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EROSION AND SEDIMENTATION IN LAKE ASHTABULA, SOUTHEASTERN NORTH DAKOTA

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This dissertation submitted by Darryll T. Pederson in partial fulfillment of the requirements for the Degree of Doctor of Philosophy from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

(Chairman)

Dean of the Graduate School

Permission

Title Erosion and Sedimentation in

Lake Ashtabula, Southeastern North Dakota

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Date May 7, 1971

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ABSTRACT

Erosion along the shore of Lake Ashtabula and nearshore and offshore sedimentation were studied from May 1969 to December 1970. The lake, located in the southeastern part of North Dakota, was formed when the Baldhill Dam stopped the flow of the Sheyenne River in 1950. Maximum depth of the lake is 45 feet in the inundated river channel immediately above the dam. The lake is 27 miles long and ranges in width from 1/3 to 1/2 mile.

Shoreline erosion, measured at stations located at 100-foot intervals around the margins of the lake, was found to be a major source of sediment filling the lake. The shorelines have attained 6 percent of the projected shoreline erosion based on a stable-shelf profile. All incoming wave energy is expended in internal turbulence when a stable shelf is attained. The shape of the profile is dependent on the wave form of deep-water waves, the angle of repose of sediments building the terrace, the slope of the exposed banks adjacent to the shoreline, the valley-wall slope, and the percentage of sand-sized and larger particles in the bank material.

The main erosional processes along the shore are slumping, frost weathering, block separation, and collapse of overhangs. The most important conditioning factors are groundwater regime, shoreline orientation, shoreline use, and organic activity. The swelling and

contraction of montmorillonitic clays in bank material is important in erosional processes. The role of the conditioning factors was analyzed for all shoreline stations using a number of specially written computer programs.

Many turbid-water currents were traced using temperature, specific electrical conductance, and suspended solids. Suspended sediment settling out of turbid water fills the depressions on the lake bottom. The Sheyenne River channel, with 6 percent of the total area, has 19 percent of the total sediment accumulating in the lake.

Sediment samples taken along coring ranges were analyzed for particle size, organic content, total carbonate, mineralogy, and compaction. The total amount of sediment between each coring range was calculated.

The accumulating sediment is gelatinous in appearance and has an initial water content of 80 percent. Compaction reduces the water content to 60 percent at 8 inches. Dominant minerals are dolomite, calcite, potassium feldspar, plagioclase, quartz, disordered cristobalite, and the clay minerals. Oxidizable organic content ranges from 8 to 12 percent.

At the present 1.5×10^9 pounds (dry weight) of sediment has accumulated in the lake, with at least 5×10^8 pounds coming from shoreline erosion. A thin blanket of sediment is being built into the lake by the Sheyenne River.

The lake will be completely filled in 5,000 years, based on the present rate of sediment accumulations. Because erosion rates will decrease as shoreline and other adjustment are made, a life expectancy of 10,000 years is suggested.

INTRODUCTION

Erosion and sedimentation in Lake Ashtabula were studied from the summer of 1969 through 1970. The lake is an Army Corps of Engineers reservoir formed when the flow of the Sheyenne River was dammed in 1950. The dam site is 8 miles northwest of Valley City, North Dakota.

The effective life of most reservoirs is limited because sediment gradually fills the basin. The sediment sources were identified by measuring shoreline erosion and the suspended sediment in contributing tributaries. It was hoped that an understanding of the erosional processes would suggest methods of reducing lake sedimentation.

Because some of the rocks found in the geologic section are formed from lacustrine deposits, a better understanding of the environment of deposition of these deposits can be gained by the study of present-day lake basins. This case study is, in part, an attempt to further define the processes operating in lakes and relate them to the accumulating sediment.

GENERAL DESCRIPTION OF AREA

Climate

Southeastern North Dakota has a Dbf climate, as classified by Trewartha (1954). Freezing or colder temperatures can be expected for at least six months of the year. Temperatures of 60 to 90 degrees Fahrenheit are common in the summer. Precipitation averages 18 inches a year, occurring primarily as heavy summer thunderstorms. Five inches (water content) or more falls as snow. Rapid melting of snow in the spring can cause flooding of streams. Wind velocities of 10 to 30 miles per hour are common. Prevailing winds are from the northwest.

Lake Ashtabula

Lake Ashtabula has a capacity of 69,100 acre-feet. The surface area of the reservoir at normal pool elevation (1,266.0 feet above sea level) is 5,400 acres. The reservoir stretches for 39 river miles above Baldhill Dam. Depth of the reservoir on the inundated floodplain ranges from 30 to 35 feet near the dam to 3 to 6 feet near the border of Griggs and Barnes Counties (Figure 1).

Two main streams, the Sheyenne River and the Baldhill Creek, empty into the reservoir. The total drainage area of tributaries

