.00	.03	-4.00	.07	-4.00	-1.00	-1.00
8 682	2	38.0	.30	.24	.16	.36	.29	.26	-1.00	-1.00
8 682	2	239.0	.19	-5.00	.03	-4.00	.07	-4.00	.12	-4.00
7 682	3	27.0	.41	.53	.22	.93	-2.00	-2.00	-1.00	-1.00
7 682	3	64.0	.81	-5.00	.30	1.56	.75	1.50	.81	1.24
8 682	3	20.0	.06	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
8 682	3	25.0	.13	-4.00	.09	-4.00	-2.00	-2.00	-1.00	-1.00
8 682	3	227.0	.15	-5.00	.02	-4.00	.04	-4.00	.06	-4.00
9 682	3	15.0	.04	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
15 682	1	63.0	.80	-5.00	.29	1.50	.71	1.40	.80	1.22
18 682	1	104.0	.60	-5.00	.09	-4.00	.36	.38	.51	.48
20 682	1	76.0	.25	-5.00	.12	.22	.16	-4.00	.19	-4.00
15 682	2	75.0	.95	-5.00	.23	1.00	.78	1.59	.91	1.42
18 682	2	94.0	.40	-5.00	.06	-4.00	.24	.20	.33	.23
15 682	3	79.0	.60	-5.00	.15	.32	.51	.85	.58	.69
18 682	3	92.0	.67	-5.00	.14	.30	.48	.75	.57	.68
22 682	1	60.0	.47	.22	.11	-4.00	.29	-4.00	.46	.21
26 682	1	104.0	.45	-5.00	.16	-4.00	.40	.23	.42	-4.00
27 682	i	94.0	.51	-5.00	.18	.23	.42	.24	.48	.23

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
22 682	2	32.0	.21	-4.00	.06	-4.00	.21	-4.00	-1.00	-1.00
22 682	2	47.0	.39	-4.00	.17	-4.00	.36	-4.00	-1.00	-1.00
26 682	2	92.0	.25	-5.00	.09	-4.00	.20	-4.00	.23	-4.00
27 682	2	168.0	.63	-5.00	.18	.24	.42	.24	.47	.22
22 682	3	74.0	.66	-5.00	.34	1.75	.46	.28	.62	.35
26 682	3	38.0	.29	-4.00	.06	-4.00	.26	-4.00	-1.00	-1.00
27 682	3	49.0	.25	-4.00	.07	-4.00	.20	-4.00	-1.00	-1.00
28 682	1	38.0	.38	-4.00	.11	-4.00	.37	.20	-1.00	-1.00
2 782	1	103.0	.66	-5.00	.15	-4.00	.54	.38	.56	.29
3 782	1	225.0	.82	-5.00	.16	-4.00	.46	.28	.54	.27
3 782	1	48.0	.12	-4.00	.04	-4.00	.10	-4.00	-1.00	-1.00
4 782	1	21.0	.09	-4.00	.06	-4.00	-2.00	-2.00	-1.00	-1.00
1 782	2	137.0	.13	-5.00	.01	-4.00	.05	-4.00	.09	-4.00
3 782	2	261.0	.88	-5.00	.11	-4.00	.32	-4.00	.42	-4.00
3 782	2	40.0	.06	-4.00	.02	-4.00	.06	-4.00	-1.00	-1.00
3 782	2	17.0	.14	-4.00	.08	-4.00	-2.00	-2.00	-1.00	-1.00
1 782	3	119.0	.10	-5.00	.01	-4.00	.04	-4.00	.06	-4.00
2 782	3	15.0	.25	-4.00	.21	.30	-2.00	-2.00	-1.00	-1.00
3 782	3	255.0	.60	-5.00	.07	-4.00	.22	-4.00	.26	-4.00
3 782	3	80.0	.11	-5.00	.02	-4.00	.05	-4.00	.09	-4.00
10 782	1	251.0	2.98	13.52	.30	.90	1.02	2.68	1.29	2.30
10 782	2	326.0	2.77	7.55	.27	.60	1.02	2.68	1.58	4.44
10 782	2	39.0	.43	.22	.31	.95	.43	.25	-1.00	-1.00
10 782	3	259.0	1.80	-5.00	.17	.20	.55	.40	.85	.70
19 782	1	32.0	.08	-4.00	.04	-4.00	.08	-4.00	-1.00	-1.00
21 782	1	94.0	.20	-5.00	.04	-4.00	.09	-4.00	.15	-4.00
19 782	2	34.0	.40	.21	.20	.28	.40	.23	-1.00	-1.00
21 782	2	40.0	.06	-4.00	.03	-4.00	.07	-4.00	-1.00	-1.00
19 782	3	42.0	.49	.27	.19	.25	.48	.31	-1.00	-1.00
21 782	3	43.0	.18	-4.00	.06	-4.00	.16	-4.00	-1.00	-1.00
6 882	1	42.0	.10	-4.00	.02	-4.00	.08	-4.00	-1.00	-1.00
8 882	1	98.0	.19	-5.00	.02	-4.00	.08	-4.00	.11	-4.00
10 882	1	123.0	.09	-5.00	.01	-4.00	.03	-4.00	.06	-4.00
10 882	1	175.0	.64	-5.00	.07	-4.00	.26	-4.00	.30	-4.00
15 882	1	204.0	.18	-5.00	.01	-4.00	.07	-4.00	.08	-4.00
15 882	1	65.0	.10	-5.00	.02	-4.00	.06	-4.00	.10	-4.00
10 882	2	308.0	.15	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
10 882	2	257.0	.48	-5.00	.04	-4.00	.13	-4.00	.20	-4.00
15 882	2	273.0	.10	-5.00	.01	-4.00	.03	-4.00	.04	-4.00
15 882	2	94.0	.02	-5.00	.00	-4.00	.02	-4.00	.02	-4.00
10 882	3	358.0	.22	-5.00	.03	-4.00	.06	-4.00	.07	-4.00
10 882	3	242.0	.41	-5.00	.05	-4.00	.14	-4.00	.18	-4.00
15 882	3	380.0	.18	-5.00	.02	-4.00	.06	-4.00	.08	-4.00
23 882	1	229.0	.42	-5.00	.13	-4.00	.29	-4.00	.33	-4.00
24 882	1	34.0	.06	-4.00	.01	-4.00	.06	-4.00	-1.00	-1.00
26 882	1	482.0	.97	-5.00	.14	-4.00	.30	-4.00	.38	-4.00

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
30 882	1	62.0	.10	-5.00	.02	-4.00	.08	-4.00	.10	-4.00
23 882	2	66.0	.14	-5.00	.03	-4.00	.09	-4.00	.13	-4.00
26 882	2	474.0	1.14	-5.00	.10	-4.00	.33	-4.00	.43	-4.00
30 882	2	174.0	.08	-5.00	.01	-4.00	.04	-4.00	.04	-4.00
23 882	3	50.0	.08	-4.00	.02	-4.00	.08	-4.00	-1.00	-1.00
26 882	3	463.0	1.10	-5.00	.10	-4.00	.38	.21	.48	.23
30 882	3	98.0	.10	-5.00	.01	-4.00	.02	-4.00	.04	-4.00
31 882	1	21.0	.11	-4.00	.05	-4.00	-2.00	-2.00	-1.00	-1.00
1 982	1	217.0	.55	-5.00	.11	-4.00	.34	-4.00	.37	-4.00
2 982	1	190.0	.95	-5.00	.14	-4.00	.56	.42	.67	.40
31 882	2	41.0	.55	.34	.20	.28	.47	.29	-1.00	-1.00
31 882	2	84.0	.54	-5.00	.26	.50	.46	.28	.52	.25
1 982	2	207.0	.50	-5.00	.09	-4.00	.21	-4.00	.34	-4.00
2 982	2	129.0	.32	-5.00	.02	-4.00	.10	-4.00	.17	-4.00
31 882	3	38.0	.20	-4.00	.07	-4.00	.18	-4.00	-1.00	-1.00
31 882	3	17.0	.17	-4.00	.13	-4.00	-2.00	-2.00	-1.00	-1.00
31 882	3	68.0	.65	-5.00	.15	-4.00	.55	.40	.64	.37
1 982	3	231.0	.93	-5.00	.19	.25	.73	.81	.80	.58
2 982	3	117.0	.22	-5.00	.02	-4.00	.10	-4.00	.16	-4.00
12 982	1	48.0	.09	-4.00	.06	-4.00	.08	-4.00	-1.00	-1.00
11 982	2	89.0	.06	-5.00	.03	-4.00	.05	-4.00	.06	-4.00
12 982	2	21.0	.06	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
13 982	2	62.0	.33	-5.00	.12	-4.00	.19	-4.00	.33	-4.00
12 982	3	37.0	.08	-4.00	.02	-4.00	.08	-4.00	-1.00	-1.00
13 982	1	51.0	.41	-4.00	.08	-4.00	.32	-4.00	-1.00	-1.00
13 982	1	256.0	.44	-5.00	.02	-4.00	.11	-4.00	.16	-4.00
14 982	1	13.0	.10	-4.00	.08	-4.00	-2.00	-2.00	-1.00	-1.00
14 982	1	137.0	.66	-5.00	.20	.28	.50	.33	.52	.25
17 982	1	176.0	1.01	-5.00	.21	.29	.75	.85	.91	.82
13 982	2	275.0	.28	-5.00	.01	-4.00	.06	-4.00	.11	-4.00
14 982	2	24.0	.31	-4.00	.15	-4.00	-2.00	-2.00	-1.00	-1.00
14 982	2	175.0	.21	-5.00	.03	-4.00	.07	-4.00	.10	-4.00
17 982	2	198.0	1.41	-5.00	.20	.28	.81	1.03	.98	.97
13 982	3	105.0	1.05	-5.00	.26	.48	.60	.47	.59	.32
13 982	3	176.0	.17	-5.00	.01	-4.00	.05	-4.00	.07	-4.00
14 982	3	147.0	.19	-5.00	.08	-4.00	.12	-4.00	.13	-4.00
15 982	3	49.0	.13	-4.00	.10	-4.00	.11	-4.00	-1.00	-1.00
17 982	3	210.0	1.20	-5.00	.26	.50	.76	.89	.95	.90
20 982	3	30.0	.04	-4.00	.02	-4.00	.04	-4.00	-1.00	-1.00
31082	1	71.0	.07	-5.00	..01	-4.00	.02	-4.00	.06	-4.00
41082	1	132.0	.32	-5.00	.08	-4.00	.15	-4.00	.25	-4.00
31082	2	126.0	.32	-5.00	.08	-4.00	.23	.23	.27	.21
31082	2	41.0	.06	-4.00	.05	-4.00	.06	-4.00	-1.00	-1.00
41082	2	52.0	.14	-4.00	.04	-4.00	.10	-4.00	-1.00	-1.00
41082	2	87.0	.11	-5.00	.03	-4.00	.08	-4.00	.08	-4.00
61082	1	351.0	2.27	3.44	.25	1.38	.84	1.77	.95	1.54

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
71082	1	36.0	.10	-4.00	.03	-4.00	.10	-4.00	-1.00	-1.00
81082	1	278.0	1.39	-5.00	.24	1.31	.83	1.75	.91	1.48
91082	1	170.0	.10	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
61082	2	292.0	1.82	-5.00	.24	1 .31	.70	1.46	.84	1.37
71082	2	28.0	.05	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
81082	2	286.0	1.47	-5.00	.21	1.15	.92	1.93	1.05	1.69
191082	1	135.0	.56	-5.00	.07	-4.00	.23	.22	.35	.31
191082	2	140.0	.51	-5.00	.05	-4.00	.17	-4.00	.27	.21
191082	3	26.0	.03	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
191082	3	219.0	.48	-5.00	.08	-4.00	.22	.21	.33	.28
281082	1	177.0	.15	-5.00	.02	-4.00	.06	-4.00	.06	-4.00
311082	1	299.0	.38	-5.00	.07	-4.00	.10	-4.00	.13	-4.00
281082	2	124.0	.08	-5.00	.02	-4.00	.04	-4.00	.05	-4.00
311082	2	33.0	.06	-4.00	.02	-4.00	.06	-4.00	-1.00	-1.00
311082	2	24.0	.03	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
311082	2	160.0	.43	-5.00	.19	1.00	.31	.35	.20	-4.00
281082	3	181.0	.12	-5.00	.03	-4.00	.06	-4.00	.06	-4.00
311082	3	331.0	.42	-5.00	.14	.39	.29	.32	.30	.24
21182	1	94.0	.07	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
21182	2	93.0	.05	-5.00	.01	-4.00	.03	-4.00	.04	-4.00
21182	3	130.0	.04	-5.00	.01	-4.00	.02	-4.00	.03	-4.00
111182	1	24.0	.23	.25	.13	.31	-2.00	-2.00	-1.00	-1.00
121182	1	143.0	.41	-5.00	.11	.25	.20	-4.00	.23	-4.00
111182	2	100.0	.07	-5.00	.02	-4.00	.05	-4.00	.05	-4.00
121182	2	158.0	.48	-5.00	.17	.67	.23	.23	.26	.20
111182	3	194.0	.15	-5.00	.03	-4.00	.06	-4.00	.08	-4.00
121182	3	170.0	.39	-5.00	.08	-4.00	.15	-4.00	.20	-4.00
181182	1	167.0	.13	-5.00	.01	-4.00	.05	-4.00	.06	-4.00
201182	1	491.0	.39	-5.00	.06	-4.00	.11	-4.00	.13	-4.00
181182	2	179.0	.09	-5.00	.01	-4.00	.03	-4.00	.06	-4.00
191182	2	54.0	.05	-4.00	.01	-4.00	.04	-4.00	-1.00	-1.00
201182	2	539.0	.38	-5.00	.03	-4.00	.09	-4.00	.16	-4.00
181182	3	94.0	.04	-5.00	.00	-4.00	.01	-4.00	.03	-4.00
191182	3	159.0	.06	-5.00	.01	-4.00	.04	-4.00	.02	-4.00
201182	3	584.0	.81	-5.00	.08	-4.00	.21	-4.00	.37	.35
231182	1	202.0	.74	-5.00	.15	.43	.43	.77	.66	1.09
231182	1	356.0	.32	-5.00	.02	-4.00	.10	-4.00	.14	-4.00
261182	1	786.0	.62	-5.00	.01	-4.00	.06	-4.00	.10	-4.00
271182	1	618.0	.49	-5.00	.03	-4.00	.11	-4.00	.17	-4.00
231182	2	130.0	.36	-5.00	.04	-4.00	.20	-4.00	.33	.28
231182	2	282.0	.23	-5.00	.02	-4.00	.07	-4.00	.10	-4.00
261182	2	732.0	.59	-5.00	.02	-4.00	.06	-4.00	.12	-4.00
271182	2	375.0	.51	-5.00	.03	-4.00	.12	-4.00	.20	-4.00
231182	3	256.0	.21	-5.00	.02	-4.00	.09	-4.00	.16	-4.00
231182	3	205.0	.11	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
261182	3	301.0	.33	-5.00	.01	-4.00	.07	-4.00	.09	-4.00