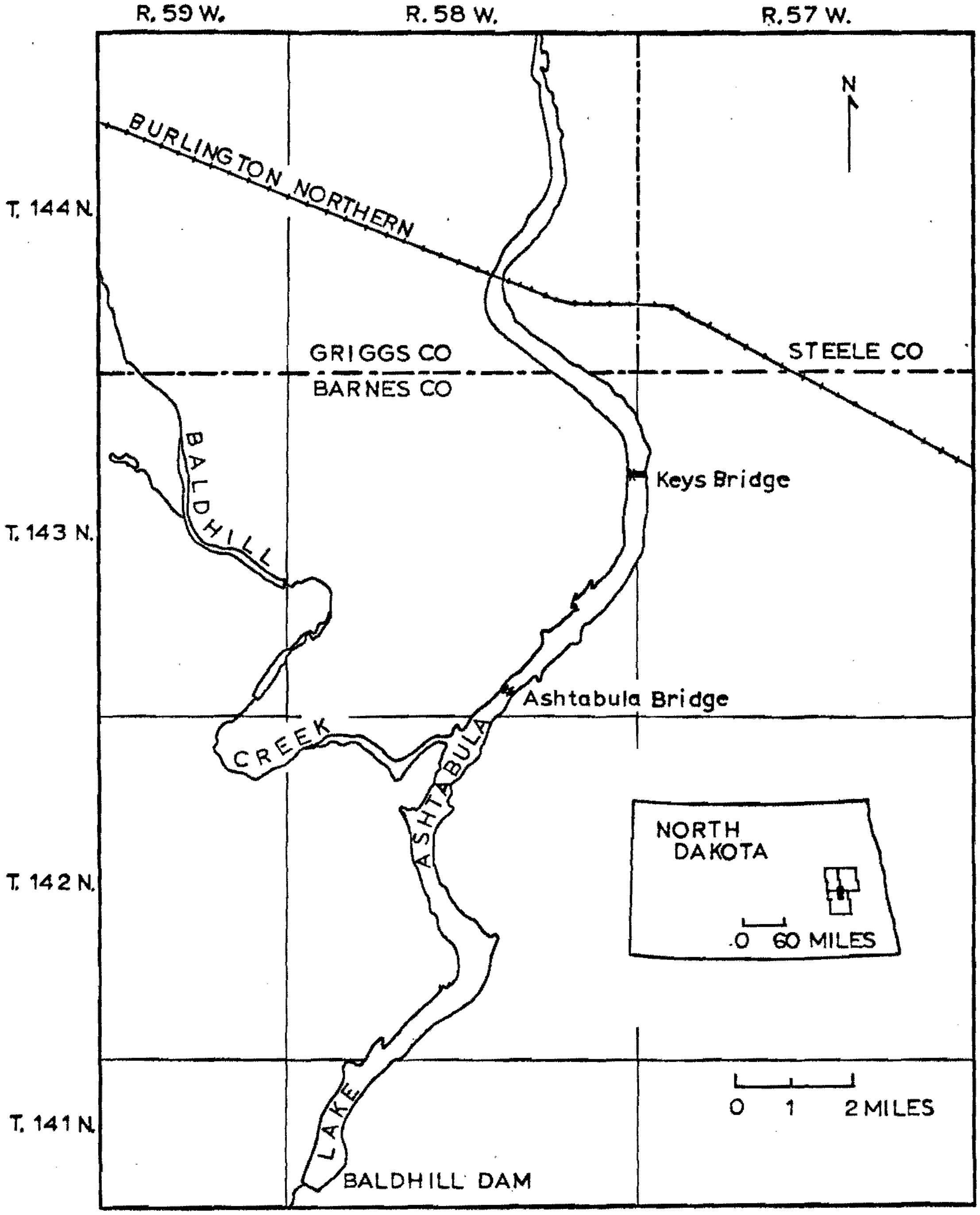

Figure 1.--Map showing location of Lake Ashtabula

emptying into the reservoir is 1,910 square miles (U. S. Geol. Survey, 1968).

Reservoir Operation

During the greater part of the year the pool elevation is maintained at or near 1,266.0 feet. Drawdown of the reservoir to 1,262.5 feet during the winter provides a flood storage capacity of 18,000 acre-feet for spring melt runoff (Resor, p. 70). A minumum discharge of 3 cubic feet per second is maintained at all times.

The reservoir was prematurely filled because of a flood emergency during the spring of 1950. After a maximum pool elevation of 1,269.46 feet the reservoir was drawn down to 1,245.13 feet during August of 1950 (U. S. Geol. Survey, 1968). Because of another flood emergency the reservoir was drawn down to 1,257.78 feet during the winter of 1969. This low pool level allowed the ice cover to rest on bottom sediment in areas normally under 9 feet of water.

Pre-lake Geology

General

Lake Ashtabula is on the eastern flank of the Williston Basin. There has been little post-Cambrian deformation. During much of the Paleozoic and Mesozoic the area was covered by, or was marginal to shallow inland seas. Cenozoic deposits have been eroded away. Downwarping of the Williston Basin has caused bedrock to dip toward the center of the basin.

Pierre Formation

The Pierre Formation (Gregory Member?) exposed along the lake is light-gray, calcareous and fractured shale with well defined bedding planes. The shale banks in the SE 1/4 section 21, T. 142 N., R. 58 W., have weathered to dark-gray angular fragments with numerous concretions and abundant selenite crystals. Glacial drift blankets the Pierre over most of the area.

Glacial geology

Lake Ashtabula inundates a large meltwater channel cut by water draining from glacial Lake Souris during late Wisconsin time. Baldhill Creek occupies an earlier formed meltwater channel cut when continental glaciers covered the area just north of the present junction of Baldhill Creek and Lake Ashtabula.

Till deposited in the area by Wisconsin glaciers is 50 to 70 percent silt and clay. Clay and silt in the till were derived primarily from the Pierre Formation. Large dolomite, limestone, metamorphic, and igneous boulders, transported from Canada by glacial movement, are common in the till. The calcareous till ranges in thickness from less than 1 foot to 200 feet (Kelly and Block, 1967), with an average thickness of 100 feet.

Postglacial geology

Selective hillslope erosion has removed much of the finer material from the valley walls leaving a boulder-armored surface. Some segments of beaches on Lake Ashtabula are well protected by this lag deposit.

Because the Pierre Formation forms a relatively impermeable boundary for local groundwater flow, many springs are found along the valley wall at the contact of the Pierre Formation with the overlying glacial drift. This groundwater discharge has triggered many slumps involving the Pierre Formation and the overlying glacial drift.

The Lake Ashtabula area is poorly drained with numerous closed depressions. Most sediment movement occurs during the spring melt runoff and during thunderstorm activity. Much of the transported sediment moves into the many closed depressions that are not part of the integrated drainage network.

Biological Observations

General comments

Lake Ashtabula, a fisherman's paradise, has a large variety of fish. Among them are walleye, pike, crappie, yellow perch, white bass, and bullheads (other fishermen, personal communication). Some wildlife present along the shoreline are whitetail deer, ground squirrels, beaver, cottontails, and birds.

Bottom fauna

Reid (1967) collected and identified specimens along the bottom of the lake. He found in all cases greater varieties and greater numbers in shallower water. Among genera which he identifies are the bivalves Pisidium and Musculium, the gastropods Valvata, Physa, and Amnicola, and the insect Oecetis. Pisidium sp. and Musculium sp. were consistently found in deeper water. He also identified the insect families Certopogonidae, Tendipedidae, and Enchytraeidae. The Oligochaetes (Enchytraeidae) increased in biomass with depth.

Phytoplankton

Reid (1967) determined that three phyla of phytoplankton Cyanophyta (blue-green algae), Chlorophyta (green algae), and Chrysophyta (diatoms) are responsible for the phytoplanktonic blooms in Lake Ashtabula. The blue-green algae were most abundant in the area around Ashtabula Bridge (Figure 1) during the summers of 1969 and 1970. Some extremely heavy phytoplanktonic blooms were encountered during coring operations. On 28 June, 1970, a pelican, flying off the surface of the reservoir, left tracks in the floating bloom which persisted for 15 minutes. The blooms commonly occur in patches up to 300 acres in area and develop earlier in the season in the upper reaches of the reservoir.

Macrophytes

Potamogeton sp. makes up most of the submergent vegetation that grows in a band along the shoreline. The vegetation band found in water depths of 2 feet to 6.5 feet can reduce the heights of waves passing through it by one-half.

Typha, *Scirpus*, *Sagittaria*, *Lemna*, *Spirodila*, and *Phragmites* are genera identified by Reid (1967) as the dominant emergent plants in Lake Ashtabula. *Typha sp.* (cattails) predominate in the area of the Burlington Northern Railway Bridge (Figure 1). The emergent plants grow in water depths of less than 2 feet.

Water Chemistry

Previous work

Reid (1967), Aspelund (1970), and the United States Geological Survey have conducted chemical surveys of the water in the Sheyenne

River and Lake Ashtabula. At the present time a group from the Department of Biology at the University of North Dakota is sampling water from the headwaters of the Sheyenne River to Baldhill Dam.

Interpretation of available data

The concentration of dissolved solids in the Sheyenne River is dependent on the source of water that is maintaining flow. During the fall and winter months when groundwater discharge is maintaining base flow the dissolved solids concentration is high. Spring melt and thunderstorm runoff during the spring and summer dilutes this base flow, and the concentration of dissolved solids decreases.

The specific electrical conductance, a measure of dissolved solids, in the Sheyenne River ranges from 300 micromhos to 1200 micromhos with the higher values occurring during the winter months. No recognizable pattern was found in the concentration of dissolved solids along the length of the Sheyenne River.

Groundwater discharge from springs along the margin of Lake Ashtabula is similar to groundwater discharge upstream and downstream from the lake. The specific electrical conductance of groundwater discharging into Lake Ashtabula during the fall of 1970 ranged from about 500 to about 2000 micromhos. These values are similar to values of specific electrical conductance of Sheyenne River water during winter months. Concentration of dissolved solids, by evaporation of spring water trapped in lagoons behind bay-mouth beaches, has resulted in specific electrical conductance values of 2700 micromhos or greater.

Lake Ashtabula is unstratified chemically or thermally during ice-free months. The range of water temperature seldom exceeds 4 degrees centigrade with depth or arealy.

SHORELINE BANK EROSION

Problem

A major problem on most man-made lakes is the erosion of the shoreline banks. These large banks erode rapidly and appear as ugly scars detracting from the natural beauty of the lake. The eroded sediment gradually fills the lake and reduces the water storage capacity. With time, slopes should adjust and a vegetative cover once again will protect the shoreline.

The shores of Lake Ashtabula were studied to identify what erosional processes were most important and to determine the effect of conditioning factors.

Procedure

Valley-wall slope angle, bank height, shoreline orientation, fetch, groundwater action, bank sediment, and land use were determined (technique described in Appendix D) at stations located at 100-foot intervals around the entire shore of the lake. Closeness of the pre-lake river channel to each station was found using the Army Corps of Engineers acquisition maps.

Because of the large amount of shoreline data, numerical values were calculated using computer programs (Appendix C) run on an IBM 360/40 computer. All data were coded (described in Appendix D) and these values (Table 10, Appendix D) punched on computer data cards.

Amounts of Erosion

Erosion between 1950 and 1970

Calculation of erosion up to the present time was made for each station listed in table 10 (Appendix D) using computer program 1 (Appendix C). Bank heights at each station were averaged with the preceding and the following station. The valley-wall slope angles were averaged in the same manner. The erosional surface of the shoreline bank was assumed to be vertical. The area of erosion, represented on a vertical plane perpendicular to the beach, was calculated using the following equation:

$$\text{Area} = \frac{H^2 \cdot \cot A}{2}$$

where H is bank height and A is the valley-wall slope angle. Multiplying this area by 1 foot gives the volume eroded from a foot of shoreline at that station. This volume represents a minimum because subaqueous erosion was not considered.