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
21282	1	1251.0	3.34	4.36	.26	1.44	.75	1.57	.89	1.45
31282	1	106.0	.07	-5.00	.02	-4.00	.04	-4.00	.04	-4.00
41282	1	272.0	.09	-5.00	.02	-4.00	.04	-4.00	.07	-4.00
51282	1	122.0	.12	-5.00	.02	-4.00	.08	-4.00	.09	-4.00
51282	1	36.0	.16	-4.00	.07	-4.00	.15	-4.00	-1.00	-1.00
21282	2	1263.0	3.22	3.95	.22	1.19	.75	1.58	.85	1.38
41282	2	223.0	.14	-5.00	.03	-4.00	.12	-4.00	.12	-4.00
51282	2	60.0	.18	-4.00	.07	-4.00	.15	-4.00	.18	-4.00
51282	2	46.0	.14	-4.00	.06	-4.00	.14	-4.00	-1.00	-1.00
21282	3	1441.0	2.99	2.87	.17	.67	.41	.70	.49	.63
41282	3	83.0	.16	-5.00	.03	-4.00	.11	-4.00	.15	-4.00
51282	3	48.0	.11	-4.00	.03	-4.00	.10	-4.00	-1.00	-1.00
51282	3	24.0	.05	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
71282	3	47.0	.08	-4.00	.03	-4.00	.07	-4.00	-1.00	-1.00
101282	1	278.0	.18	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
101282	2	341.0	.18	-5.00	.01	-4.00	.03	-4.00	.06	-4.00
101282	3	361.0	.20	-5.00	.01	-4.00	.03	-4.00	.06	-4.00
231282	1	1318.0	3.00	3.14	.10	-5.00	.23	-5.00	.36	1.04
241282	1	680.0	.70	-5.00	.09	-5.00	.17	~5.00	.25	.50
231282	2	1603.0	3.12	3.16	.10	-5.00	.28	-5.00	.38	1 .06
251282	2	324.0	.24	-5.00	.03	-5.00	.09	-5.00	.10	-4.00
231282	3	1916.0	3.04	2.72	.10	-5.00	.29	-5.00	.45	1.14
271282	3	207.0	.20	-5.00	.02	-5.00	.06	-5.00	.10	-4.00
271282	1	262.0	.25	-5.00	.02	-5.00	.07	-5.00	.09	-4.00
271282	2	236.0	.21	-5.00	.02	-5.00	.06	-5.00	.08	-4.00
271282	3	129.0	.10	-5.00	.01	-5.00	.05	-5.00	.08	-4.00
21 183	1	173.0	.05	-5.00	.00	-5.00	.01	-5.00	.03	-4.00
21 183	1	956.0	.28	-5.00	.02	-5.00	.04	-5.00	.07	-4.00
22 183	1	1004.0	.34	-5.00	.02	-5.00	.03	-5.00	.04	-4.00
21 183	2	983.0	.13	-5.00	.00	-5.00	.01	-5.00	.02	-4.00
22 183	2	155.0	.10	-5.00	.01	-5.00	.03	-5.00	.06	-4.00
22 183	2	302.0	.04	-5.00	.01	-5.00	.01	-5.00	.01	-4.00
21 183	3	893.0	.15	-5.00	.00	-5.00	.02	-5.00	.03	-4.00
22 183	3	186.0	.14	-5.00	.01	-5.00	.05	-5.00	.08	-4.00
22 183	3	685.0	.09	-5.00	.00	-5.00	.02	-5.00	.02	-4.00
23 183	3	77.0	.05	-5.00	.02	-5.00	.04	-5.00	.05	-4.00
29 183	1	331.0	.14	-5.00	.02	-5.00	.06	-5.00	.08	-4.00
29 183	2	594.0	.09	-5.00	.01	-5.00	.03	-5.00	.04	-4.00
1 283	2	392.0	.11	-5.00	.02	-5.00	.04	-5.00	.06	-4.00
29 183	3	196.0	.09	-5.00	.01	-5.00	.05	-5.00	.05	-4.00
1 283	3	142.0	.11	-5.00	.02	-5.00	.07	-5.00	.09	-4.00
1 283	1	1180.0	.85	-5.00	.01	-5.00	.06	-5.00	.10	-4.00
1 283	2	816.0	.71	-5.00	.02	-5.00	.06	-5.00	.10	-4.00
1 283	3	757.0	.80	-5.00	.02	-5.00	.08	-5.00	.12	-4.00
5 383	1	136.0	.33	-5.00	.04	-5.00	.12	-5.00	.18	.27
5 383	1	168.0	.36	-5.00	.04	-5.00	.11	-5.00	.18	.28

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	RI	MAX 5 MIN DEPTH	RI	MAX 30 MIN DEPTH	RI	MAX 60 MIN DEPTH	RI
6 383	1	135.0	.12	-5.00	.02	-5.00	.05	-5.00	.06	-4.00
7 383	1	126.0	.08	-5.00	.04	-5.00	.02	-5.00	.03	-4.00
7 383	1	14.0	.03	-5.00	.02	-5.00	-2.00	-2.00	-1.00	-1.00
5 383	3	137.0	.29	-5.00	.04	-5.00	.12	-5.00	.15	.22
5 383	3	197.0	.49	-5.00	.02	-5.00	.10	-5.00	.19	.34
6 383	3	151.0	.11	-5.00	.01	-5.00	.04	-5.00	.05	-4.00
7 383	3	182.0	.04	-5.00	.00	-5.00	.01	-5.00	.02	-4.00
7 383	1	52.0	.07	-5.00	.01	-5.00	.05	-5.00	-1.00	-1.00
9 383	1	35.0	.07	-5.00	.02	-5.00	.06	-5.00	-1.00	-1.00
17 383	1	863.0	1.26	-5.00	.02	-5.00	.08	-5.00	.13	-4.00
20 383	1	1054.0	.68	-5.00	.02	-5.00	.08	-5.00	.14	.21
7 383	2	161.0	.04	-5.00	.01	-5.00	.02	-5.00	.02	-4.00
7 383	3	158.0	.06	-5.00	.01	-5.00	.03	-5.00	.01	-4.00
7 383	3	350.0	.05	-5.00	.01	-5.00	.01	-5.00	.02	-4.00
17383	2	991.0	1.40	-5.00	.02	-5.00	.10	-5.00	.16	.23
20 383	2	541.0	.56	-5.00	.01	-5.00	.08	-5.00	.14	.20
17 383	3	1011.0	1.34	-5.00	.02	-5.00	.09	-5.00	.16	.24
20 383	3	690.0	.60	-5.00	.02	-5.00	.08	-5.00	.15	.22
26 383	1	871.0	.36	-5.00	.03	-4.00	.10	-4.00	.19	-4.00
26 383	2	570.0	.41	-5.00	.02	-4.00	.11	-4.00	.18	-4.00
30 383	2	246.0	.09	-5.00	.00	-4.00	.02	-4.00	.04	-4.00
30 383	2	411.0	.08	-5.00	.00	-4.00	.01	-4.00	.02	-4.00
26 383	3	185.0	.22	-5.00	.02	-4.00	.11	-4.00	.15	-4.00
26 383	3	32.0	.04	-4.00	.01	-4.00	.03	-4.00	-1.00	-1.00
26 383	3	49.0	.03	-4.00	.01	-4.00	.03	-4.00	-1.00	-1.00
27 383	3	69.0	.11	-5.00	.02	-4.00	.05	-4.00	.08	-4.00
30 383	3	109.0	.04	-5.00	.01	-4.00	.03	-4.00	.03	-4.00
30 383	3	433.0	.05	-5.00	.00	-4.00	.01	-4.00	.01	-4.00
1 483	1	156.0	.64	-5.00	.05	-4.00	.22	-4.00	.33	.23
1 483	1	127.0	.15	-5.00	.02	-4.00	.08	-4.00	.11	-4.00
2 483	1	227.0	.14	-5.00	.02	-4.00	.05	-4.00	.08	-4.00
2 483	1	79.0	.05	-5.00	.00	-4.00	.01	-4.00	.02	-4.00
1 483	2	160.0	.56	-5.00	.04	-4.00	.20	-4.00	.32	.22
1 483	2	131.0	.16	-5.00	.02	-4.00	.09	-4.00	.11	-4.00
2 483	2	225.0	.14	-5.00	.02	-4.00	.07	-4.00	.03	-4.00
4 483	2	45.0	.03	-4.00	.01	-4.00	.03	-4.00	-1.00	-1.00
5 483	2	164.0	.41	-5.00	.10	-4.00	.25	.21	.26	-4.00
1 483	3	195.0	.61	-5.00	.06	-4.00	.21	-4.00	.33	.23
1 483	3	152.0	.19	-5.00	.03	-4.00	.09	-4.00	.13	-4.00
2 483	3	314.0	.16	-5.00	.01	-4.00	.06	-4.00	.08	-4.00
5 483	3	137.0	.29	-5.00	.12	.21	.22	-4.00	.24	-4.00
6 483	3	271.0	.17	-5.00	.02	-4.00	.05	-4.00	.06	-4.00
5 483	1	134.0	.39	-5.00	.10	-4.00	.24	.20	.29	-4.00
6 483	1	346.0	.26	-5.00	.01	-4.00	.06	-4.00	.07	-4.00
6 483	2	286.0	.21	-5.00	.02	-4.00	.05	-4.00	.05	-4.00
8 483	1	538.0	.42	-5.00	.06	-4.00	.17	-4.00	.18	-4.00

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
13 483	1	630.0	2.69	3.86	.43	6.50	.72	1.45	.79	1.20
8 483	2	388.0	.29	-5.00	.03	-4.00	.08	-4.00	.09	-4.00
9 483	2	93.0	.05	-5.00	.01	-4.00	.03	-4.00	.04	-4.00
13 483	2	637.0	2.61	3.51	.31	1.67	.55	1.02	.60	.77
17 463	2	466.0	.21	-5.00	.01	-4.00	.06	-4.00	.10	-4.00
18 483	2	24.0	.03	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
8 483	3	637.0	.45	-5.00	.08	-4.00	.17	-4.00	.17	-4.00
9 483	3	409.0	.14	-5.00	.04	-4.00	.08	-4.00	.09	-4.00
12 483	3	269.0	.10	-5.00	.02	-4.00	.06	-4.00	.06	-4.00
13 483	3	631.0	3.09	5.99	.19	.55	.62	1.20	1.10	1.74
17 483	3	507.0	.23	-5.00	.01	-4.00	.05	-4.00	.08	-4.00
17 483	1	632.0	.37	-5.00	.01	-4.00	.07	-4.00	.13	-4.00
18 483	1	66.0	.07	-5.00	.01	-4.00	.04	-4.00	.07	-4.00
27 483	1	594.0	.67	-5.00	.10	-4.00	.23	-4.00	.25	-4.00
28 483	1	315.0	.80	-5.00	.13	.24	.31	.28	.34	.24
29 483	1	361.0	.41	-5.00	.13	.25	.21	-4.00	.25	-4.00
30 483	1	529.0	1.28	-5.00	.17	.42	.58	1.10	.62	.82
1 583	1	74.0	.74	-5.00	.45	7.50	.72	1.43	.74	1.11
27 483	2	649.0	.89	-5.00	.11	.21	.31	.29	.36	.26
28 483	2	281.0	.40	-5.00	.03	-4.00	.13	-4.00	.17	-4.00
30 483	2	167.0	.42	-5.00	.19	.60	.26	.22	.28	-4.00
30 483	2	161.0	.66	-5.00	.21	.80	.48	.73	.59	.74
1 583	2	223.0	.75	-5.00	.08	-4.00	.29	.25	.44	.37
1 583	2	62.0	.11	-5.00	.03	-4.00	.09	-4.00	.12	-4.00
1 583	2	54.0	.36	.28	.19	.60	.31	.28	-1.00	-1.00
3 583	1	163.0	.04	-5.00	.01	-4.00	.02	-4.00	.04	-4.00
3 583	2	168.0	.10	-5.00	.00	-4.00	.03	-4.00	.05	-4.00
3 583	3	152.0	.17	-5.00	.01	-4.00	.05	-4.00	.10	-4.00
13 583	1	216.0	.67	-5.00	.10	-4.00	.31	.29	.34	.24
14 583	1	408.0	.41	-5.00	.02	-4.00	.09	-4.00	.13	-4.00
12 583	2	242.0	.03	-5.00	.00	-4.00	.01	-4.00	.02	-4.00
13 583	2	256.0	.88	-5.00	.14	.29	.55	1.01	.63	.86
14 583	2	35.0	.13	-4.00	.05	-4.00	.13	-4.00	-1.00	-1.00
14 583	2	537.0	.37	-5.00	.02	-4.00	.08	-4.00	.10	-4.00
12 583	3	119.0	.05	-5.00	.01	-4.00	.04	-4.00	.04	-4.00
13 583	3	248.0	.40	-5.00	.04	-4.00	.16	-4.00	.21	-4.00
14 583	3	189.0	.06	-5.00	.00	-4.00	.02	-4.00	.03	-4.00
14 583	3	366.0	.27	-5.00	.02	-4.00	.08	-4.00	.10	-4.00
18 583	1	28.0	.15	-4.00	.07	-4.00	-2.00	-2.00	-1.00	-1.00
18 583	1	326.0	.23	-5.00	.02	-4.00	.07	-4.00	.08	-4.00
22 583	1	200.0	.71	-5.00	.15	.33	.42	.51	.51	.48
18 583	2	104.0	.15	-5.00	.04	-4.00	.11	-4.00	.13	-4.00
19 583	2	150.0	.13	-5.00	.04	-4.00	.06	-4.00	.09	-4.00
21 583	2	424.0	.84	-5.00	.11	-4.00	.28	.24	.39	.30
18 583	3	316.0	.45	-5.00	.11	-4.00	.25	.21	.26	-4.00
21 583	3	423.0	.91	-5.00	.08	-4.00	.34	.33	.43	.35

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
27 583	1	63.0	.11	-5.00	.03	-4.00	.07	-4.00	.11	-4.00
28 583	1	64.0	.38.	-5.00	.14	.28	.22	-4.00	.37	.27
27 583	2	65.0	.12	-5.00	.02	-4.00	.08	-4.00	.12	-4.00
28 583	2	76.0	.08	-5.00	.05	-4.00	.05	-4.00	.06	-4.00
27 583	3	165.0	.08	-5.00	.02	-4.00	.03	-4.00	.04	-4.00
2 683	1	137.0	.07	-5.00	.01	-4.00	.04	-4.00	.05	-4.00
2 683	1	450.0	3.83	19.16	.34	1.88	1.03	2.75	1.33	2.60
3 683	1	348.0	.42	-5.00	.20	.70	.30	.26	.33	.23
5 683	1	445.0	.48	-5.00	.07	-4.00	.17	-4.00	.26	-4.00
2 683	2	124.0	.08	-5.00	.01	-4.00	.03	-4.00	.04	-4.00
2 683	2	792.0	3.48	7.58	.22	.90	.79	1 .61	1.14	1.81
3 683	2	158.0	.21	-5.00	.03	-4.00	.08	-4.00	.14	-4.00
5 683	2	351.0	.88	-5.00	.15	.33	.42	.50	.49	.45
31 583	3	25.0	.18	-4.00	.15	.33	-2.00	-2.00	-1.00	-1.00
2 683	3	1087.0	1.54	-5.00	.12	.24	.37	.38	.52	.49
3 683	3	164.0	.25	-5.00	.07	-4.00	.12	-4.00	.15	-4.00
3 683	3	21.0	.11	-4.00	.09	-4.00	-2.00	-2.00	-1.00	-1.00
5 683	3	411.0	.87	-5.00	.12	.21	.38	.42	.49	.46
18 683	1	72.0	.20	-5.00	.04	-4.00	.14	-4.00	.19	-4.00
20 683	1	173.0	1.32	-5.00	.12	.23	.44	.60	.75	1.14
17 683	2	39.0	.16	-4.00	.04	-4.00	.15	-4.00	-1.00	-1.00
18 683	2	105.0	.69	-5.00	.15	.35	.48	.76	.60	.78
20 683	2	124.0	.32	-5.00	.06	-4.00	.17	-4.00	.25	-4.00
26 683	1	82.0	.55	-5.00	.13	-4.00	.50	.34	.53	.26
27 683	1	15.0	.05	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
27 683	1	129.0	.27	-5.00	.06	-4.00	.17	-4.00	.22	-4.00
28 683	1	23.0	.15	-4.00	.11	-4.00	-2.00	-2.00	-1.00	-1.00
28 683	1	18.0	.09	-4.00	.05	-4.0.0	-2.00	-2.00	-1.00	-1.00
26 683	2	133.0	.25	-5.00	.05	-4.00	.16	-4.00	.19	-4.00
27 683	2	40.0	.05	-4.00	.01	-4.00	.04	-4.00	-1.00	-1.00
27 683	2	17.0	.31	.21	.22	.33	-2.00	-2.00	-1.00	-1.00
27 683	2	106.0	.18	-5.00	.02	-4.00	.08	-4.00	.13	-4.00
28 683	2	34.0	.24	-4.00	.10	-4.00	.24	-4.00	-1.00	-1.00
28 683	2	141.0	.85	-5.00	.55	15.00	.81	1.04	.81	.61
28 683	2	23.0	.48	.37	.33	1.50	-2.00	-2.00	-1.00	-1.00
4 783	1	11.0	.02	-4.00	.01	-4.00	-2.00	-2.00	-1.00	-1.00
4 783	2	12.0	.03	-4.00	.01	-4.00	-2.00	-2.00	-1.00	-1.00
4 783	3	12.0	.11	-4.00	.08	-4.00	-2.00	-2.00	-1.00	-1.00
24 783	1	12.0	.08	-4.00	.05	-4.00	-2.00	-2.00	-1.00	-1.00
25 783	1	256.0	.37	-5.00	.06	-4.00	.16	-4.00	.24	-4.00
24 783	2	16.0	.09	-4.00	.06	-4.00	-2.00	-2.00	-1.00	-1.00
25 783	2	217.0	.40	-5.00	.09	-4.00	.19	-4.00	.29	-4.00
25 783	3	178.0	.35	-5.00	.09	-4.00	.18	-4.00	.26	-4.00
5 883	2	106.0	.06	-5.00	.02	-4.00	.04	-4.00	.05	-4.00
22 883	1	131.0	1.14	-5.00	.26	.53	.91	1.73	1.01	1.09
22 883	2	33.0	.02	-4.00	.00	-4.00	.02	-4.00	-1.00	-1.00

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
22.883	3	61.0	.01	-5.00	.02	-4.00	.02	-4.00	.04	-4.00
27 883	1	85.0	.09	-5.00	.03	-4.00	.09	-4.00	.09	-4.00
22 883	2	130.0	.51	-5.00	.13	-4.00	.37	.20	.40	-4.00
27 883	2	60.0	.23	-4.00	.11	-4.00	.20	-4.00	.23	-4.00
22 883	3	121.0	.36	-5.00	.07	-4.00	.24	-4.00	.27	-4.00
27 883	3	15.0	.20	-4.00	.12	-4.00	-2.00	-2.00	-1.00	-1.00
10 983	1	31.0	.10	-4.00	.06	-4.00	.10	-4.00	-1.00	-1.00
11 983	1	206.0	.10	-5.00	.06	-4.00	.07	-4.00	.07	-4.00
12 983	1	156.0	.65	-5.00	.13	-4.00	.44	.26	.55	.28
11 983	2	12.0	.04	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
12 983	2	265.0	.75	-5.00	.18	.23	.25	-4.00	.29	-4.00
11 983	3	29.0	.03	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
12 983	3	31.0	.15	-4.00	.04	-4.00	.15	-4.00	-1.00	-1.00
12 983	3	20.0	.22	-4.00	.10	-4.00	-2.00	-2.00	-1.00	-1.00
12 983	3	135.0	.27	-5.00	.07	-4.00	.15	-4.00	.17	-4.00
18 983	1	154.0	.09	-5.00	.03	-4.00	.02	-4.00	.03	-4.00
18 983	2	79.0	.03	-5.00	.00	-4.00	.02	-4.00	.03	-4.00
20 983	1	455.0	.35	-5.00	.04	-4.00	.08	-4.00	.10	-4.00
20 983	2	427.0	.77	-5.00	.09	-4.00	.26	-4.00	.36	-4.00
20 983	3	383.0	.37	-5.00	.03	-4.00	.09	-4.00	.15	-4.00
41083	1	828.0	.40	-5.00	.02	-4.00	.08	-4.00	.13	-4.00
81083	1	93.0	.07	-5.00	.02	-4.00	.04	-4.00	.05	-4.00
41083	2	281.0	.21	-5.00	.01	-4.00	.06	-4.00	.09	-4.00
41083	2	62.0	.05	-5.00	.01	-4.00	.05	-4.00	.05	-4.00
81083	2	151.0	.35	-5.00	.03	-4.00	.13	-4.00	.22	-4.00
41083	3	251.0	.21	-5.00	.01	-4.00	.07	-4.00	.10	-4.00
81083	3	121.0	.45	-5.00	.10	.23	.31	.35	.41	.42
111083	1	765.0	.80	-5.00	.04	-4.00	.11	-4.00	.16	-4.00
171083	1	59.0	.09	-4.00	.04	-4.00	.09	-4.00	-1.00	-1.00
171083	1	271.0	.19	-5.00	.02	-4.00	.07	-4.00	.10	-4.00
111083	2	675.0	.69	-5.00	.04	-4.00	.12	-4.00	.15	-4.00
171083	2	157.0	.23	-5.00	.05	-4.00	.13	-4.00	.10	-4.00
111083	3	706.0	.99	-5.00	.05	-4.00	.16	-4.00	.23	-4.00
171083	3	108.0	.09	-5.00	.02	-4.00	.04	-4.00	.04	-4.00
191083	1	3263.0	5.20	11.48	.12	.29	.48	.98	.73	1.21
221083	1	3.0	.03	-3.00	-3.00	-3.00	-2.00	-2.00	-1.00	-1.00
171083	2	133.0	.12	-5.00	.01	-4.00	.06	-4.00	.09	-4.00
191083	2	3308.0	4.35	6.20	.09	-4.00	.24	.24	.36	.33
221083	2	7.0	.04	-4.00	.04	-4.00	-2.00	-2.00	-1.00	-1.00
171083	3	48.0	.16	-4.00	.03	-4.00	.12	-4.00	-1.00	-1.00
171083	3	103.0	.07	-5.00	.01	-4.00	.04	-4.00	.05	-4.00
191083	3	3308.0	4.30	5.94	.15	.42	.50	1.04	.57	.89
21183	1	180.0	.54	-5.00	.04	-4.00	.17	-4.00	.31	.25
31183	1	238.0	.76	-5.00	.05	-4.00	.28	.31	.44	.48
21183	2	328.0	.57	-5.00	.04	-4.00	.17	-4.00	.26	.20
31183	2	274.0	.96	-5.00	.17	.67	.43	.76	.52	.73

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
21183	3	331.0	.87	-5.00	.05	-4.00	.14	-4.00	.21	-4.00
31183	3	315.0	1.35	-5.00	.08	-4.00	.33	.40	.58	.93
91183	1	1085.0	.80	-5.00	.03	-4.00	.13	-4.00	.21	-4.00
91183	2	1070.0	.87	-5.00	.03	-4.00	.09	-4.00	.17	-4.00
91183	3	1069.0	1.03	-5.00	.03	-4.00	.12	-4.00	.17	-4.00
191183	1	515.0	1.77	-5.00	.18	.83	.48	1.01	.66	1.09
191183	2	1082.0	1.75	-5.00	.09	-4.00	.20	-4.00	.27	.21
191183	3	1009.0	1.77	-5.00	.10	.23	.21	-4.00	.28	.22
271183	1	919.0	1.79	-5.00	.10	.22	.36	.48	.52	.73
221183	2	22.0	.04	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
221183	2	648.0	1.43	-5.00	.08	-4.00	.20	-4.00	.31	.25
271183	2	905.0	1.70	-5.00	.12	.29	.49	1.02	.65	1.07
221183	3	18.0	.05	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
221183	3	20.0	.03	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
221183	3	604.0	1.43	-5.00	.09.	.20	.30	.33	.34	.30
271183	3	1071.0	2.21	-5.00	.12	.29	.57	1.19	.81	1.33
51283	1	114.0	.17	-5.00	.02	-4.00	.07	-4.00	.11	-4.00
11283	2	480.0	.22	-5.00	.01	-4.00	.04	-4.00	.07	-4.00
31283	2	576.0	.98	-5.00	.03	-4.00	.14	-4.00	.26	-4.00
51283	2	181.0	.14	-5.00	.02	-4.00	.06	-4.00	.07	-4.00
11283	3	427.0	.14	-5.00	.01	-4.00	.04	-4.00	.05	-4.00
31283	3	608.0	.92	-5.00	.05	-4.00	.14	-4.00	.20	-4.00
51283	3	132.0	.28	-5.00	.06	-4.00	.17	-4.00	.22	-4.00
101283	2	997.0	1.77	-5.00	.03	-4.00	.15	-4.00	.23	-4.00
111283	2	518.0	.32	-5.00	.02	-4.00	.10	-4.00	.14	-4.00
101283	3	966.0	2.54	2.36	.08	-4.00	.39	.58	.66	1.09
111283	3	437.0	.17	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
131283	3	375.0	.18	-5.00	.01	-4.00	.04	-4.00	.05	-4.00
131283	2	418.0	.21	-5.00	.01	-4.00	.03	-4.00	.06	-4.00
221283	3	423.0	.38	-5.00	.03	-5.00	.08	-5.00	.13	-4.00
271283	2	494.0	.11	-5.00	.00	-5.00	.01	-5.00	.03	-4.00
271283	3	375.0	.12	-5.00	.00	-5.00	.02	-5.00	.03	-4.00
9 184	1	168.0	.13	-5.00	.01	-5.00	.04	-5.00	.06	-4.00
9 184	2	316.0	.24	-5.00	.01	-5.00	.05	-5.00	.08	-4.00
9 184	3	321.0	.25	-5.00	.02	-5.00	.06	-5.00	.08	-4.00
23 184	3	220.0	.19	-5.00	.01	-5.00	.05	-5.00	.08	-4.00
23 184	2	174.0	.13	-5.00	.01	-5.00	.04	-5.00	.05	-4.00
23 184	3	326.0	.19	-5.00	.01	-5.00	.04	-5.00	.06	-4.00
2 284	2	875.0	.16	-5.00	.01	-5.00	.05	-5.00	.07	-4.00
4 284	2	60.0	.05	-4.00	.03	-5.00	.04	-5.00	.06	-4.00
2 284	3	445.0	.14	-5.00	.01	-5.00	.05	-5.00	.06	-4.00
4 284	3	246.0	.06	-5.00	.02	-5.00	.05	-5.00	.05	-4.00
9 284	2	812.0	.46	-5.00	.02	-5.00	.10	-5.00	.15	.22
12 284	2	1232.0	.90	-5.00	.03	-5.00	.10	-5.00	.20	.35
17 284	2	27.0	.05	-5.00	.03	-5.00	-2.00	-2.00	-1.00	-1.00
17 284	2	39.0	.10	-5.00	.04	-5.00	.09	-5.00	-1.00	-1.00

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
18 284	2	38.0	.12	-5.00	.03	-5.00	.11	-5.00	-1.00	-1.00
25 284	3	1106.0	.49	-5.00	.02	-5.00	.07	-5.00	.11	-4.00
4 384	1	315.0	.71	-5.00	.03	-5.00	.16	-5.00	.30	.88
4 384	1	256.0	.13	-5.00	.02	-5.00	.07	-5.00	.11	-4.00
4 384	3	340.0	.66	-5.00	.05	-5.00	.21	-5.00	.32	.98
4 384	3	25.0	.05	-5.00	.02	-5.00	-2.00	-2.00	-1.00	-1.00
7 384	1	117.0	.11	-5.00	.02	-5.00	.05	-5.00	.05	-4.00
12 384	1	66.0	.07	-5.00	.01	-5.00	.04	-5.00	.07	-4.00
7 384	2	103.0	.09	-5.00	.01	-5.00	.04	-5.00	.05	-4.00
7 384	3	93.0	.10	-5.00	.01	-5.00	.05	-5.00	.06	-4.00
12 384	1	500.0	.30	-5.00	.01	-5.00	.04	-5.00	.07	-4.00
15 384	1	60.0	.24	.47	.07	-5.00	.16	-5.00	.24	.47
17 384	1	159.0	.24	-5.00	.03	-5.00	.12	-5.00	.17	.24
18 384	1	238.0	.31	-5.00	.05	-5.00	.14	-5.00	.21	.39
19 384	1	138.0	.25	-5.00	.11	-5.00	.16	-5.00	.20	.37
12 384	2	387.0	.11	-5.00	.00	-5.00	.02	-5.00	.03	-4.00
14 384	2	66.0	.04	-5.00	.01	-5.00	.03	-5.00	.03	-4.00
15 384	2	70.0	.35	-5.00	.09	-5.00	.23	-5.00	.34	1.02
12 384	3	541.0	.19	-5.00	.01	-5.00	.03	-5.00	.04	-4.00
19 384	1	220.0	.72	-5.00	.14	-5.00	.41	-5.00	.46	1.15
24 384	1	205.0	.25	-5.00	.02	-4.00	.06	-4.00	.11	-4.00
24 384	1	530.0	1.11	-5.00	.09	-4.00	.29	.26	.41	.32
25 384	1	122.0	.04	-5.00	.01	-4.00	.03	-4.00	.03	-4.00
19 384	2	303.0	.70	-5.00	.07	-5.00	.18	-5.00	.25	.49
24 384	2	143.0	.15	-5.00	.02	-4.00	.05	-4.00	.08	-4.00
24 384	2	589.0	.82	-5.00	.04	-4.00	.20	-4.00	.32	.22
19 384	3	370.0	1.41	-5.00	.20	-5.00	.37	-5.00	.45	1.14
24 384	3	165.0	.14	-5.00	.02	-4.00	.05	-4.00	.06	-4.00
24 384	3	634.0	.90	-5.00	.05	-4.00	.24	.20	.34	.24
26 384	1	337.0	.42	-5.00	.07	-4.00	.19	-4.00	.21	-4.00
27 384	1	759.0	.54	-5.00	.02	-4.00	.05	-4.00	.08	-4.00
2 484	1	648.0	.63	-5.00	.02	-4.00	.08	-4.00	.14	-4.00
26 384	3	375.0	.20	-5.00	.02	-4.00	.07	-4.00	.11	-4.00
27 384	3	750.0	.33	-5.00	.02	-4.00	.05	-4.00	.09	-4.00
6 484	1	36.0	.03	-4.00	.01	-4.00	.03	-4.00	-1.00	-1.00
7 484	1	89.0	.06	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
8 484	1	601.0	.28	-5.00	.02	-4.00	.06	-4.00	.08	-4.00
2 484	2	693.0	.80	-5.00	.02	-4.00	.10	-4.00	.15	-4.00
3 484	2	342.0	1.55	-5.00	.29	1.50	.95	2.00	1.15	1.83
7 484	2	178.0	.05	-5.00	.01	-4.00	.02	-4.00	.02	-4.00
8 484	2	374.0	.22	-5.00	.01	-4.00	.03	-4.00	.06	-4.00
2 484	3	696.0	.72	-5.00	.03	-4.00	.09	-4.00	.15	-4.00
3 484	3	222.0	1.03	-5.00	.14	.29	.58	1.10	.75	1.13
7 484	3	112.0	.02	-5.00	.00	-4.00	.01	-4.00	.02	-4.00
8 484	3	605.0	.13	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
12 484	1	240.0	.12	-5.00	.01	-4.00	.03	-4.00	.06	-4.00

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
14 484	1	93.0	.07	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
15 484	1	102.0	.07	-5.00	.01	-4.00	.05	-4.00	.06	-4.00
15 484	1	54.0	.02	-4.00	.01	-4.00	.02	-4.00	-1.00	-1.00
12 484	2	194.0	.08	-5.00	.01	-4.00	.03	-4.00	.05	-4.00
14 484	2	122.0	.08	-5.00	.02	-4.00	.04	-4.00	.04	-4.00
15 484	2	595.0	.13	-5.00	.03	-4.00	.04	-4.00	.06	-4.00
12 484	3	166.0	.04	-5.00	.01	-4.00	.03	-4.00	.04	-4.00
14 484	3	169.0	.13	-5.00	.03	-4.00	.07	-4.00	.09	-4.00
14 484	3	737.0	.17	-5.00	.02	-4.00	.06	-4.00	.07	-4.00
20 484	1	1997.0	2.06	-5.00	.11	-4.00	.23	-4.00	.30	.20
22 484	1	757.0	.10	-5.00	.04	-4.00	.06	-4.00	.06	-4.00
20 484	2	2012.0	2.67	-5.00	.11	-4.00	.23	-4.00	.44	.38
22 484	2	35.0	.05	-4.00	.02	-4.00	.04	-4.00	-1.00	-1.00
20 484	3	1790.0	2.59	-5.00	.08	-4.00	.27	.23	.44	.38
23 484	3	258.0	.05	-5.00	.02	-4.00	.02	-4.00	.03	-4.00
29 484	1	59.0	.21	-4.00	.06	-4.00	.12	-4.00	-1.00	-1.00
2 584	1	74.0	.03	-5.00	.01	-4.00	.02	-4.00	.04	-4.00
27 484	2	26.0	.05	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
29 484	2	782.0	.34	-5.00	.09	-4.00	.16	-4.00	.31	.21
27 484	3	17.0	.34	.54	.20	.70	-2.00	-2.00	-1.00	-1.00
29 484	3	769.0	.45	-5.00	.07	-4.00	.22	-4.00	.30	.20
3 584	1	17.0	.07	-4.00	.06	-4.00	-2.00	-2.00	-1.00	-1.00
3 584	2	36.0	.08	-4.00	.03	-4.00	.08	-4.00	-1.00	-1.00
4 584	1	19.0	.04	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
5 584	1	448.0	.66	-5.00	.06	-4.00	.21	-4.00	.27	-4.00
6 584	1	30.0	.07	-4.00	.03	-4.00	.06	-4.00	-1.00	-1.00.
7 584	1	81.0	.11	-5.00	.01	-4.00	.06	-4.00	.10	-4.00
4 584	2	24.0	.07	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
5 584	2	494.0	.58	-5.00	.06	-4.00	.13	-4.00	.17	-4.00
6 584	2	35.0	.08	-4.00	.02	-4.00	.08	-4.00	-1.00	-1.00
7 584	2	77.0	.08	-5.00	.01	-4.00	.06	-4.00	.08	-4.00
5 584	3	511.0	.65	-5.00	.05	-4.00	.14	-4.00	.18	-4.00
6 584	3	31.0	.06	-4.00	.02	-4.00	.06	-4.00	-1.00	-1.00
7 584	3	49.0	.06	-4.00	.01	-4.00	.04	-4.00	-1.00	-1.00
13 584	1	57.0	.07	-4.00	.02	-4.00	.07	-4.00	-1.00	-1.00
13 584	1	64.0	.36	-5.00	.15	.32	.28	.24	.35	.25
13 584	2	84.0	.38	-5.00	.13	.25	.27	.23	.36	.26
13 584	3	28.0	.16	-4.00	.07	-4.00	-2.00	-2.00	-1.00	-1.00
13 584	3	73.0	.40	-5.00	.09	-4.00	.26	.22	.37	.28
20 584	1	27.0	.16	-4.00	.08	-4.00	-2.00	-2.00	-1.00	-1.00
20 584	2	43.0	.04	-4.00	.02	-4.00	.04	-4.00	-1.00	-1.00
20 584	2	17.0	.02	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
20 584	2	16.0	.03	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
20 584	2	29.0	.06	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
21 584	2	58.0	.09	-4.00	.03	-4.00	.07	-4.00	-1.00	-1.00
19 584	3	17.0	.04	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
20 584	3	13.0	.16	-4.00	.13	.25	-2.00	-2.00	-1.00	-1.00
21 584	3	79.0	.07	-5.00	.02	-4.00	.05	-4.00	.06	-4.00
21 584	1	41.0	.15	-4.00	.04.	-4.00	.14	-4.00	-1.00	-1.00
22 584	1	56.0-	.12	-4.00	.02	-4.00	.08	-4.00	-1.00	-1.00
25 584	1	208.0	.75	-5.00	.21	.80	.36	.37	.41	.34
27 584	1	160.0	.56	-5.00	.07	-4.00	.30	.27	.41	.33
21 584	2	35.0	.09	-4.00	.02	-4.00	.09	-4.00	-1.00	-1.00
22 584	2	44.0	.13	-4.00	.03	-4.00	.11	-4.00	-1.00	-1.00
25 584	2	207.0	1.28	-5.00	.18	.50	.49	.80	.56	.63
27 584	2	139.0	.52	-5.00	.07	-4.00	.25	.21	.41	.33
21 584	3	45.0	.10	-4.00	.04	-4.00	.10	-4.00	-1.00	-1.00
21 584	3	16.0	.05	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
22 584	3	72.0	.18	-5.00	.04	-4.00	.11	-4.00	.17	-4.00
25 584	3	219.0	.84	-5.00	.16	.39	.39	.44	.46	.40
27 584	3	214.0	.69	-5.00	.13	.26	.41	.48	.51	.48
5 684	1	12.0	.05	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
5 684	1	18.0	.16	-4.00	.12	.23	-2.00	-2.00	-1.00	-1.00
5 684	2	14.0	.18	.20	.14	.29	-2.00	-2.00	-1.00	-1.00
21 684	1	98.0	.09	-5.00	.01	-4.00	.06	-4.00	.08	-4.00
21 684	1	39.0	.08	-4.00	.02	-4.00	.07	-4.00	-1.00	-1.00
22 684	1	82.0	.43	-5.00	.24	.42	.41	.23	.43	-4.00
23 684	1	48.0	.04	-4.00	.02	-4.00	.03	-4.00	-1.00	-1.00
23 684	1	53.0	.20	-4.00	.08	-4.00	.19	-4.00	-1.00	-1.00
23 684	1	138.0	.34	-5.00	.09	-4.00	.19	-4.00	.23	-4.00
21 684	2	44.0	.05	-4.00	.01	-4.00	.04	-4.00	-1.00	-1.00
22 684	2	72.0	.34	-5.00	.23	.37	.32	-4.00	.34	-4.00
23 684	2	22.0	.02	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
23 684	2	42.0	.06	-4.00	.02	-4.00	.06	-4.00	-1.00	-1.00
21 684	3	49.0	.12	-4.00	.02	-4.00	.10	-4.00	-1.00	-1.00
22 684	3	71.0	.59	-5.00	.26	.48	.58	.44	.59	.32
23 684	3	60.0	.05	-4.00	.01	-4.00	.04	-4.00	.05	-4.00
23 684	3	22.0	.29	-4.00	.19	.25	-2.00	-2.00	-1.00	-1.00
23 684	3	38.0	.13	-4.00	.05	-4.00	.12	-4.00	-1.00	-1.00
3 784	1	31.0	.05	-4.00	.01	-4.00	.05	-4.00	-1.00	-1.00
3 784	1	73.0	.26	-5.00	.16	-4.00	.24	-4.00	.26	-4.00
4 784	1	130.0	.15	-5.00	.01	-4.00	.06	-4.00	.11	-4.00
4 784	1	82.0	.11	-5.00	.02	-4.00	.08	-4.00	.11	-4.00
3 784	2	41.0	.25	-4.00	.13	-4.00	.25	-4,00	-1.00	-1.00
3 784	2	30.0	.03	-4.00	.01	-4.00	.03	-4.00	-1.00	-1.00
4 784	2	84.0	.10	-5.00	.02	-4.00	.06	-4.00	.08	-4.00
4 784	2	77.0	.08	-5.00	.01	-4.00	.04	-4.00	.06	-4.00
4 784	2	81.0	.09	-5.00	.01	-4.00	.05	-4.00	.08	-4.00
3 784	3	48.0	.11	-4.00	.04	-4.00	.11	-4.00	-1.00	-1.00
4 784	3	93.0	.08	-5.00	.01	-4.00	.05	-4.00	.07	-4.00
4 784	3	107.0	.09	-5.00	.01	-4.00	.05	-4.00	.07	-4.00
15 784	1	110.0	.19	-5.00	.04	-4.00	.08	-4.00	.12	-4.00