The total eroded volumes of shale, till, and other bank material for the entire lake below the Burlington Northern Railway Bridge (Table 10, Appendix D) were 2.5×10^6 cubic feet (shale), 3.0×10^6 cubic feet (till), and 5.0×10^5 cubic feet (other). Using typical weights of 110 pounds, 110 pounds, and 100 pounds per cubic foot for shale, till, and other types of shoreline sediment total eroded weights of 2.7×10^8 pounds, 33×10^8 pounds, and 5.0×10^7 pounds were calculated.

Assuming that 80 percent of the shale, 60 percent of the till, and 40 percent of the remaining material, by weight, is silt and clay and that fraction is carried into the lake, 4.4×10^8 pounds of sediment accumulating in the lake was derived from erosion of the shores.

Because the bulk of shoreline erosion has occurred below Keys Bridge, the main computer programs were modified so this area could be studied in detail (Table 1). Other modifications were also made so selected categories could be studied.

Projected erosion

Kondratjev (1966) reported that the equation

$$x = ay^2 + \frac{1}{m_n} y,$$

where

$$a = \frac{m_n - m_o}{20\ m_n m_o},$$

approximates the form of a stable-shelf profile. A shelf with this profile will cause the energy of incoming waves to be expended in internal turbulence. Kondratjev (1966, p. 805) reported "m_n and m_o are emperical parameters expressing the slope of the shelf on the water edge (m_n) and on a definite depth (m_o) and depending on the fractional composition of the eroded above water slope".

A modification of this concept yields the linear equation $Y = -X \cdot \tan B$, where B is the wave-response slope (Figure 2). Wave-response slope is emperical and was measured for different bank materials along the shores of Lake Ashtabula. Three other equations (Figure 2) were generated to describe the repose face of the wave-built terrace, the stable-bank slope behind the strandline, and the slope of the valley wall.

TABLE 1

ANALYSIS OF BANK EROSION BELOW KEYS BRIDGE[a]

Condition	Number of Stations	Erosion Sum (Ft^{3}X10^2)	Mean (Ft^3/Ft)	Standard Deviation (Ft^3/Ft)
Orientation class 1[b]	344	15000	43	47
Orientation class 2	229	6700	29	35
Orientation class 3	31	1200	39	31
Orientation class 4	82	1700	21	24
Orientation class 5	199	4900	25	26
Orientation class 6	415	13000	32	38
Orientation class 7	44	1500	33	32
Orientation class 8	69	4000	59	100
Orientation class 9	141	8000	58	63
No groundwater evidence	1332	44000	33	41
Groundwater evidence	222	12000	54	67
Native land	209	6600	32	40
Cabin and recreation areas	283	7500	27	26
Cattle have access to shore	1062	42000	40	51
Gravel alluvium banks	222	4300	20	20
Slope angles of gravel banks	222	2300[c]	10[c]	4[c]
Gravel banks, no groundwater	200	3900	20	20
Gravel banks with groundwater	22	400	19	23
Shale banks	357	25000	69	73
Slope angles of shale banks	357	5900[c]	17[c]	8[c]
Shale banks, no groundwater	257	17000	65	66
Shale banks with groundwater	100	8000	80	88
Till banks	975	27000	28	29
Slope angles of till banks	975	12000[c]	13[c]	3[c]
Till banks, no groundwater	875	24000	27	29
Till banks with groundwater	100	3600	36	31

[a] The number of stations used in this analysis is 1554.

[b] Appendix D contains a description of all classes.

[c] These values are in degrees.