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
15 784	2	66.0	.52	-5.00	.13	-4.00	.46	.29	.52	.25
15 784	3	119.0	.77	-5.00	.14	-4.00	.62	.50	.69	.42
3 884	1	38.0	.12	-4.00	.03	-4.00	.11	-4.00	-1.00	-1.00
3 884	2	70.0	.30	-5.00	.16	-4.00	.26	-4.00	.27	-4.00
3 884	3	47.0	.05	-4.00	.01	-4.00	.04	-4.00	-1.00	-1.00
8 884	1	273.0	.54	-5.00	.06	-4.00	.23	-4.00	.42	-4.00
8 884	2	181.0	.84	-5.00	.22	.32	.66	.62	.81	.61
15 884	2	24.0	.12	-4.00	.05	-4.00	-2.00	-2.00	-1.00	-1.00
17 884	2	32.0	.06	-4.00	.04	-4.00	.06	-4.00	-1.00	-1.00
18 884	2	236.0	.59	-5.00	.04	-4.00	.20	-4.00	.31	-4.00
8 884	3	31.0	.08	-4.00	.03	-4.00	.08	-4.00	-1.00	-1.00
17 884	1	26.0	.06	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
18 884	1	231.0	.27	-5.00	.03	-4.00	.09	-4.00	.15	-4.00
18 884	1	164.0	.78	-5.00	.13	-4.00	.32	-4.00	.55	.28
22 884	1	166.0	.80	-5.00	.19	.26	.54	.38	.62	.35
22 884	1	29.0	.05	-4.00	.03	-4.00	-2.00	-2.00	-1.00	-1.00
22 884	2	89.0	.54	-5.00	.14	-4.00	.46	.28	.50	.24
22 884	2	28.0	.03	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
17 884	3	37.0	.04	-4.00	.02	-4.00	.04	-4.00	-1.00	-1.00
18 884	3	233.0	.55	-5.00	.06	-4.00	.21	-4.00	.29	-4.00
18 884	3	146.0	.65	-5.00	.14	-4.00	.39	.21	.49	.23
22 884	3	108.0	.35	-5.00	.06	-4.00	.25	-4.00	.31	-4.00
22 884	3	37.0	.07	-4.00	.02	-4.00	.07	-4.00	-1.00	-1.00
2 984	1	147.0	.56	-5.00	.05	-4.00	.23	-4.00	.37	-4.00
2 984	1	81.0	.03	-5.00	.01	-4.00	.02	-4.00	.02	-4.00
2 984	2	358.0	.52	-5.00	.02	-4.00	.15	-4.00	.23	-4.00
1 984	3	42.0	.08	-4.00	.03	-4.00	.07	-4.00	-1.00	-1.00
2 984	3	316.0	1.15	-5.00	.48	8.79	.83	1 .18	.89	.78
8 984	1	189.0	1.40	-5.00	.47	8.50	1.11	3.55	1.23	1.94
8 984	1	241.0	.41	-5.00	.02	-4.00	.10	-4.00	.18	-4.00
9 984	1	55.0	.04	-4.00	.02	-4.00	.04	-4.00	-1.00	-1.00
10 984	1	405.0	1.00	-5.00	.20	.28	.33	-4.00	.50	.24
8 984	2	201.0	1.44	-5.00	.46	8.20	1.14	3.94	1.23	1.93
8 984	2	164.0	.35	-5.00	.02	-4.00	.12	-4.00	.20	-4.00
9 984	2	42.0	.05	-4.00	.01	-4.00	.04	-4.00	-1.00	-1.00
10 984	2	390.0	1.76	-5.00	.43	6.25	.63	.52	.75	.49
13 984	2	173.0	1.00	-5.00	.12	-4.00	.52	.36	.73	.47
14 984	2	25.0	.20	-4.00	.12	-4.00	-2.00	-2.00	-1.00	-1.00
8 984	3	307.0	1.35	-5.00	.28	.65	.79	.97	1.06	1.26
8 984	3	150.0	.27	-5.00	.02	-4.00	.09	-4.00	.16	-4.00
10 984	3	395.0	2.58	4.67	.21	.29	.82	1.13	1.14	1.58
22 984	1	1074.0	2.67	2.58	.40	5.05	.81	1.70	.95	1.54
22 984	2	98.0	.02	-5.00	.01	-4.00	.02	-4.00	.02	-4.00
22 984	2	928.0	3.11	4.43	.32	1.80	.66	1.38	.87	1.42
22 984	3	93.0	.04	-5.00	.01	-4.00	.02	-4.00	.03	-4.00
22 984	3	936.0	2.14	-5.00	.11	.25	.28	.30	.43	.46

Appendix A. Continued

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	TOTAL RI	MAX 5 MIN DEPTH	MAX 5 MIN RI	MAX 30 MIN DEPTH	MAX 30 MIN RI	MAX 60 MIN DEPTH	MAX 60 MIN RI
24 984	1	29.0	.02	-4.00	.01	-4.00	-2.00	-2.00	-1.00	-1.00
24 984	1	13.0	.02	-4.00	.01	-4.00	-2.00	-2.00	-1.00	-1.00
25 984	1	21.0	.01	-4.00	.01	-4.00	-2.00	-2.00	-1.00	-1.00
25 984	1	46.0	.08	-4.00	.04	-4.00	.08	-4.00	-1.00	-1.00
24 984	2	88.0	.04	-5.00	.01	-4.00	.02	-4.00	.02	-4.00
25 984	2	91.0	.16	-5.00	.05	-4.00	.14	-4.00	.14	-4.00
25 984	3	53.0	.09	-4.00	.03	-4.00	.08	-4.00	-1.00	-1.00
61084	1	50.0	.16	-4.00	.05	-4.00	.13	-4.00	-1.00	-1.00
61084	1	55.0	.21	-4.00	.04	-4.00	.17	-4.00	-1.00	-1.00
71084	1	168.0	.08	-5.00	.01	-4.00	.04	-4.00	.06	-4.00
61084	2	48.0	.08	-4.00	.02	-4.00	.07	-4.00	-1.00	-1.00
61084	2	65.0	.13	-5.00	.03	-4.00	.08	-4.00	.14	-4.00
61084	2	50.0	.21	-4.00	.03	-4.00	.18	-4.00	-1.00	-1.00
71084	2	141.0	.09	-5.00	.01	-4.00	.04	-4.00	.06	-4.00
81084	2	18.0	.09	-4.00	.06	-4.00	-2.00	-2.00	-1.00	-1.00
61084	3	52.0	.05	-4.00	.01	-4.00	.06	-4.00	-1.00	-1.00
61084	3	57.0	.38	.38	.09	.20	.32	.38	-1.00	-1.00
71084	3	129.0	.10	-5.00	.01	-4.00	.04	-4.00	.07	-4.00
91084	3	32.0	.07	-4.00	.02	-4.00	.06	-4.00	-1.00	-1.00
101084	1	459.0	.77	-5.00	.03	-4.00	.15	-4.00	.24	-4.00
111084	1	79.0	.08	-5.00	.01	-4.00	.05	-4.00	.08	-4.00
131084	1	99.0	.08	-5.00	.01	-4.00	.05	-4.00	.07	-4.00
131084	1	204.0	.72	-5.00	.10	.23	.23	.23	.43	.46
151084	1	54.0	.14	-4.00	.07	-4.00	.11	-4.00	-1.00	-1.00
151084	1	24.0	.03	-4.00	.01	-4.00	-2.00	-2.00	-1.00	-1.00
111084	2	325.0	.57	-5.00	.05	-4.00	.20	-4.00	.26	-4.00
111084	2	104.0	.32	-5.00	.06	-4.00	.16	-4.00	.19	-4.00
131084	2	105.0	.17	-5.00	.02	-4.00	.09	-4.00	.13	-4.00
131084	2	197.0	.39	-5.00	.02	-4.00	.11	-4.00	.23	-4.00
151084	2	69.0	.15	-5.00	.04	-4.00	.08	-4.00	.14	-4.00
151084	2	16.0	.03	-4.00	.01	-4.00	-2.00	-2.00	-1.00	-1.00
151084	2	33.0	.02	-4.00	.01	-4.00	.02	-4.00	-1.00	-1.00
111084	3	331.0	.61	-5.00	.05	-4.00	.18	-4.00	.28	.22
111084	3	125.0	.20	-5.00	.02	-4.00	.08	-4.00	.12	-4.00
131084	3	194.0	.27	-5.00	.02	-4.00	.09	-4.00	.16	-4.00
151084	3	62.0	.12	-5.00	.04	-4.00	.09	-4.00	.11	-4.00
151084	3	25.0	.04	-4.00	.02	-4.00	-2.00	-2.00	-1.00	-1.00
161084	1	82.0	.07	-5.00	.03	-4.00	.05	-4.00	.07	-4.00
161084	1	50.0	.07	-4.00	.02	-4.00	.06	-4.00	-1.00	-1.00
181084	1	159.0	.38	-5.00	.04	-4.00	.19	-4.00	.23	-4.00
201084	1	715.0	1.03	-5.00	.03	-4.00	.14	-4.00	.22	-4.00
161084	2	87.0	.05	-5.00	.01	-4.00	.03	-4.00	.04	-4.00
171084	2	96.0	.10	-5.00	.02	-4.00	.05	-4.00	.09	-4.00
181084	2	143.0	.35	-5.00	.03	-4.00	.14	-4.00	.17	-4.00
201084	2	719.0	1.10	-5.00	.03	-4.00	.15	-4.00	.27	.21
161084	3	148.0	.24	-5.00	.03	-4.00	.09	-4.00	.17	-4.00

DATE DYMOYR	GAGE NO	DURATION MIN	TOTAL DEPTH	RI	MAX 5 MIN DEPTH	RI	MAX 30 MIN DEPTH	RI	MAX 60 MIN DEPTH	RI
171084	3	47.0	.08	-4.00	.02	-4.00	.07	-4.00	-1.00	-1.00
181084	3	228.0	.66	-5.00	.13	.32	.35	.46	.42	.45
201084	3	712.0	1.11	-5.00	.02	-4.00	.13	-4.00	.24	-4.00
251084	1	213.0	.35	-5.00	.02	-4.00	.09	-4.00	.16	-4.00
251084	1	96.0	.17	-5.00	.03	-4.00	.12	-4.00	.16	-4.00
291084	1	287.0	.32	-5.00	.02	-4.00	.06	-4.00	.12	-4.00
251084	2	179.0	.25	-5.00	.02	-4.00	.08	-4.00	.13	-4.00
251084	2	91.0	.26	-5.00	.06	-4.00	.20	-4.00	.24	-4.00
291084	2	222.0	.16	-5.00	.02	-4.00	.05	-4.00	.08	-4.00
251084	3	208.0	.28	-5.00	.02	-4.00	.09	-4.00	.16	-4.00
251084	3	83.0	.37	-5.00	.05	-4.00	.20	-4.00	.32	.27
271084	3	103.0	.09	-5.00	.02	-4.00	.06	-4.00	.09	-4.00
311084	2	35.0	.19	-4.00	.05	-4.00	.18	-4.00	-1.00	-1.00

NOTE: -1. = EVENT LESS THAN 60 MIN
-2. = EVENT LESS THAN 30 MIN
-3. = EVENT LESS THAN 5 MIN
-4. = EVENT WITH RI OF LESS THAN 5 PER YEAR
-5. = EVENT WITH RI OF LESS THAN ONCE IN 2 YEARS
RI = RECURRENCE INTERVAL, YEARS
DEPTH HAS UNITS OF INCHES

Appendix B. Storm Event Runoff Ratios for the Field Sites
(Rainfall and runoff in inches)

Date	Field Site 1 Rainfall	Field Site 1 Runoff	Runoff ratio	Field Site 2 Rainfall	Field Site 2 Runoff	Runoff ratio	Field Site 3 Rainfall	Field Site 3 Runoff	Runoff ratio	Field Site 4 Rainfall	Field Site 4 Runoff	Runoff ratio
220182	S[1]	.03								S[1]	.16	
290182										1.13	.49	.43[2]
160282										.51	.07	.14[2]
140382	.54	.02	.04									
180382										.26	.00	.00[3]
250382	.88	.19	.22							.88	.03	.03[2]
020482	1.56	.82	.53									
160482	.13	.00	.00[3]									
280582	.64	.18	.28[3]							1.67	.08	.05
300582	.53	.02	.04							.53	.00	.00
310582	.42	.32	.76[3]									
070682	.77	.62	.81							.77	.10	.13[2]
150682	.95	.17	.18							.95	.18	.19
180682	.23	.00	.00[3]									
100782	2.77	1.79	.65[3]									
010982				.50	.03	.06						
020982							.36	.00	.00[3]			
140982				.52	.02	.03[2]						
170982	.41	.16	.39[3]				.16	.01	.063	.26	.05	.19[3]
061082	1.87	.22	.12				2.27	.32	.14[2,5]	1.07	.20	.19[3,5]
081082	1.47	.57	.39				1.39	.35	.25	1.47	.56	.38
231182							.74	.02	.02[3]			
261182							.21	.00	.00[3]	.23	.19	.82[3]
271182	.51	.06	.12[2]				.25	.03	.12[4]			
021282	2.20	1.47				.67[4]				2.02	.84	.42[4]
031282	.97	.97	1.00[2]							.92	.59	.64[2]
271282	.21	.02	.09[2]									
010283	.69	.10	.14[3]				.58	.05	.09[3]	.71	.22	.30[2,4]
180383	1.40	.36	.26[2]	.62	.26	.41[3]	.32	.02	.06[3]	1.04	.28	.27[2]
200383	.56	.16	.28[2]							.16	.08	.503
010483				.63	.13	.21[3]	.64	.06	.09[2]	.72	.15	.21[2,4]
130483							2.69	1.13	.42[2]	2.61	1.25	.48[4]

Appendix B. Continued

Date	Field Site 1 Rainfall	Field Site 1 Runoff	Field Site 1 Runoff ratio	Field Site 2 Rainfall	Field Site 2 Runoff	Field Site 2 Runoff ratio	Field Site 3 Rainfall	Field Site 3 Runoff	Field Site 3 Runoff ratio	Field Site 4 Rainfall	Field Site 4 Runoff	Field Site 4 Runoff ratio
270483							.67	.07	.10[2]			
130583										1.36	.00	.00[3]
030683	3.69	2.42	.66[2,4]				4.25	.33[5]	.33[5]			
280683	1.57	.28	.18[2]							.25	.08	.32[3]
201083	1.92	.01	.02[3]							1.92	.04	.02[3]
211083							.59	.00	.00[3]	.57	.02	.04[2]
031183	.44	.02	.05[3]				.29	.00	.00[3]	.17	.02	.11[3]
191183	.78	.12	.15[3]	1.04	.16	.15[3]	1.77	.10	.05	1.72	.05	.04[4]
231183	1.43	.72	.50[2]	1.43	.52[2]	.89	.55	.05	.09[3]	1.43	.43	.28[2]
271183	1.70	1.13	.66[2,5]	1.70	.63	.37[2,5]	.55	.06	.11[3]	.63	.37	.58[5]
101283	1.48	1.12	.54[3]	1.48	1.03	.69[3]	1.61	.18	.11[2]	1.48	.81	.55[3]
030484	1.55	1.00	.65									
210484	2.67	1.32	.49[2,5]	2.67	1.23	.46[2,5]	1.22	.57	.47[3,5]	.83	.54	.60[3]
100984	.51	.00	.00[3]	.51	.01	.00[3]						

Note: [1] Snowmelt
[2] Incomplete hydrograph; data collection began after onset of runoff but before peak flow
[3] Incomplete hydrograph; data collection began after peak flow
[4] Portion of recession limb of hydrograph is absent
[5] Complex storm

Appendix B. Continued

Date	Field Site 5 Rainfall	Field Site 5 Runoff	Field Site 5 Runoff ratio	Field Site 6 Rainfall	Field Site 6 Runoff	Field Site 6 Runoff ratio	Field Site 7 Rainfall	Field Site 7 Runoff	Field Site 7 Runoff ratio	Field Site 8 Rainfall	Field Site 8 Runoff	Field Site 8 Runoff ratio
220182				S[1]	.43		S[1]	.46				
290182	.91	.35[4]	.34[3]	1.21	.36	.30[4]						
160282							S[1]	.83				
140382	.45	.13	.29	.29	.04	.13[3]	.39	.10	.26[3,5]			
180382	.55	.19	.35	1.69	.80	.47	1.74	.02	.01			
250382				.88	.24	.27	.73	.07	.10[2]			
020482	.76	.16	.21	1.87	.92	.49[5]						
050482	.37	.00	.00[2]									
160482	.69	.04	.06	.64	.11	.17[3]	.65	.05.	.08			
280582	1.49	.15	.10	1.67	.50	.30	1.53	.07	.05[5]			
300582	.81	.10	.12[4]	.53	.04	.08						
310582	.88	.16	.18	.42	.33	.79[3]	1.33	.24	.18			
040682	.40	.08	.20									
070682	1.15	.52	.45[4]	.70	.19	.27	.27	.01	.04[3]			
150682	.60	.09	.15	.95	.18	.19	.80	.08	.10			
180682				.40	.00	.00						
220682				.60	.03	.05						
100782	1.80	.58	.32	2.77	1.14	.41						
310882	1.58	.01	.01									
010982							.55	.05	.09	.08	.00	.00[3]
020982							.95	.06	.06[4]			
130982	1.22	.16	.13									
140982				.52	.00	.00						
170982	1.20	.48	.40[3]	1.41	.03	.02	1.01	.06	.06	1.41	.03	.02[3]
061082	1.87	.17	.09	1.87	.30	.16[5]	2.37	.29	.12[5]	1.82	.12	.07
081082	1.47	.58	.39				1.49	.38	.26	1.47	.17	.12
311082	.42	.02	.04									
231182							1.06	.14	.13[4,5]			
261182	.21	.06	.29[3]				.62	.10	.16			
021282	1.78	1.60	.90[3]	2.25	.86	.38[3]	2.31	1.18	.51[3]	2,24	.44	.20[3]
031282				.79	.66	.83[3,4]	.99	.99	1.00[3]	.90	.52	.58[3]

Appendix B. Concluded

Date	Field Site 5 Rainfall	Field Site 5 Runoff	Field Site 5 Runoff ratio	Field Site 6 Rainfall	Field Site 6 Runoff	Field Site 6 Runoff ratio	Field Site 7 Rainfall	Field Site 7 Runoff	Field Site 7 Runoff ratio	Field Site 8 Rainfall	Field Site 8 Runoff	Field Site 8 Runoff ratio
231282	2.85	1.23		-43[4]			2.88	1.32	.46[4]	2.65	.97	.37[2,4]
010283	.80	.39	.49	.71	.16	.22[2]	.61	.30	.49[2,4]	.71	.18	.25[2]
060383	.53	.01		.02[2,4,5]			.36	.01	.02[2]			
180383	.84	.29	.35	.56	.21	.38[3]	1.08	.36	.33[3]	.69	.18	.263
200383	.25	.20	.80[3,4]	.24	.09	.38[3,4]	.68	.20	.29[3]	.06	.02	.33[3]
010483	.96	.42	.44[4]	.56	.16	.27[4]	.79	.20	.25[4]	.72	.09	.12
130483	2.22	.69	.31[2,5]	2.61	1.02	.39				2.61	.89	.34
270483							.67	.06	.09[2]			
280483										.40	.06	.15[2]
300483	1.08	.10	.09[2,4]	.45	.03	.07[2,5]						
130583							.67	.01	.01[2]	1.01	.04	.04[2]
220583	.91	.05	.05							.84	.05	.06
030683	1.54	.55	.36	.21	.01	.05				3.48	1.18	.33
280683	1.57	.22	.14[5]							1.33	.14	.11[2,5]
201083	1.08	.19	.18[2,4]	.83	.16	.19[2]	1.86	.15	.08[5]	.71	.06	.08[2]
211083				.55	.08	.143,4,5	.69	.06	.09[3,4,5]	.57	.04	.07[4,5]
031183	.63	.23	.363	.31	.06	.193	.15	.03	.20[3]			
191183	1.77	.77	.43[2,4]	.88	.35	.39[3,4]	1.77	.30	.16	.81	.16	.19[3]
231183	1.43	.70	.50	1.43	.76	.53	.81	.32	.403	.68	.25	.36[3]
271183	1.21	.58	.47[2,5]	1 .70	1.05			.62[4]		.63	.12	.19[3]
101283	2.59	1.09	.42[4]	1.40	1.20	.86[2,4]	1.53	.61	.40[4]	1.59	.32	.20[4]
190384				.28	.20	.71[3]				.28	.07	.25[3]
240384	.38	.19	.503				.97	.85	.87[3]			
030484				1.55	1.19	.77						
210484	.97	.62	.63[3]	.86	.58	.67[3]	1.36	.70	.51[3]	.60	.18	.30[3]
080884							.54	.03	.06			
100984	2.58	.36	.14	.51	.00	.003						

Note: [1] Snowmelt
[2] Incomplete hydrograph; data collection begun after onset of runoff but before peak flow
[3] Incomplete hydrograph; data collection begun after peak flow
[4] Portion of recession limb of hydrograph is absent
[5] Complex storm

Appendix C. Storm Event Runoff Ratios for the Gaging Stations
(Rainfall and runoff in inches)

Date	Gaging Station 1 Rainfall	Runoff	Runoff ratio	Gaging Station 2 Rainfall	Runoff	Runoff ratio	Gaging Station 3 Rainfall	Runoff	Runoff ratio
220182	S[1]	.66							
290182	S[1]	1 .87							
160282	S[1]	4.56							
170282				S[1]	3.36				
240282	S[1]	.06							
040382	.23	.04	.17						
130382				.52	.01	.02			
140382				.54	.07	.13			
180382	1.69	.48	.28	1.69	.22	.13	1.69	.39	.23
250382	.99	.24	.24	.88	.11	.12	.88	.13	.15
020482	1.56	.74	.44	1.56	.44	.26	1.56	.46	.29
050482	.33	.05	.15						
160482	.67	.08	.12						
280582	1.67	.23	.13				1.67	.13	.07
300582	2.84	.80	.28				1.24	.13	.10
310582							1.60	.22	.14
040682	.40	.08	.20				.40	.05	.12
070682	1.26	.56	.44				1.26	.78	.62
150682	.95	.17	.18				.95	.07	.07
180682	.40	.05	.12						
220682	.60	.08	.13				.60	.03	.05
260682	.25	.05	.20				.25	.04	.16
270682	.63	.17	.27				.63	.20	.32
030782	1.08	.17	.16				1.08	.24	.22
100782	3.20	1.45	.45	3.20	1.28	.40	3.20	1.38	.43
310882	1.04	.06	.06	1.04	.07	.07			
020982	.32	.03	.09	.32	.01	.03			
130982	.80	.27	.34	.80	.26	.33	.61	.09	.15
140982							.52	.15	.29
170982	1.41	.31	.22	1.41	.36	.26	1.41	.56	.40
061082	3.34	1.20	.36	1.87	.30	.16	1.87	.29	.16
081082				1.47	.97	.66	1.47	1.05	.71
121182	.48	.04	.08						
211182	.97	.23	.24						
231182				.59	.08	.14			
261182	1.10	.64	.58	1.10	.71	.65	.59	.14	.24
271182							.51	.27	.53
021282	3.68	2.85	.77	3.68	2.93	.80	2.20	1 .81	.82
101282	.18	.02	.11						
231282	3.57	2.73	.76	3.36	2.44	.67	3.36	3.19	.95
271282				S[1]	.22		.21	.13	.62
010283	.82	.60	.73	.82	.56	.68	.82	.59	.72
050383	.60	.04	.07						
070383	.15	.08	.53	.15	.02	.13			
180383	1.96	1.03	.53	1.40	.59	.42	1.40	.57	.40
200383				.56	.48	.86	.56	.41	.73

Appendix C. Continued

	Gaging Station 1			Gaging Station 2			Gaging Station 3		
Date	Rainfall	Runoff	Runoff ratio	Rainfall	Runoff	Runoff ratio	Rainfall	Runoff	Runoff ratio
010483	.86	.55	.64	.86	.58	.67	.86	.48	.56
050483	.62	.26	.42	.62	.31	.50	.41	.08	.19
060483							.21	.07	.33
090483	.45	.14	.31	.45	.16	.36	.45	.15	.33
100483	.14	.03	.21	.14	.03	.21			
130483	2.61	1.73	.66	2.61	1.84	.70	2.61	2.50	.96
270483	3.69	2.30	.62	3.69	2.17	.59			
300483							.42	.15	.36
300483							.66	.12	.18
130583				1.01	.02	.02			
140583				.37	.03	.08			
220583	.84	.11	.13	.84	.16	.19	.84	.03	.04
030683	3.69	1.23	.33	3.69	1.42	.38	.62	.26	.42[2]
050683	.88	.22	.25	.88	.38	.43	.88	.10	.11
200683	.32	.01	.03	.32	.02	.06			
280683	1.57	.27	.17	1.57	.34	.21	1.57	.31	.20
201083	4.35	.24	.06						
211083							.79	.05	.06
031183	1.53	.15	.10	.96	.02	.02	.96	.25	.26
101183	.87	.08	.09				.87	.09	.10
191183	1.75	.44	.25	1.75	.19	.11	1.75	.42	.24
231183	1.43	.87	.61	1.43	.40	.28	1.43	.97	.68
271183	1.70	1.33	.78	1.70	.67	.39	1.70	1.35	.79
031283	1.12	.77	.69	.98	.27	.28	.98	.54	.55
101283	2.09	1.88	.90	2.09	1.06	.51	2.71	2.20	.81
141283	.21	.06	.29						
070184	S[1]	.04							
090184	.24	.11	.46	.24	.01	.04			
240184	S[1]	.54							
250184				S[1]	.06				
260184				S[1]	.06				
280184	S[1]	.19							
020284	S[1]	.23		.16	.04	.25			
090284	S[1]	1.67							
100284				.46	.28	.61			
120284				.90	.38	.42			
180284	.12	.04	.33						
260284	.49	.06	.12						
030384	S[1]	.96		S[1]	.87		S[1]	1.47	
140384	S[1]	1.99							
150384				.39	.20	.51	.39	.28	.72
170384				.25	.03	.12	.25	.08	.32
180384				.95	.66	.69	.31	.14	.45
190384							1.66	1.57	.94
210384	S[1]	.04							
240384	.97	.79	.81	.82	.40	.49	.97	.90	.93
260384	.53	.44	.83	.20	.04	.20	.20	.09	.45

Appendix C. Concluded

Date	Gaging Station 1 Rainfall	Gaging Station 1 Runoff	Gaging Station 1 Runoff ratio	Gaging Station 2 Rainfall	Gaging Station 2 Runoff	Gaging Station 2 Runoff ratio	Gaging Station 3 Rainfall	Gaging Station 3 Runoff	Gaging Station 3 Runoff ratio
280384				.33	.08	.24	.33	.15	.45
020484	1.75	1.37	.78	1.75	.78	.45	1.75	1.57	.90
210484	2.72	2.00	.74	2.72	1.17	.43	2.72	2.13	.78
290484	.34	.02	.06						
060584	.73	.05	.07						
250584	1.28	.01	.01						
270584	.52	.03	.06						
100984	1.76	.18	.10						
110984				1.76	.03	.02	1.76	.25	.14
140984	1.20	.02	.02						
220984	3.13	.62	.20	3.13	.24	.08	3.13	.63	.20
131084	.39	.03	.08						
181084							.35	.15	.43
191084	.35	.12	.34						
201084	1.10	.51	.46	1.10	.16	.15	1.10	.41	.37
251084	.26	.16	.62				.26	.10	.38

S[1]Snowmelt
[2]Incomplete hydrograph

Appendix D. Monthly Runoff Ratios for the Gaging Stations
(Precipitation and runoff in inches)

Date		Gaging Station 1		Gaging Station 2		Gaging Station 3	
MoYr	Precip.	Runoff	Runoff ratio	Runoff	Runoff ratio	Runoff	Runoff ratio
01-82	3.47	2.54[1]	.73				
02-82[2]	2.02	4.66[1]	2.31	3.36[1]	1.66	.01	.10
03-82	3.80	.90[1]	.21	.41	.11	.59	.16
04-82	3.17	.96	.30	.44[1]	.14	.49	.15
05-82	5.61	.79	.14	.00[1]	.00	.47	.08
06-82	4.46	1.46	.36	0.00[1]	0.00	1.25	.28
07-82	4.45	1.64	.37	1.28[1]	.29	1.66	.37
08-82	3.12	.01	.00	.01	.00	.02	.01
09-82	3.79	.66	.17	.71	.19	.85	.22
10-82	5.21	1.25	.24	1.28	.24	1.38	.26
11-82	3.10	1.13	.36	.84	.27	.54	.17
12-82	7.43	5.87	.79	5.62	.77	5.18[1]	.70
01-83	.56	.35	.62	.01	.02	.02	.04
02-83[2]	.86	.86	1.00	.57	.66	.61[1]	.71
03-83	3.13	1.30	.42	1.13	.36	1.02	.32
04-83	7.32	3.29	.45	3.39	.46	3.53	.48
05-83	4.02	3.01	.75	1.95	.48	.14[1]	.03
06-83	7.82	1.75	.22	2.17	.28	.68[1]	.09
07-83	.48	.00	.00	.00	.00	.00	.00
08-83	.88	.00	.00	.00	.00	.00	.00
09-83	1.31	.00	.00	.00	.00	.00	.00
10-83	6.37	.24[1]	.04	.00	.00	.22	.03
11-83	7.25	2.92	.40	1.28	.18	3.23[1]	.44
12-83	4.73	2.74	.58	1.33	.28	2.85	.60
01-84[2]	.63	.94	1.49	.19	.30	.03	.05
02-84[2]	1.81	2.02	1.12	.71	.39	.10	.06
03-84	5.44	4.24[1]	.78	2.28	.42	5.00[1]	.92
04-84	5.38	3.39	.63	1.95	.36	3.84	.71
05-84	3.38	.10	.03	.00	.00	.14	.04
06-84	1.17	.00	.00	.00	.00	.00	.00
07-84	.96	.00	.00	0.00	.00		
08-84	2.30	.00	.00	.00	.00	0.00	0.00
09-84	7.52	.84	.11	.27	.04	.95	.13
10-84	4.76	.83	.17	.16	.03	.81	.17
TOTAL	127.71	48.92	.38	31.34	.24	35.61	.28

Note: [1] Incomplete record
[2] Snowmelt

Appendix E. Monthly Runoff Ratios for the Spillway
(Precipitation and runoff in inches)