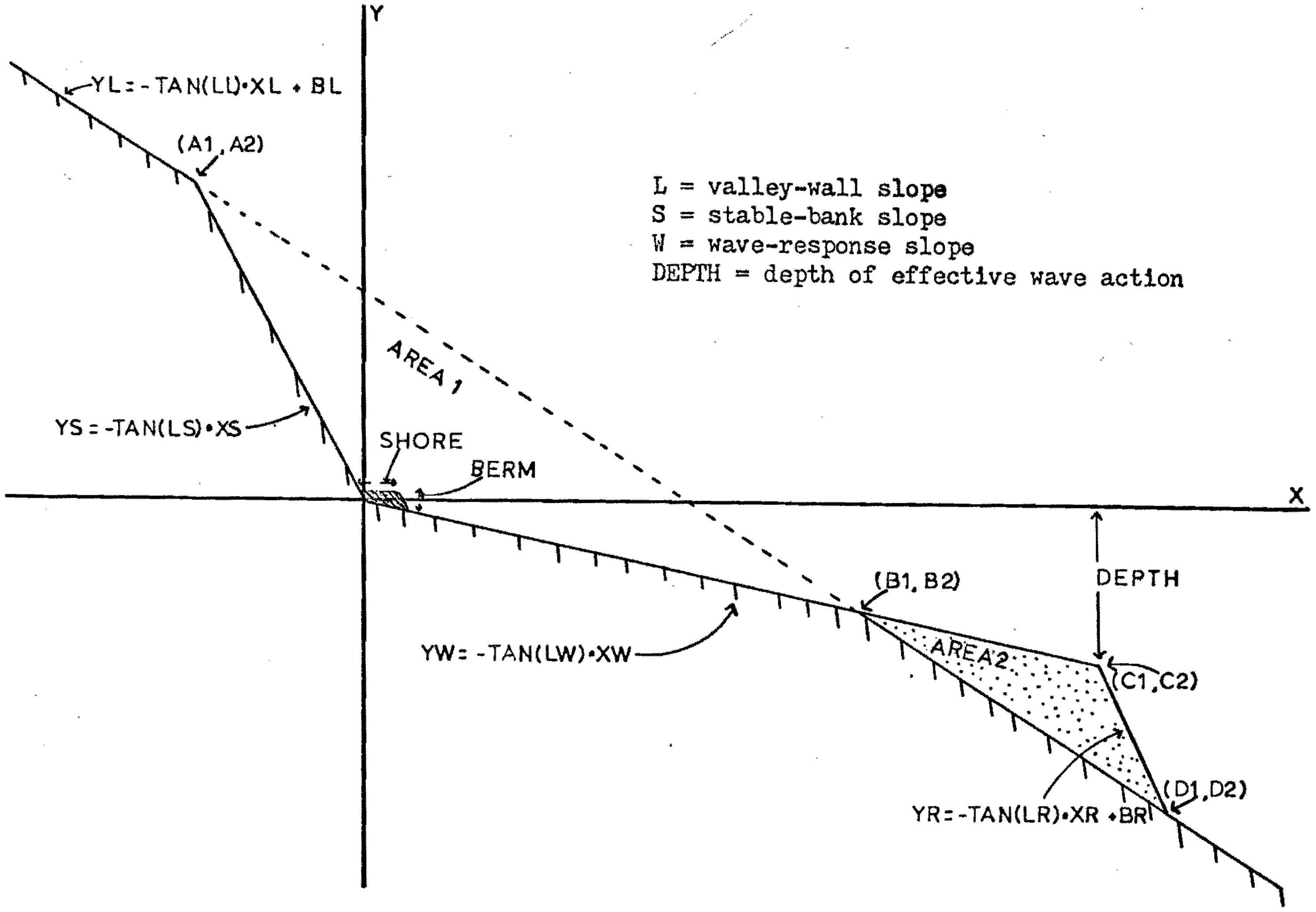

Figure 2.--Graph of stable shelf concept

AREA2 (Figure 2) is composed of sand-sized or larger particles derived from AREA1. AREAB is the area of the accumulated beach sediment. The equation

$$AREA2 = AREA1 \cdot PERCENT - AREAB,$$

where PERCENT is the amount of sand-sized or larger particles in AREA1, must be satisfied when the stable-shelf profile is attained.

At point C1, C2 (Figure 2) incoming waves start acting on the bottom. Maximum wave lengths on Lake Ashtabula are 12 to 14 feet. Assuming that wave base is 1/2 wavelength, a depth of -6.5 feet was used for C2. This value is supported by field observations of large waves that were observed to slow down and steepen just outside the submergent vegetation band (maximum depth of 6.5 feet).

Computer program 4 (Appendix C) was written to find simultaneous solutions of all equations and conditions for values of the valley-wall slope from 4 to 29 degrees. A stable-bank slope of 35 degrees was assumed for all calculations. Tables 2, 3, and 4 list calculated bank heights and projected erosion amounts for shale, till, and gravel banks.

The concept of the stable-shelf profile is useful for making percentage-of-development studies. Table 10 (Appendix D) lists the percentage development of erosion at each station using the projected erosion under stable-shelf conditions for a final erosion amount. Calculations of the percentage of development for 1500 shore stations below Keys Bridge yields a range of means from 3.3 to 9.0 percent, with a combined mean of 5.4 percent. Because the calculation of shore erosion between 1950 and 1970 represents a minimum, the state of development of banks along Lake Ashtabula is slightly greater or about 6 percent. The selective attacking of headlands by erosional agencies is shown by the greater percentage development of headlands (Table 10).

TABLE 2

PROJECTED BANK EROSION OF SHALE BANKS WITH 20 PERCENT SAND SIZED OR LARGER PARTICLES AND WAVE-RESPONSE ANGLE OF 2 DEGREES

Valley-wall Slope in Degrees	Projected Amount Eroded Ft^3/Ft of Shoreline	Bank Height in Feet
4	314	5.0
5	472	7.6
6	646	10.4
7	836	13.4
8	1040	16.6
9	1230	19.9
10	1490	23.5
11	1720	27.3
12	1970	31.3
13	2260	35.7
14	2570	40.5
15	2910	45.6
16	3270	51.1
17	3680	57.2
18	4120	63.8
19	4630	71.2
20	5190	79.3
21	5820	88.4
22	6556	98.7
23	7400	110.3
24	8400	123.8
25	9590	139.4
26	11000	157.9
27	12900	180.4
28	15400	208.7
29	19100	246.7

TABLE 3

PROJECTED BANK EROSION OF TILL BANKS WITH 45 PERCENT SAND SIZED OR LARGER PARTICLES AND WAVE-RESPONSE ANGLE OF 3 DEGREES

Valley-wall Slope in Degrees	Projected Amount Eroded Ft^3/Ft of Shoreline	Bank Height in Feet
4	53	1.5
5	104	3.0
6	165	4.7
7	222	6.4
8	289	8.3
9	358	10.3
10	436	12.5
11	516	14.8
12	609	17.4
13	709	20.2
14	819	23.3
15	942	26.7
16	1080	30.4
17	1220	34.5
18	1400	39.2
19	1600	44.5
20	1830	50.6
21	2080	57.5
22	2400	65.7
23	2780	75.4
24	3250	87.1
25	3850	101.6
26	4640	120.0
27	5730	144.2
28	7370	178.1
29	10200	230.6

The stable-shelf profile will never be attained. The rates of erosion decrease with time as stable conditions are approached. Conditioning factors will increasingly dominate; factors such as heavy vegetation growths can be expected to be the controlling factor.