Date	Precip.	Runoff	Runoff ratio	Municipal[3] use
01-82	3.47	0.00[1]	0.00	.029
02-82	2.02	.54	.27	.026
03-82	3.80	1.11	.29	.029
04-82	3.17	.91	.29	.028
05-82	5.61	.33	.06	.031
06-82	4.46	1.37	.31	.029
07-82	4.45	2.59	.58	.032
08-82	3.12	0.00	0.00	.030
09-82	3.79	.31	.08	.027
10-82	5.21	.60	.12	.029
11-82	3.10	.60	.19	.026
12-82	7.43	7.31[1]	.98	.027
01-83	.56	.06	.11	.028
02-83	.86	.14	.16	.026
03-83	3.13	1.45	.46	.028
04-83	7.32	3.81	.52	.028
05-83	4.02	3.64	.91	.030
06-83	7.82	3.08	.49	.030
07-83	.48	.02	.04	.033
08-83	.88	0.00	0.00	.034
09-83	1.31	0.00	0.00	.029
10-83	6.37	0.00	0.00	.029
11-83	7.25	2.94	.41	.031
12-83	4.73	2.79	.59	.032
01-84	.63	0.00	0.00	.033
02-84	1.81	.34[1]	.19	.027
03-84[2]	5.44	6.75	1.24	.028
04-842	5.38	6.57	1.22	.029
05-84	3.38	1.52	.45	.031
06-84	1.17	0.23	.20	.033
07-84	.96	0.00	0.00	.034
08-84	2.30	0.00	0.00	.033
09-84	7.52	.64	.08	.028
10-84	4.76	1.90	.40	.029
TOTALS	127.71	51.55	.40	1.005

[1] Incomplete record
[2] Snowmelt
[3] Municipal use was normalized using the watershed area

Appendix F. Occurrence of Calculated Runoff, Suspended Sediment Load, and Nutrient Loads for the Monitoring Sites

DATE (day/mon/yr)	F1	F2	F3	F4	F5	F6	F7	F8	G1	G2	G3
220182	1			1		1	1		1		
230182				1		1					
290182				1	1	1			2		
160282				2			1		1		
170282										1	
240282									1		
040382									1		
130382										1	
140382	1				1	1	1			1	
180382				1	1	1	1		1	1	1
250382	1			1		1	1		2	1	1
020482	1				1	1			1	3	3
050482						1			1		
160482	1				1	1	1		1		
280582	3			3	3	3	2		1		3
300582	1			1	1	1			2		1
310582	3				1	3	1				3
040682					3				1		1
070682	1			2	2	1	1		2		1
150682	3			3	3	1	3		1		1
180682	1					1			1		
220682						1			1		1
260682									1		1
270682									1		1
030782									1		1
100782	1				3	3			1	1	1
310882					1				3	1	
010982		1					3	3			
020982			1				3		3	1	
130982					1				1	1	1
140982		1				1				1	1
170982	2		1	1	3	3	3	3	3	1	3
061082	3		3	3	3	3	3	3	2	3	3
081082	1		1	2	1		1	1		1	1
311082					1						
121182									1		
211182									2		
231182			1				1			1	
261182			3	3	3		1		2	1	3
271182	3										1
281182			1								
021282	1			1	2	3	3	3	3	3	3
031282	3		3	3		3	3	3			
101282									1		
231282					3		1	1	1	1	1
271282	1								1	1	1

DATE (day/mon/yr)	F1	F2	F3	F4	F5	F6	F7	F8	G1	G2	G3
010283	3		3	1	3	3	1	3	3	1	3
050383			3				1		1		
070383										1	
180383	3	3	3	3	2	1	3	3	3	3	3
200383	1			3	3	1	1	2		1	1
010483		3	3	3	3	1	3	3	3	3	3
050483									1	1	1
060483										1	1
090483									1	1	1
100484									1	1	
130483			3	3	1	1		3	3	1	3
270483			3				1		1	3	
280483						1		3			
300483					3						1
130583				3			1	3		3	
140583										1	
220583					1			1	3	1	1
030683	1		3	1	1	3		3	3	1	3
050683									1	1	3
200683									1	1	
280683	1				3			1	3	1	1
201083	3			3	3	1	1	3	3		
211083			3	3		1	1	3			1
031183	2		3	2	3	2	1		2	3	1
101183									1		1
191183	2	2	1	2	2	2	1	2	2	2	1
231183	1	1		1	2	1	2	1	2	2	1
271183	2	2	1	2	1	1		3	1	1	1
031283									1	1	1
101283	3	3	3	1	3	3	1	3	3	3	3
141283									1		
070184									1		
090184									1	1	
240184									1		
250184										1	
260184										1	
280184									1		
020284									1	1	
090284									1		
100284										1	
120284										1	
180284									1		
260284									1		
030384									1	1	1
140384									1		
150384										1	1
170384										1	1
180384										3	3
190384						3		3			3
210384									1		

DATE (day/mon/yr)	F1	F2	F3	F4	F5	F6	F7	F8	G1	G2	G3
240384					3		3		3	3	3
260384									3	1	3
280384										1	3
030484	1					3					
210484	1	1	1	3	3	3	1	3	3	3	3
290484									1		
060584									1		
250584									1		
270584									1		
080884							1				
100984	3	3			3	3			3	2	3
140984									1		
220984									1	1	1
131084									1		
191084									1		1
201084									1	1	1
251084									1		1

CODE	EXPLANATION
1	RUNOFF CALCULATED
2	RUNOFF AND SEDIMENT LOAD CALCULATED
3	RUNOFF AND LOADS FOR ALL WATER QUALITY PARAMETERS CALCULATED

COMMENTS

A LOAD IS CALCULATED WHEN THE GIVEN WATER QUALITY PARAMETER ENCOMPASSES GREATER THAN 50 PERCENT OF THE RUNOFF BY VOLUME.

Appendix G. Event Mean Concentrations and Loads of the Water Quality Parameters

FIELD SITE 1

DATE	TSS		TVS		TKN		TPHS		TURB	COD	
DATE DYMOYR	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	EMC MG/L	LOAD TONS
280582	342.9	.339	74.5	.074	5.69	.00563	.98	.00097	609.8	86.1	.085
310582	694.1	1.173	130.1	.220	2.42	.00409	.51	.00086	NA	49.2	.083
150682	1507.0	1.384	53.5	.049	3.70	.00340	.52	.00047	527.9	97.7	.090
170982	277.2	.239	44.1	.038	NA	NA	NA	NA	182.2	NA	NA
061082	1087.3	1.267	99.8	.116	9.00	.01049	2.31	.00269	1446.9	211.3	.246
271182	420.8	.129	84.8	.026	3.78	.00116	1.13	.00035	491.7	76.3	.023
031282	307.1	1.584	64.4	.332	2.86	.01474	.76	.00390	409.8	65.9	.340
010283	554.0	.298	68.4	.037	9.55	.00514	.84	.00045	147.7.	71.3	.038
180383	333.9	.632	45.0	.085	1.50	.00283	.45	.00084	190.5	94.9	.180
201083	698.1	.034	103.8	.005	4.38	.00021	.94	.00005	211.6	111.8	.005
031183	630.9	.055	68.8	.006	NA	NA	NA	NA	67.1	NA	NA
191183	472.0	.297	61.2	.039	NA	NA	NA	NA	228.8	NA	NA
271183	535.3	3.234	60.6	.366	NA	NA	NA	NA	244.8	NA	NA
101283	728.8	4.355	63.5	.380	3.54	.02114	.76	.00453	211.5	86.4	.516
100984	275.1	.003	44.0	.000	3.08	.00003	.77	.00001	135.1	42.0	.000

Note: TSS = total suspended solids, TVS = total volatile solids,
TKN = total Kjeldahl nitrogen, TPHS = total phosphorus,
TURB = turbidity, COD = chemical oxygen demand, NA = not available

Appendix G. Continued

FIELD SITE 2

DATE DYMOYR	TSS EMC MG/L	TSS LOAD TONS	TVS EMC MG/L	TVS LOAD TONS	TKN EMC MG/L	TKN LOAD TONS	TPHS EMC MG/L	TPHS LOAD TONS	TURB EMC MG/L	COD EMC MG/L	COD LOAD TONS
180383	2050.5	2.611	122.7	.156	2.31	.00294	.45	.00058	269.8	130.3	.166
010483	1784.2	1.134	162.1	.103	2.72	.00173	.46	.00029	229.9	119.6	.076
191183	525.5	.424	64.9	.052	NA	NA	NA	NA	50.8	NA	NA
271183	1190.9	3.636	115.0	.351	NA	NA	NA	NA	274.8	NA	NA
101283	191.7	.967	25.4	.128	2.85	.01439	.77	.00390	136.5	34.4	.173
100984	270.6	.011	38.2	.002	2.82	.00012	1.49	.00006	179.6	65.8	.003

Appendix G. Continued

FIELD SITE 3

DATE	TSS		TVS		TKN		TPHS		TURB	COD	
	EMC	LOAD	EMC	LOAD	EMC	LOAD	EMC	LOAD	EMC	EMC	LOAD
DYMOYR	MG/L	TONS	MG/L	TONS	MG/L	TONS	MG/L	TONS	MG/L	MG/L	TONS
061082	939.1	.987	86.5	.091	6.28	.00661	1.82	.00191	1141.6	132.8	.140
261182	374.3	.002	42.6	.000	3.03	.00001	1.11	.00001	373.6	60.5	.000
031282	563.4	.522	50.5	.047	3.24	.00300	1.41	.00130	557.0	61.7	.057
010283	1144.4	.203	135.3	.024	2.32	.00041	.96	.00017	162.1	47.2	.008
180383	926.1	.054	80.0	.005	1.69	.00010	1.08	.00006	308.6	71.0	.004
010483	823.5	.172	71.1	.015	2.17	.00045	1.24	.00026	312.0	96.6	.020
130483	1574.1	5.873	119.6	.446	2.58	.00961	1.53	.00571	75.0	92.2	.344
270483	611.6	.148	88.8	.022	8.00	.00194	1.17	.00028	121.8	68.0	.016
030683	795.1	3.691	47.7	.221	4.42	.02051	1.18	.00548	66.8	106.8	.496
211083	28.0	.000	9.0	.000	2.90	.00004	1.20	.00001	16.0	33.0	.000
031183	246.0	.001	154.0	.001	16.00	.00008	2.20	.00001	46.0	93.0	.000
101283	254.7	.147	7.4	.004	2.03	.00117	.68	.00039	122.6	38.0	.022

Appendix G. Continued

FIELD SITE 4

	TSS		TVS		TKN		TPHS		TURB	COD	
DATE DYMOYR	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	EMC MG/L	LOAD TONS
160282	20.2	.018	12.7	.011	NA	NA	NA	NA	6.4	NA	NA
280582	471.1	.487	87.2	.090	7.88	.00814	1.27	.00132	847.4	128.3	.132
070682	516.3	.698	55.4	.075	NA	NA	NA	NA	25.6	NA	NA
160682	383.8	.918	44.7	.107	5.35	.01280	.96	.00229	403.7	110.9	.265
061082	191.3	.494	23.5	.061	2.21	.00571	.76	.00196	91.6	65.3	.169
081082	333.1	2.454	40.1	.295	NA	NA	NA	NA	172.6	NA	NA
261182	78.8	.194	15.7	.039	3.13	.00771	1.42	.00350	90.6	53.2	.131
031282	129.7	.995	33.6	.258	2.14	.01645	.91	.00699	195.0	51.1	.392
180383	134.4	.487	19.2	.070	1.30	.00471	.45	.00165	112.1	65.3	.237
200383	8.8	.009	5.1	.005	.53	.00053	.28	.00028	43.0	35.3	.035
010483	248.2	.498	38.8	.078	1.77	.00354	.42	.00084	76.6	63.1	.126
130483	804.0	13.079	97.3	1.583	2.00	.03246	.79	.01278	56.4	94.3	1.534
130583	189.3	.006	48.3	.002	2.74	.00009	.74	.00002	31.3	67.6	.002
201083	33.7	.020	8.1	.005	1.61	.00095	.86	.00051	15.2	45.8	.027
211083	60.8	.017	9.8	.003	1.36	.00039	1.02	.00029	14.4	42.1	.012
031183	81.4	.018	16.5	.004	NA	NA	NA	NA	24.1	NA	NA
191183	161.8	.110	28.1	.019	NA	NA	NA	NA	179.2	NA	NA
271183	221.0	1.058	36.8	.176	NA	NA	NA	NA	142.9	NA	NA
210484	619.1	4.348	90.0	.632	3.81	.02673	.65	.00457	177.9	82.3	.578

Appendix G. Continued

FIELD SITE 5

	TSS		TVS		TKN		TPHS		TURB	COD	
DATE DYMOYR	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	EMC MG/L	LOAD TONS
280582	3868.9	21.628	321.7	1.798	20.26	.11327	2.40	.01341	2474.6	350.2	1.958
040682	199.3	.575	42.1	.121	2.22	.00641	.52	.00150	NA	40.6	.117
070682	793.2	15.705	63.0	1.247	NA	NA	NA	NA	NA	NA	NA
150682	314.3	1.060	22.5	.076	2.33	.00787	.57	.00194	188.7	56.2	.190
100782	109.1	2.365	23.0	.499	1.95	.04231	.52	.01133	63.6	49.9	1.083
170982	77.6	1.397	16.1	.289	1.68	.03026	.45	.00805	36.4	40.0	.721
061082	507.1	3.336	121.6	.800	5.01	.03295	2.31	.01521	499.6	131.7	.867
261182	60.0	.134	18.7	.042	2.25	.00501	.73	.00162	126.2	49.6	.110
021282	664.8	40.186	87.3	5.278	NA	NA	NA	NA	573.2	NA	NA
231282	515.0	23.842	44.1	2.041	4.90	.22700	1.07	.04934	479.1	113.4	5.252
020283	128.1	1.885	33.5	.494	2.77	.04077	.48	.00709	168.7	42.8	.629
060383	93.3	.028	11.5	.003	2.14	.00065	.20	.00006	49.0	51.2	.015
180383	251.9	2.739	35.1	.382	2.04	.02215	.33	.00356	162.2	NA	NA
200383	78.4	.583	16.6	.124	.89	.00663	.36	.00268	71.2	44.8	.333
010483	334.8	5.316	56.7	.900	1.70	.02696	.44	.00694	123.8	75.3	1.196
300483	79.9	.288	18.5	.067	2.04	.00736	.28	.00101	71.4	55.4	.200
280683	111.4	.934	1.1	.009	2.44	.02043	.77	.00649	12.9	47.2	.395
201083	31.2	.222	10.6	.075	1.84	.01309	.86	.00613	28.8	52.2	.372
031183	131.1	1.119	20.2	.172	2.13	.01818	.74	.00628	37.0	53.1	.454
191183	169.0	4.920	33.2	.965	NA	NA	NA	NA	97.3	NA	NA
231183	249.4	6.605	33.5	.887	NA	NA	NA	NA	174.0	NA	NA
101283	779.5	32.026	95.6	3.929	4.02	.16534	.96	.03955	207.5	90.0	3.699
240384	201.0	1.417	21.4	.151	1.84	.01297	.42	.00294	202.6	46.4	.327
210484	417.9	9.777	357.7	8.369	2.10	.04911	.39	.00915	160.5	51.0	1.193
100984	96.6	1.319	13.1	.179	1.21	.01659	.48	.00657	39.0	30.3	.413

Appendix G. Continued

FIELD SITE 6

DATE	TSS		TVS		TKN		TPHS		TURB	COD	
DATE DYMOYR	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	EMC MG/L	LOAD TONS
280582	999.0	3.309	60.1	.199	3.23	.01069	.93	.00308	229.7	NA	NA
310582	2193.2	4.777	251.2	.547	4.69	.01021	1.03	.00225	NA	105.2	.229
100782	1392.6	10.447	122.5	.919	5.42	.04065	1.18	.00884	796.3	143.0	1.072
170982	314.7	.055	32.2	.006	2.13	.00037	.61	.00011	117.8	58.6	.010
061082	290.7	.581	24.0	.048	1.88	.00376	.71	.00142	68.9	64.9	.130
021282	1433.3	8.146	97.7	.555	9.99	.05680	1.54	.00875	1455.4	234.6	1.333
031282	448.6	1.938	87.7	.379	3.90	.01684	.83	.00358	580.8	88.0	.380
010283	254.5	.277	65.5	.071	3.19	.00347	.66	.00072	244.2	73.7	.080
030683	1377.1	.124	1215.5	.110	6.65	.00060	1.57	.00014	6.4	157.5	.014
031183	215.6	.092	28.8	.012	NA	NA	NA	NA	43.7	NA	NA
191183	152.0	.355	25.2	.059	NA	NA	NA	NA	36.8	NA	NA
101283	152.9	1.209	25.4	.201	1.43	.01128	.72	.00571	113.0	36.8	.291
190384	178.3	.241	7.4	.010	2.19	.00297	.59	.00080	193.9	60.4	.082
030484	736.9	5.769	56.0	.438	3.24	.02538	.69	.00544	199.2	83.1	.650
210484	92.4	.350	11.1	.042	13.38	.05070	.35	.00134	9.6	33.3	.126
100984	55.6	.001	15.6	.000	1.23	.00003	.57	.00002	12.5	59.1	.002

Appendix G. Continued

FIELD SITE 7

DATE	TSS		TVS		TKN		TPHS		TURB	COD	
	EMC	LOAD	EMC	LOAD	EMC	LOAD	EMC	LOAD	EMC	EMC	LOAD
DYMOYR	MG/L	TONS	MG/L	TONS	MG/L	TONS	MG/L	TONS	MG/L	MG/L	TONS
280582	16628.9	22.785	918.1	1.299	NA	NA	NA	NA	NA	NA	NA
150682	4863.4	8.186	234.0	.394	5.45	.00917	1.47	.00247	2447.8	237.5	.400
010982	1778.1	1.728	183.3	.178	4.36	.00424	1.21	.00118	961.2	132.9	.129
020982	1143.7	1.470	123.6	.159	2.42	.00311	.73	.00093	419.9	80.3	.103
170982	838.0	1.007	66.6	.080	2.94	.00353	.95	.00114	506.3	77.4	.093
061082	2465.9	14.425	155.7	.911	9.44	.05520	1.73	.01010	1540.8	222.8	1.304
021282	906.0	21.876	55.1	1.331	4.99	.12048	2.59	.06265	727.4	93.4	2.255
031282	434.9	8.796	57.9	1.171	1.92	.03876	.41	.00822	297.1	51.0	1.031
180383	974.4	7.165	154.9	1.139	1.37	.01008	.48	.00351	232.1	58.3	.429
010483	2043.5	8.196	126.0	.505	2.38	.00953	.82	.00328	217.2	124.0	.498
231183	5656.5	36.984	339.6	2.221	NA	NA	NA	NA	274.1	NA	NA
240384	3468.4	60.034	208.7	3.612	4.73	.08186	1.10	.01903	191.2	116.7	2.020

Appendix G. Continued

FIELD SITE 8

DATE	TSS		TVS		TKN		TPHS		TURB	COD	
DATE DYMOYR	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	EMC MG/L	LOAD TONS
010982	31.7	.000	19.7	.000	5.13	.00000	4.70	.00000	6.6	116.7	.000
170982	92.5	.001	21.0	.000	5.05	.00005	3.50	.00003	34.5	59.0	.001
061082	168.8	.007	49.1	.002	10.73	.00043	5.24	.00021	191.8	202.3	.008
021282	85.9	.013	11.4	.002	4.37	.00065	2.25	.00033	187.0	70.3	.010
031282	59.2	.011	20.0	.004	2.17	.00039	1.62	.00029	150.7	52.0	.009
010283	186.5	.011	76.8	.005	21.55	.00129	6.02	.00036	157.0	430.6	.026
180383	226.6	.014	61.4	.004	9.84	.00061	4.77	.00030	59.3	402.5	.025
200383	105.6	.001	85.6	.000	29.00	.00016	11.00	.00006	64.7	NA	NA
010483	329.2	.011	94.4	.003	10.04	.00032	4.05	.00013	28.0	353.5	.011
130483	252.4	.076	102.9	.031	13.68	.00413	6.65	.00201	12.4	382.8	.116
280483	202.4	.004	124.3	.002	42.00	.00081	13.27	.00025	130.8	953.7	.018
130583	155.0	.002	50.0	.001	12.88	.00017	7.16	.00010	4.1	235.4	.003
030683	217.6	.088	104.3	.042	17.18	.00692	5.95	.00240	60.2	289.7	.117
201083	61.4	.001	45.5	.001	10.99	.00024	5.66	.00012	33.0	215.2	.005
211083	33.9	.000	26.6	.000	8.72	.00012	4.24	.00006	47.6	169.1	.002
191183	97.3	.005	70.1	.004	NA	NA	NA	NA	200.4	NA	NA
271183	56.2	.002	45.7	.002	13.36	.00054	5.23	.00021	99.7	251.5	.010
101283	73.6	.008	56.9	.006	20.36	.00222	5.92	.00064	27.7	371.8	.040
190384	79.1	.002	11.6	.000	44.32	.00105	13.89	.00033	99.7	763.6	.018
210484	72.5	.004	36.0	.002	31.55	.00190	10.41	.00063	31.8	578.2	.035

Appendix G. Continued

GAGING STATION 1

DATE	TSS		TVS		TKN		TPHS		TURB	COD	
DATE DYMOYR	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	EMC MG/L	LOAD TONS
290182	439.7	1854.504	84.9	358.258	NA	NA	NA	NA	174.9	NA	NA
250382	490.3	266.149	69.6	37.756	4.14	2.24509	.95	.51706	201.3	NA	NA
310582	670.0	1217.642	107.7	195.791	2.76	5.01831	.64	1.16357	NA	NA	NA
070682	979.4	1235.853	38.8	48.939	NA	NA	NA	NA	228.2	NA	NA
010982	171.3	22.946	51.7	6.932	2.00	.26741	.76	.10182	116.4	68.4	9.156
020982	103.3	6.526	27.2	1.720	2.15	.13601	.81	.05106	81.2	56.6	3.576
170982	642.2	443.127	84.8	58.485	2.85	1.96684	.93	.64090	308.0	65.5	45.180
061082	653.1	1766.585	62.7	169.616	NA	NA	NA	NA	494.5	NA	NA
221182	40.4	20.690	18.4	9.414	NA	NA	NA	NA	44.4	NA	NA
261182	131.0	190.547	15.4	22.464	NA	NA	NA	NA	103.3	NA	NA
021282	537.6	3462.876	56.8	366.095	4.41	28.43243	1.05	6.76745	556.0	92.1	593.388
020283	559.1	60.763	63.2	85.989	2.96	4.03255	.74	1.00997	220.5	53.9	73.290
180383	673.9	1574.858	54.6	127.687	4.00	9.34278	.79	1.83527	117.6	78.8	184.093
010483	443.3	551.533	50.2	62.427	2.94	3.65317	.74	.92442	148.7	98.6	122.686
130483	902.6	3531.366	106.0	414.832	1.94	7.57788	.84	3.29906	61.9	96.4	377.136
220583	346.2	88.538	64.6	16.528	3.05	.77915	.63	.16003	81.3	80.6	20.604
030683	966.6	2695.200	123.4	344.164	5.22	14.55962	.72	1.99751	53.3	96.7	269.713
280683	922.7	555.619	78.8	47.457	8.39	5.04942	1.31	.78739	67.0	160.4	96.571
201083	262.6	144.258	44.0	24.176	3.31	1.81844	1.10	.60672	23.7	66.7	36.616
031183	633.0	216.931	64.4	22.081	NA	NA	NA	NA	27.4	NA	NA
191183	340.6	336.295	41.4	40.849	NA	NA	NA	NA	179.4	NA	NA
231183	392.6	773.438	41.1	81.066	NA	NA	NA	NA	173.4	NA	NA
101283	644.8	2733.782	54.9	232.714	2.80	11.88780	.86	3.63638	188.3	64.7	274.403
240384	1505.5	2673.577	89.6	159.093	4.06	7.20934	.54	.96670	256.5	117.0	207.833
030484	972.5	3001.392	78.0	240.855	4.35	13.40994	.86	2.66688	176.3	110.4	340.676
210484	894.1	4029.867	111.8	503.856	4.03	18.15912	.56	2.53106	150.0	64.9	292.735
110984	674.0	278.266	64.1	26.463	1.99	.82052	.85	.35132	305.4	55.0	22.716

Appendix G. Continued

GAGING STATION 2

DATE	TSS		TVS		TKN		TPHS		TURB	COD	
DYMOYR	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	EMC MG/L	LOAD TONS
020482	1325.1	860.629	151.9	98.653	9.13	5.93000	1.74	1.13237	1458.5	282.8	183.642
061082	428.3	189.081	77.3	34.104	3.51	1.54829	1.59	.69982	467.5	115.4	50.957
021282	645.0	2803.824	121.4	527.862	5.62	24.41752	1.14	4.97259	675.7	129.7	563.877
180383	448.2	394.148	46.6	40.960	1.34	1.17978	.85	.74831	118.2	82.6	72.626
010483	389.6	332.764	49.3	42.086	2.16	1.84713	.80	.67907	142.0	95.7	81.705
290483	394.3	1272.020	62.1	200.240	2.99	9.65015	.61	1.95904	101.2	82.3	265.499
130583	357.2	12.007	54.8	1.841	3.35	.11248	.79	.02652	36.6	70.2	2.359
041183	288.6	9.673	32.8	1.099	2.39	.08005	.89	.02978	45.5	57.8	1.936
191183	198.2	55.261	31.8	8.861	NA	NA	NA	NA	35.9	NA	NA
231183	236.3	138.990	31.2	18.363	NA	NA	NA	NA	103.0	NA	NA
101283	224.8	353.483	44.8	70.505	2.34	3.68073	.80	1.25558	196.3	53.8	84.533
180384	796.2	783.905	67.4	66.342	4.49	4.41631	1.09	1.07048	210.5	98.3	96.821
240384	502.4	298.842	43.3	25.773	3.49	2.07798	.65	.38797	254.8	63.8	37.927
030484	1100.9	1268.806	118.2	136.270	3.56	4.10052	.85	.97622	181.3	88.8	102.300
210484	433.8	754.586	82.6	143.755	2.33	4.05308	.38	.66268	166.9	45.2	78.583
110984	NA	NA	NA	NA	2.19	.08825	.86	.03453	NA	39.5	1.588

Appendix G. Concluded

GAGING STATION 3

	TSS		TVS		TKN		TPHS		TURB	COD	
DATE DYMOYR	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	LOAD TONS	EMC MG/L	EMC MG/L	LOAD TONS
020482	2142.8	387.859	236.4	37.531	11.86	1.88288	1.79	.28349	1658.3	326.0	51.763
290582	286.3	13.176	37.0	1.701	13.45	.619.10	1.81	.08352	1724.9	257.4	11.843
310582	633.4	47.334	114.2	8.533	4.79	.35796	.85	.06326	NA	60.8	4.543
070682	2456.9	662.128	150.2	40.488	NA	NA	NA	NA	169.6	NA	NA
170982	466.4	90.288	59.9	11.589	1.91	.36897	.90	.17424	225.5	51.0	9.873
061082	495.7	49.248	70.9	7.041	3.64	.36151	1.48	.14748	489.4	105.6	10.488
261182	172.9	8.225	35.4	1.684	2.72	.12964	.89	.04239	163.0	56.0	2.667
021282	2102.5	1307.500	287.7	178.916	9.95	6.18855	1.34	.83352	1707.6	247.1	153.654
010283	298.8	60.639	41.5	8.422	2.86	.58067	.61	.12473	188.3	50.7	10.282
180383	449.1	88.003	45.7	8.958	1.52	.29712	.64	.12479	112.5	74.1	14.523
010483	386.7	64.139	51.9	8.614	2.46	.40850	.58	.09547	171.9	91.3	15.146
130483	998.2	857.987	84.4	72.528	2.19	1.88078	.74	.63481	62.3	103.8	89.204
030683	476.1	42.037	73.3	6.473	4.01	.35406	.58	.05090	58.9	69.1	6.103
060683	231.6	7.728	40.8	1.360	3.67	.12244	.42	.01395	49.2	70.2	2.342
280683	1370.8	145.240	195.7	20.730	5.74	.60807	1.09	.11569	36.5	122.8	13.006
101283	756.1	573.698	90.1	68.340	3.76	2.84962	.82	.62083	169.4	77.8	59.054
180384	336.6	15.832	64.2	3.019	2.70	.12722	.59	.02793	219.1	78.6	3.699
190384	975.0	528.939	88.8	48.188	3.86	2.09571	.93	.50375	248.6	88.3	47.928
240384	1268.8	394.501	333.8	103.791	3.86	1.19882	.72	.22378	248.7	101.3	31.507
260384	447.2	14.151	218.1	6.902	2.34	.07414	.42	.01344	193.0	65.6	2.075
280384	455.0	24.056	177.2	9.367	2.27	.11975	.38	.01984	193.7	56.5	2.990
030484	1124.8	606.851	97.8	52.784	5.21	2.80862	.65	.34970	173.1	124.5	67.192
210484	622.0	456.928	74.7	54.902	4.00	2.93701	.49	.35930	183.8	71.6	52.583
110984	308.4	27.082	27.5	2.418	1.12	.09868	.51	.04466	158.1	38.5	3.377

Appendix H. Monthly Sediment and Water Quality Loads at the Gaging Stations

Gaging Station 1
(tons)

Water Quality Parameter

Date MoYr	TSS	TVS	NH3	TKN	N23	TPHS	DSPH	COD
01-82*	1639.4	333.9	6.316	16.42	8.421	3.874	0.000	252.6
02-82*	378.8	243.8	35.720	65.14	21.012	7.669	0.000	252.6
03-82*	1009.2	153.7	3.314	8.40	4.158	2.504	.474	142.8
04-82	2286.0	241.9	.690	16.87	4.450	2.791	.346	448.9
05-82	2536.1	273.4	1.600	10.21	1.918	1.864	.833	104.9
06-82	1633.8	138.3	3.066	7.85	3.666	2.087	1.600	138.4
07-82	125.3	55.9	.555	5.17	2.624	.924	.518	107.2
08-82	5.1	1.5	.000	.06	.000	.015	.001	1.9
09-82	419.1	66.4	.213	3.44	.254	1.157	.433	83.2
10-82	1406.7	132.7	.049	11.07	1.006	3.724	.177	293.2
11-82	179.1	32.4	.025	8.10	.681	2.371	.859	221.1
12-82	3309.3	272.7	.132	35.69	19.951	9.506	2.620	820.7
01-83	17.2	6.2	.782	1.86	1.524	.215	.087	24.0
02-83	798.0	90.4	4.057	5.23	4.213	1.125	.338	86.2
03-83	1102.0	120.4	9.354	10.23	2.034	1.996	.924	204.0
04-83	4120.4	487.3	1.185	14.42	8.656	4.875	1.358	582.1
05-83	859.2	193.9	2.274	14.09	11.048	1.969	.988	287.9
06-83	3651.2	412.0	.636	21.55	6.142	3.060	.589	407.1
07-83	.4	.0	.000	.01	.000	.001	.000	.2
08-83	.0	.0	.000	.00	.000	.000	.000	.0
09-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
10-83*	152.9	26.0	.159	1.95	.066	.615	.033	39.8
11-83	1401.4	174.4	1.622	14.34	8.737	4.512	3.310	332.9
12-83	2920.4	264.2	1.731	16.37	8.666	5.034	2.905	379.5
01-84	145.8	15.4	2.089	4.47	5.220	.821	.625	44.8
02-84	845.5	102.9	1.580	10.82	5.973	2.163	1.320	228.4
03-84*	4671.2	405.1	.986	24.75	8.548	5.404	2.101	691.9
04-84	6578.5	730.2	.812	30.34	11.273	5.021	.788	607.0
05-84	13.7	3.7	.046	.34	.160	.074	.036	9.6
06-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
07-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
08-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
09-84	446.9	61.3	.435	3.34	.321	1.216	.851	95.0
10-84	79.7	19.5	.016	.11	.011	.037	.030	3.2
TOTAL	42732.3	5059.5	79.444	362.64	150.733	76.624	24.144	7657.6

* Indicates incomplete record

Note: TSS = total suspended solids, TVS = total volatile solids,
NH3 = ammonia, TKN = total Kjeldahl nitrogen,
N23 = nitrate and nitrite, TPHS = total phosphorus,
DSPH = dissolved phosphorus, COD = chemical oxygen demand

Appendix H. Continued

Gaging Station 2
(tons)

Water Quality Parameter

Date MoYr	TSS	TVS	NH3	TKN	N23	TPHS	DSPH	COD
02-82*	120.1	99.7	0.000	0.00	0.000	0.000	0.000	0.0
03-82	233.8	35.4	1.024	2.52	.758	.632	.196	84.3
04-82*	892.3	104.3	.339	5.80	.848	1.090	.143	172.4
05-82*	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
06-82*	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
07-82*	51.2	30.3	.436	2.65	.796	.530	.303	56.8
08-82	.6	.1	.000	.02	.000	.003	.001	.5
09-82	71.0	11.6	.011	2.15	.404	.312	.130	46.2
10-82	358.4	90.3	.359	5.48	.227	2.690	.039	153.9
11-82	93.2	21.5	.031	3.74	.564	1.336	.610	73.2
12-82	2244.8	371.0	1.039	23.62	10.301	5.118	2.181	481.7
01-83	.2	.1	.013	.03	.015	.004	.003	.3
02-83	888.0	106.9	2.075	3.09	1.071	.556	.349	44.0
03-83	447.1	64.6	6.596	2.51	1.126	1.236	.595	108.7
04-83	631.3	157.4	.486	7.30	4.501	2.270	.949	243.9
05-83	881.3	172.2	.077	8.18	3.985	1.654	.362	213.9
06-83	1959.7	284.9	.542	9.16	5.601	1.256	.514	218.9
07-83	.1	.0	.000	.00	.000	.000	.000	.0
08-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
09-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
10-83	.6	.1	.001	.01	.000	.004	.000	.2
11-83	229.2	34.9	.439	4.51	2.675	1.514	.990	136.5
12-83	409.9	77.1	.493	4.76	2.956	1.586	.966	117.6
01-84	25.0	2.4	.426	.77	.543	.147	.116	7.7
02-84*	196.7	23.1	.443	2.64	1.370	.559	.337	58.0
03-84	1565.5	116.4	.456	11.48	2.526	2.325	.775	210.7
04-84	1795.7	252.1	.914	10.88	3.684	2.065	.554	232.9
05-84	.0	.0	.000	.00	.000	.000	.000	.0
06-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
07-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
08-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
09-84	24.0	5.2	.043	.48	.185	.197	.150	12.0
10-84	13.7	2.8	.000	.00	0.000	0.000	.000	.0
TOTAL	13,133.4	2064.4	16.243	111.78	44.136	27.084	10.263	2674.3