TABLE 4

PROJECTED BANK EROSION OF GRAVEL BANKS WITH 60 PERCENT SAND SIZED OR LARGER PARTICLES AND WAVE-RESPONSE ANGLE OF 3 DEGREES

Valley-wall Slope in Degrees	Projected Amount Eroded Ft^3/Ft of Shoreline	Bank Height in Feet
4	47	1.4
5	97	2.9
6	144	4.4
7	202	6.1
8	255	7.8
9	318	9.7
10	389	11.8
11	461	14.0
12	541	16.4
13	627	19.0
14	730	22.0
15	839	25.2
16	960	28.7
17	1090	32.6
18	1250	37.0
19	1430	42.1
20	1610	47.8
21	1870	54.4
22	2150	62.2
23	2500	71.5
24	2930	82.7
25	3480	96.5
26	4210	114.2
27	5220	137.7
28	6770	170.7
29	9520	222.7

Erosional Processes

Slumping

Terzaghi (1950, p. 91) lists a variety of means by which groundwater can help trigger slumping. These are (1) an increase in pore-water pressure decreasing the shearing resistance of the material, (2) the dissolution of a cement binder by groundwater, (3) the elimination of surface tension by the replacement of air in the voids with groundwater, and (4) the addition of groundwater, which increases the unit weight of the material.

Most slumps along the shorelines of Lake Ashtabula appear to be triggered by groundwater activity. Saturated bank material and flowing springs are common around slump blocks. A few slumps have become saturated to the point of flowing. Most slump movement was noticed during and immediately after heavy thunderstorm activity.

Fractures in the Pierre Formation provide excellent conduits by which thunderstorm runoff can enter the ground. This water, when trapped by the closing of fractures at depth, can build up large hydrostatic pressures, reducing the shearing resistance between blocks. Once movement of the slump block occurs, additional fractures develop and the process is enhanced.

The swelling action of montmorillonitic clays in shoreline bank material helps develop fractures which lead to slumping. In the SW 1/4 section 16, T. 142 N., R. 58 W., a cow trail provided a catchment for thunderstorm runoff. The clays in the trail swelled with the addition of water and maintained this state while the surrounding surface dried. With the drying of the pooled water the clays contracted and large desiccation cracks developed parallel to and in the cow trail. Each additional rainfall resulted in an increase in the size and depth of the cracks until at the present time a large slump block is intermittently moving downslope. The slump scarp is at the position of the old cow trail.

Block separation

The swelling action of the montmorillonitic clays in bank sediment along some parts of the shoreline causes the separation of blocks 2 to 5 inches thick, resulting in vertical banks. This process operates in areas of little or no groundwater activity.

Repeated wetting and drying of the exposed bank is required. Wave action and rainfall are the main sources of water wetting the banks. The swelling action of the wetted clays lifts the face of the bank upward and outward. This expansion of a block a few inches thick generates a stress that is relieved along small fractures between the wetted zone and the deeper dry zone. With cessation of wave action or rainfall the surface of the bank drys. Much like a bi-metallic thermometer strip, differential contraction due to surface desiccation results in a slight rotation lakeward of the block, opening the previously formed fractures. The drying and contraction of the deeper zones does not return the block to its original position. The opening fracture provides a catchment for rainwater runoff, and hydrostatic pressures may develop causing additional horizontal movements. The block eventually falls into the lake and the next block starts to form.

The banks on the east side of the lake on the section line separating sections 9 and 16, T. 142 N., R. 58 W., have well developed block separation.

Frost weathering

Frost weathering during early spring causes rapid disintegration of south-facing erosional banks. Talus piles composed of frost-weathered granules were found to have formed in a few weeks on the face of a shale bank (Figure 3). The granules composed of fine-grained bank sediment were angular and dry. Wave action, with rising pool level and melting of the ice cover, reworked the talus into beach deposits. The granules then disintegrated and their fine-grained portions were transported into the lake and incorporated into bottom sediment.

Organic activity

The role of animals and plants in bank erosion is difficult to assess. However, their great abundance suggests that their accumulative effects make their role important. Burrowing bank swallows have dug thousands of nests in some shoreline banks. Three or more burrows in a square foot of bank surface are common. These birds also peck out shale fragments to reach spiders and insects hiding in cracks thereby breaking down shoreline banks.

The effects of cattle were studied in detail. Greater amounts of erosion are found, all other conditioning factors considered, along shorelines where cattle have access (40 cubic feet per foot of shoreline, mean) than where access is restricted (30 cubic feet per foot of shoreline, mean) (Table 10).

Ice push

The positions of partially submerged boulders in test areas along the shores were mapped during the fall of 1969. The test sites were reoccupied the following spring. No movement of boulders during the winter was found. The lack of movement may be attributed to the lowering of the pool elevation from 1266 feet to 1262.5 feet during the winter months which fractures the ice cover. Stress built up by thermal expansion of the ice cover is dissipated along

Figure 3.--Talus slopes along shale banks

these fractures. The width and length of the lake requires that stress be transmitted long distances if it is to reach the shore. Because fractures and pressure ridges usually absorb these stresses before they are transmitted any distance there is little ice action on the shoreline.

Collapse by undercutting

Selective erosion has resulted in the development of overhanging banks. Most overhanging banks are limited to areas of restricted access because livestock, when present, destroy binding vegetation and break off the overhangs.