* Indicates incomplete record

Appendix H. Continued

Gaging Station 3
(tons)

Water Quality Parameter

Date MoYr	TSS	TVS	NH3	TKN	N23	TPHS	DSPH	COD
02-82*	.1	.1	0.000	0.00	0.000	0.000	0.000	0.0
03-82	54.6	12.1	.110	.62	.367	.186	.044	25.2
04-82	380.9	37.2	.078	1.87	.151	.283	.034	51.6
05-82	102.4	19.0	.002	1.23	.051	.187	.024	23.6
06-82	492.6	30.3	.004	.63	.138	.148	.065	13.5
07-82	420.1	42.7	.006	3.13	.074	.452	.080	84.8
08-82	.4	.1	.000	.01	.001	.002	.000	.2
09-82	84.2	11.0	.003	.52	.070	.374	.052	14.0
10-82	150.6	60.1	.005	1.26	.127	.664	.012	41.2
11-82	14.5	2.1	.003	.46	.060	.182	.306	10.0
12-82*	231.0	29.7	.284	3.89	23.093	.641	.462	65.6
01-83	.2	.0	.002	.01	.010	.001	.001	.2
02-83*	64.3	8.7	.153	.60	.301	.125	.054	10.9
03-83	106.4	12.1	.004	.42	.267	.181	.021	23.6
04-83	855.6	88.5	.012	2.36	.887	.735	.106	106.5
05-83*	2.0	.7	.002	.06	.082	.004	.004	1.0
06-83*	211.2	28.4	.016	1.14	.668	.192	.024	23.2
07-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
08-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
09-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
10-83	19.4	4.9	.013	2.57	.049	.327	.026	9.5
11-83*	293.7	35.6	.058	1.91	1.340	.533	.356	55.7
12-83	618.7	74.4	.133	3.36	1.212	.735	.226	72.1
01-84	1.0	.1	.002	.02	.015	.004	.003	.5
02-84	1.5	.3	.004	.04	.035	.009	.007	1.2
03-84*	1153.5	195.4	.117	4.94	1.164	1.032	.262	119.3
04-84	1058.0	112.3	.142	5.37	1.045	.681	.069	112.1
05-84	1.6	.6	.001	.07	.006	.021	.018	1.7
06-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
07-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
08-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
09-84	41.1	5.3	.003	.36	.003	.112	.075	8.9
10-84	5.5	1.8	.002	.02	.001	.006	.005	.7
TOTAL	6365.1	814.3	1.159	36.87	31.217	7.817	2.336	876.8

* Indicates incomplete record

Spillway
(tons)

Water Quality Parameter

Date MoYr	TSS	TVS	NH3	TKN	N23	TPHS	DSPH	COD
01-82*	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
02-82	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
03-82	125.2	68.2	3.850	6.93	3.092	1.373	.891	110.9
04-82	292.9	53.0	3.002	6.25	3.001	.916	.398	96.1
05-82	54.5	18.0	.247	1.91	2.406	.277	.068	51.7
06-82	286.1	65.1	.553	6.62	9.372	1.150	.323	166.3
07-82	222.1	91.5	1.059	10.92	10.501	1.997	1.020	223.9
08-82	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
09-82	36.5	7.9	.011	1.04	.894	.219	.048	16.0
10-82	55.1	25.5	.022	1.67	1.923	.396	.244	44.2
11-82	52.5	13.4	.110	3.33	1.689	.884	.322	70.2
12-82*	1475.9	209.4	2.637	49.99	21.751	14.911	6.094	1047.7
01-83	8.3	2.0	.024	.15	.063	.049	.020	4.3
02-83	8.4	4.3	.123	.70	.313	.187	.086	13.7
03-83	146.1	59.5	.681	3.41	5.911	1 .638	.654	192.9
04-83	249.8	121.8	1.645	10.54	17.298	3.183	1.456	479.5
05-83	344.0	102.8	1.432	16.68	9.210	3.736	1.680	384.1
06-83	205.7	30.2	.099	14.87	10.755	2.773	1.286	246.4
07-83	1.6	.2	0.000	0.00	0.000	0.000	0.000	o.o
08-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
09-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
10-83	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
11-83	431.4	66.0	1.558	14.08	9.281	3.249	1.573	332.4
12-83	531.1	87.4	1.475	18.35	8.287	4.583	2.513	394.6
01-84	5.6	.4	.012	.10	.061	.030	.020	1.8
02-84*	11.5	6.6	.052	.35	.088	.056	.038	6.3
03-84	936.0	206.1	11.007	37.11	27.708	6.862	3.732	548.1
04-84	1415.6	730.8	7.125	31.06	16.744	6.644	2.734	549.7
05-84	191.4	45.0	.884	5.86	6.263	1.207	.441	120.0
06-84	22.8	5.0	.115	.60	1.135	.171	.060	18.6
07-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
08-84	0.0	0.0	0.000	0.00	0.000	0.000	0.000	0.0
09-84	39.7	14.8	0.000	0.00	0.000	0.000	0.000	0.0
10-84	160.7	44.6	.187	1.03	.995	.172	.079	21.9
TOTAL	7310.5	2079.5	37.910	243.55	168.741	58.036	25.780	5141.3

* Indicates incomplete record

Appendix I. Summary of Minimum, Maximum, Mean, and Standard Deviation of Water Quality Parameters

STATISTICS FOR F1

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	40.00	7600.00	599.20	866.88	140
TVS	0.00	832.00	93.09	144.23	140
NH3	-1.00	-1.00	-1.00	-1.00	0
TKN	1.00	18.00	5.00	3.42	101
N23	-1.00	-1.00	-1.00	-1.00	0
TPHS	.18	2.50	.96	.51	101
DPHS	-1.00	-1.00	-1.00	-1.00	0
TURB	14.00	2900.00	397.72	488.31	129
COD	33.00	430.00	107.21	69.08	97

STATISTICS FOR F2

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	37.00	8650.00	1052.82	1503.20	74
TVS	0.00	500.00	95.46	96.75	74
NH3	-1.00	-1.00	-1.00	-1.00	0
TKN	.60	14.00	2.83	2.30	56
N23	-1.00	-1.00	-1.00	-1.00	0
TPHS	.20	2.10	.60	.41	56
DPHS	-1.00	-1.00	-1.00	-1.00	0
TURB	15.00	1700.00	168.22	214.52	74
COD	19.00	323.00	80.85	59.35	55

STATISTICS FOR F3

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	10.00	3330.00	818.45	804.57	98
TVS	0.00	400.00	75.06	65.24	98
NH3	-1.00	-1.00	-1.00	-1.00	0
TKN	1.00	36.00	4.72	5.10	100
N23	-1.00	-1.00	-1.00	-1.00	0
TPHS	.42	4.20	1.35	.71	100
DPHS	-1.00	-1.00	-1.00	-1.00	0
TURB	8.10	5500.00	312.57	681.64	98
COD	30.00	330.00	80.61	51.98	100

STATISTICS FOR F4

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	4.00	8660.00	500.00	970.23	166
TVS	0.00	510.00	54.33	69.88	166
NH3	-1.00	-1.00	-1.00	-1.00	0
TKN	.40	16.00	3.64	2.87	122
N23	-1.00	-1.00	-1.00	-1.00	0
TPHS	.11	3.50	.89	.48	122
DPHS	-1.00	-1.00	-1,00	-1.00	0
TURB	5.00	1420.00	173.75	255.78	166
COD	34.00	338.00	90.59	57.74	121

Appendix I. Continued

STATISTICS FOR F5

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	6.00	6330.00	306.12	616.33	235
TVS	0.00	870.00	51.29	94.52	235
NH3	-1.00	-1.00	-1.00	-1.00	0
TKN	.70	22.00	3.28	3.86	182
N23	-1.00	-1.00	-1.00	-1.00	0
TPHS	.12	3.80	.75	.69	182
DPHS	-1.00	-1.00	-1.00	-1.00	0
TURB	3.80	3200.00	231.96	443.12	225
COD	24.00	525.00	76.99	75.30	174

STATISTICS FOR F6

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	11.00	17900.00	744.16	1926.12	147
TVS	0.00	1580.00	101.63	229.34	147
NH3	-1.00	-1.00	-1.00	-1.00	0
TKN	.90	39.00	6.10	7.69	115
N23	-1.00	-1.00	-1.00	-1.00	0
TPHS	.12	5.20	1.00	.88	115
DPHS	-1.00	-1.00	-1.00	-1.00	0
TURB	6.20	3300.00	261.03	528.18	143
COD	26.00	938.00	124.17	154.06	113

STATISTICS FOR F7

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	12.00	19100.00	2026.74	3043.40	102
TVS	6.00	3220.00	246.38	531.39	102
NH3	-1.00	-1.00	-1.00	-1.00	0
TKN	.60	20.00	4.16	3.46	87
N23	-1.00	-1.00	-1.00	-1.00	0
TPHS	.07	5.00	.99	.74	87
DPHS	-1.00	-1.00	-1.00	-1.00	0
TURB	4.70	5000.00	588.21	828.61	95
COD	22.00	545.00	120.02	91.75	85

STATISTICS FOR F8

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	17.00	580.00	145.66	96.34	187
TVS	0.00	240.00	69.91	43.33	187
NH3	-1.00	-1.00	-1.00	-1.00	0
TKN	1.50	70.00	22.21	16.33	167
N23	-1.00	-1.00	-1.00	-1.00	0
TPHS	1.60	18.00	8.03	4.44	167
DPHS	-1.00	-1.00	-1.00	-1.00	0
TURB	2.10	840.00	104.17	117.65	187
COD	50.00	1455.00	490.70	340.90	163

Appendix I. Concluded

STATISTICS FOR G1

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	2.00	6600.00	278.56	503.10	475
TVS	0.00	260.00	35.68	39.82	475
NH3	.01	3.40	.41	.76	49
TKN	.60	15.00	3.20	2.19	223
N23	.01	4.20	1.04	.98	49
TPHS	.09"	6.67	.75	.55	224
DPHS	.02	.61	.17	.15	48
TURB	1.40	2650.00	109.63	212.73	454
COD	10.00	350.00	70.98	47.87	215

STATISTICS FOR G2

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	3.00	1620.00	174.23	241.44	413
TVS	0.00	260.00	30.28	34.48	413
NH3	.01	4.00	.44	.83	48
TKN	0.00	9.60	2.90	1.50	195
N23	.01	6.10	.99	1.10	48
TPHS	.11	1.90	.75	.37	197
DPHS	.02	.69	.22	.17	48
TURB	1.60	1640.00	86.60	149.15	404
COD	15.00	325.00	68.03	37.12	194

STATISTICS FOR G3

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	2.00	4100.00	230.65	471.60	403
TVS	0.00	510.00	37.66	60.33	403
NH3	.01	1.40	.18	.28	42
TKN	.50	73.00	3.58	5.61	221
N23	.01	13.00	1.13	2.23	42
TPHS	.03	7.70	.74	.77	222
DPHS	.01	1.70	.21	.28	41
TURB	.40	2300.00	117.20	241.91	390
COD	15.00	330.00	72.02	54.69	214

STATISTICS FOR SW

PARAMETER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER IN SAMPLE
TSS	3.00	168.00	35.42	27.60	244
TVS	0.00	100.00	10.35	9.71	244
NH3	.01	1.20	.18	.24	50
TKN	.20	2.20	1.20	.52	50
N23	.01	3.70	.97	.55	50
TPHS	.03	.78	.26	.16	52
DPHS	.02	.34	.12	.08	49
TURB	1.70	330.00	62.53	56.00	237
COD	4.00	54.00	25.31	10.28	53

Appendix J. Summary of Regression between Water Quality Parameters

REGRESSION EQUATION IS Y=A*X**B

REGRESSION FOR F1

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	.8445	.7132	.6986	136
TSS	TKN	.3686	.3978	.5913	101
TSS	TPHS	.1985	.2370	.4099	101
TSS	TURB	.5563	.6305	.5604	129
FLOW	TSS	403.4155	.2437	.4887	121
FLOW	TKN	4.0642	.0331	.0964	90
FLOW	TPHS	.8244	.0311	.1044	90

REGRESSION FOR F2

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	2.2153	.5460	.7575	73
TSS	TKN	.5539	.2270	.5414	56
TSS	TPHS	.3790	.0434	.0984	56
TSS	TURB	.1687	.6620	.7786	74
FLOW	TSS	333.9452	-.0119	-.0142	51
FLOW	TKN	1.9806	.0242	.0779	37
FLOW	TPHS	.4652	.0014	.0035	37

REGRESSION FOR F3

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	1.7249	.5637	.8289	96
TSS	TKN	1.8262	.1060	.2005	98
TSS	TPHS	.5150	.1411	.4114	98
TSS	TURB	.4703	.5571	.5842	97
FLOW	TSS	602.2838	.0942	.1747	70
FLOW	TKN	3.2232	.0639	.1812	71
FLOW	TPHS	1.1581	.0506	.2143	71

REGRESSION FOR F4

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	.8899	.6797	.8991	164
TSS	TKN	.3237	.3966	.8060	121
TSS	TPHS	.2460	.2118	.5735	121
TSS	TURB	.6800	.4775	.5358	165
FLOW	TSS	126.4094	.2700	.4507	122
FLOW	TKN	2.1268	.0702	.2044	81
FLOW	TPHS	.6966	.0487	.2025	81

REGRESSION FOR F5

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	.8523	.7083	.8300	228
TSS	TKN	.3766	.3809	.7156	179
TSS	TPHS	.1519	.2727	.5166	179
TSS	TURB	.2456	.7695	.7885	225
FLOW	TSS	79.9858	.3746	.4802	219
FLOW	TKN	2.1435	.0939	.2184	171
FLOW	TPHS	.5188	.0993	.2378	171

REGRESSION FOR F6

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	.4185	.8177	.8747	141
TSS	TKN	.5471	.3341	.5101	115
TSS	TPHS	.1204	.3305	.7499	115
TSS	TURB	.7855	.4803	.5312	143
FLOW	TSS	233.5714	.1583	.2212	122
FLOW	TKN	3.2245	.0697	.1623	99
FLOW	TPHS	.7481	.0284	.1055	99

REGRESSION FOR F7

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	.6175	.7417	.8206	102
TSS	TKN	.2109	.3932	.6108	86
TSS	TPHS	.0502	.3979	.6444	86
TSS	TURB	.3640	.6366	.6050	95
FLOW	TSS	802.0636	.2186	.3198	90
FLOW	TKN	2.6745	.1010	.2329	78
FLOW	TPHS	.6104	.1874	.4623	78

REGRESSION FOR F8

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	3.1406	.6122	.5777	182
TSS	TKN	6.7074	.1818	.1378	167
TSS	TPHS	3.8008	.1192	.1260	167
TSS	TURB	2.3261	.2190	.1378	180
FLOW	TSS	179.1159	.1294	.2228	139
FLOW	TKN	9.6411	-.1549	-.2035	128
FLOW	TPHS	4.3360	-.1368	-.2522	128

Appendix J. Concluded

REGRESSION FOR G1

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	1.1052	.6439	.8677	458
TSS	TKN	.5458	.3010	.6984	222
TSS	TPHS	.1084	.3294	.6863	223
TSS	TURB	2.0350	.3086	.3165	443
FLOW	TSS	30.8708	.4100	.7666	389
FLOW	TKN	1.9983	.0795	.3221	198
FLOW	TPHS	.4173	.1114	.4735	198

REGRESSION FOR G2

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	.8488	.6981	.8391	401
TSS	TKN	.8321	.2215	.5433	188
TSS	TPHS	.1463	.2916	.5823	191
TSS	TURB	1.9392	.3091	.2455	397
FLOW	TSS	68.1415	.2742	.7355	255
FLOW	TKN	2.4297	.0376	.2706	157
FLOW	TPHS	.6579	.0370	.2632	160

REGRESSION FOR G3

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	.7866	.7359	.8904	388
TSS	TKN	.6850	.2663	.5504	211
TSS	TPHS	.1265	.2981	.5616	212
TSS	TURB	2.0414	.3317	.3479	374
FLOW	TSS	57.2756	.4353	.8097	283
FLOW	TKN	2.2129	.0786	.3081	185
FLOW	TPHS	.5065	.0814	.3159	186

REGRESSION FOR SW

INDEPENDENT PARAMETER	DEPENDENT PARAMETER	Y-INTERCEPT A	SLOPE B	CORRELATION COEFFICIENT R	NUMBER IN SAMPLE N
TSS	TVS	.9223	.6554	.6516	234
TSS	TKN	.4585	.2723	.4277	49
TSS	TPHS	.0489	.4693	.5188	51
TSS	TURB	3.5980	.2914	.1380	235
FLOW	TSS	37.9894	-.0726	-.1377	125
FLOW	TKN	1.5099	-.0817	-.2295	24
FLOW	TPHS	.4092	-.1345	-.3466	25