A thick, heavily rooted soil is resistant to erosional processes. Erosion of less protected underlying material proceeds more rapidly than the soil causing overhangs to develop. This undercutting proceeds until the overlying vegetation mat breaks of its own weight and collapses into the lake. Overhangs also develop as erosion progresses and shoreline banks become higher. Wave action, groundwater sapping, and other erosive processes are then concentrated at the bases of the banks. This unequal erosion results in undercutting, with subsequent collapse of overhanging bank material.

Conditioning Factors

General discussion

The rate at which erosional processes proceed is determined by the conditioning factors. Conditioning factors determine how much erosional energy is available and how effective this energy is in erosional work. The large number of conditioning factors and their almost infinite interrelationships made it impossible to obtain strong statistical evidence for the role of a given conditioning factor. Means, medians, standard deviations, correlation coefficients, regression coefficients, and beta values were calculated for groups determined by the conditioning factors. These values indicate but do not conclusively demonstrate the role of each conditioning factor.

Fetch

Little correlation between fetch and bank erosion was found (Table 10). One feature that appears to reduce the effect of fetch is the presence of the trough in which the lake lies. This trough tends to funnel winds parallel to the long axis of the lake. Waves generated by these winds move nearly parallel to the long axis and continue to build until an abrupt change in direction is encountered.

Orientation

Strong northery winds funneled by the trough in which the lake lies are common during the fall season (Baldhill Dam weather records). These winds blow onto shores which are predominantly shale. At this time the dying band of submergent vegetation is much less effective in absorbing wave energy. As a result the greatest amounts of erosion are found on beaches exposed to these winds (orientation classes 1, 8, and 9, Table 1).

A greater development of boulder armor is found on the eastern shores of the lake. This feature, although not well quantified, probably accounts for the low erosion rates of beaches on the eastern side of the lake (orientation classes 4 and 5, Table 1).

Depth of water

Development of waves is hindered in the northern areas of the lake by friction of the wave base with the bottom. The shallow bottom causes waves to oversteepen and lose a large part of their energy in internal turbulence before they reach the shore. The southern shorelines of the lake have waves of greater energy acting on them. Because of the depth of the lake, little energy is lost in bottom friction before reaching the shore. There is a pronounced decrease in shoreline erosion from the south end to the north end of the lake (Table 10, Appendix D). Mean erosion values (1950 to 1970) for till and shale range from 30 to 90 cubic feet per foot of shoreline in the southern parts of the lake to about 9 cubic feet per foot of shoreline in the northern parts of the lake.

Valley-wall slope angle

The correlation coefficient, when comparing the valley-wall slope angle and the present bank erosion below Keys Bridge, is 0.23, with a z value of 9.08. The valley-wall slope angle was used in the calculation of the bank erosion at each station, therefore a stronger correlation would be expected. The low correlation indicates that other conditioning factors play a greater role in bank erosion at the present time.

Closeness of river channel to shoreline

A number of conditions develop when the pre-lake river channel is near the present shoreline. The wall of the channel may collapse, removing support for bank material, and causing subsequent slumps to develop. This appears to be happening along the west side of the lake just south of Keys Bridge, where the channel is 50 feet from the present shoreline. Profiling of the lake bottom, using a depth recorder, shows the pre-lake river channel has no well defined channel banks, probably because of collapse. The pre-lake river channel also serves as a conduit to carry turbid water out of the area. A high gradient between the shoreline and the channel enhances transportation of sediment to the pre-lake river channel. Less sediment is then left to build stable beaches.

Composition of bank material

Till with a much larger proportion of sand-sized or larger particles has a much lower erosion rate than the shale that is mainly silt and clay. To develop wave-resistant beaches, sand-sized or larger particles are required. Till and shale shorelines washed by waves of similar energy are found in the southern part of Lake Ashtabula.

In section 27, T. 142 N., R. 58 W., 30 to 40 cubic feet of till per foot of shoreline has been eroded since 1950 (Table 10, Appendix D). In section 21, T. 142 N., R. 58 W., 100 to 200 cubic feet of shale (Figure 4) per foot of shoreline has been eroded since 1950 (Table 10, Appendix D). Downstream from Keys Bridge a mean of 65 cubic feet of shale per foot of shoreline has been eroded since 1950, whereas a mean of 28 cubic feet of till per foot of shoreline has been eroded since 1950 (Table 1).

Groundwater

Groundwater plays a distinct role in bank erosion along Lake Ashtabula. Rapid recharge along fractures during thunderstorms, with resultant pore-water pressure increase, triggers most of the

Figure 4.--Eroded shale banks, since 1950

intermittent slump movements. Mean erosion for banks with no groundwater discharge was 33 cubic feet per foot of shoreline since 1950, whereas mean erosion for banks with groundwater discharge was 54 cubic feet per foot of shoreline (Table 1).

Shoreline use

About 73 percent of the shoreline is used as pasture, 15 percent is used for public recreation, and the remaining 12 percent is used for wildlife refuges and hayland (Table 10, Appendix D). The effects of grazing by livestock are especially conspicuous. In the large bay on the west side of the lake 1/2 mile south of the Baldhill Creek junction is a fence between section 8 and 9, T. 142 N., R. 58 W. Cattle have access to the shore in section 8 but not in section 9. As can be seen in figure 5, the difference in vegetation development is pronounced.

Two alluvial fans on the east side of the lake, one 1 1/2 miles south of Keys Bridge and the other 1 mile north of Ashtabula Bridge, show the comparitive effects of cattle. The first, with no livestock access, is heavily vegetated and has well developed beaches. The second, with cattle access, has erosional banks along the northwest edge. The pre-lake river channel is close to the southwest edge of this bank (Figure 20, Appendix A), but little erosion is found along this shore. The short fetch for waves impinging on this southwest edge is probably the reason for the low erosion amounts.

On a trip covering nearly the entire length of the reservoir, on a hot day in July 1970, about 2,000 cattle were seen at the water's edge or standing in the lake. They produce as much

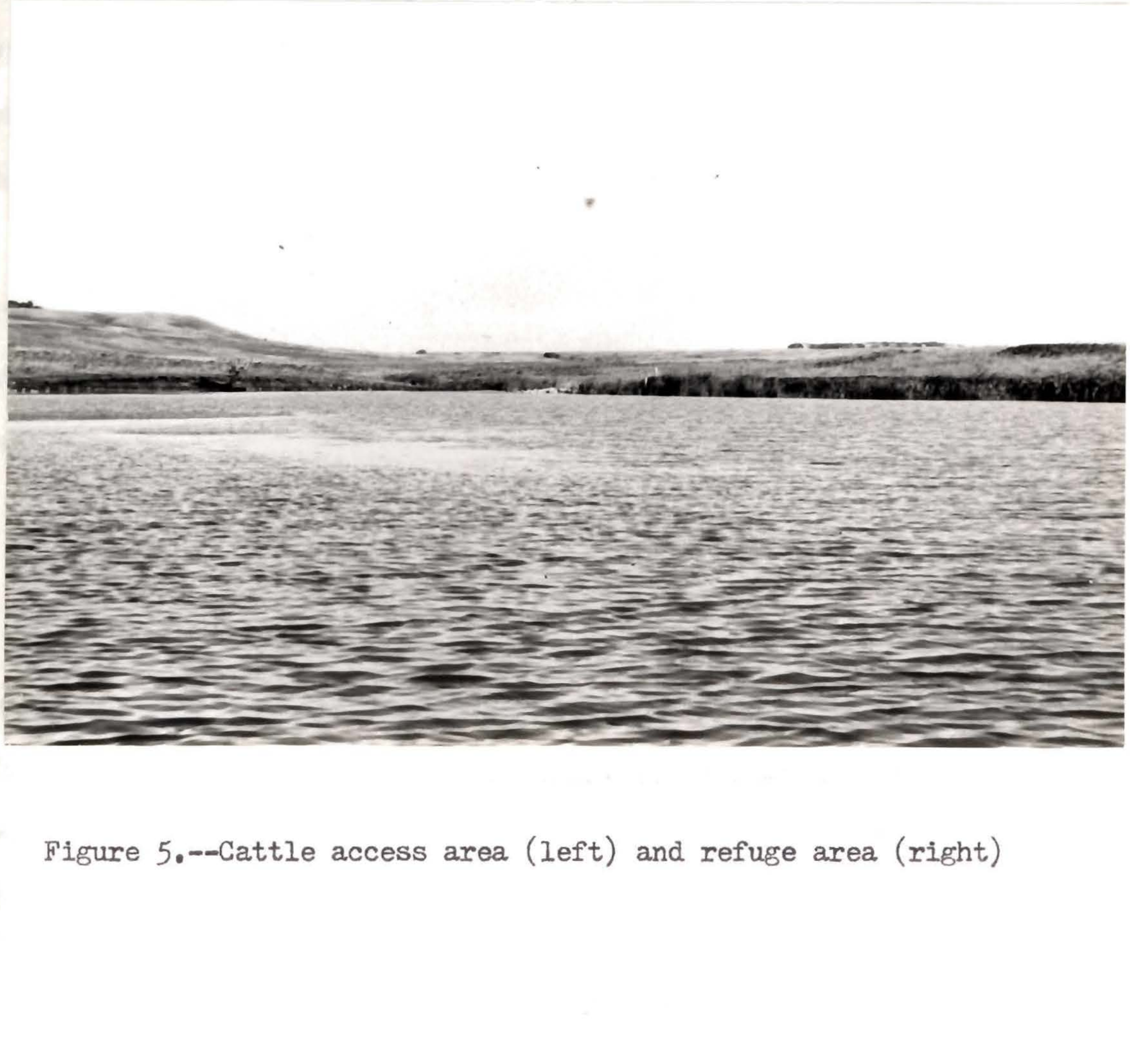

Figure 5.--Cattle access area (left) and refuge area (right)

waste as about 15,000 to 25,000 people, if weight alone is used as a comparison factor. One can imagine the outcry if a city of this size was allowed to dump untreated sewage into the lake.

Riprap has been placed around many of the public recreational areas. These shores are well protected and little additional erosion is expected. Many of the owners of private cabins have also ripraped the shores by their cabins. Because most cabins are deliberately built along shores with low slope angles and low banks, average erosion is less, as would be expected, when compared to the lake as a whole.

The beaches of the refuge and hayland areas are somewhat stabilized by plant growth and beach development. Along these stretches the beaches are compact and clean. Aquatic plants grow behind bay beaches and on headlands.

Effect of Shoreline Erosion on Reservoir Design

Erosion of the shoreline increases the volume of the reservoir at pool elevations above 1,260 feet (wave base). All sediment that accumulates in the reservoir below 1,238 feet is replacing dead storage. This storage is unavailable for any use because the maximum drawdown capabilities of Baldhill Dam is 1,238 feet.

Reduction of Bank Erosion Rates

A number of steps may be taken to reduce erosion rates. One method would utilize natural plant succession. Livestock trample the vegetation while they are drinking water from the lake; allowing livestock access to the lake only on selected bay areas would allow the growth of natural vegetation along the other segments of the shoreline. This limited access would cause little hardship to the farmers. Because of the aesthetic and pollution effects of cattle, a better choice is to fence the livestock off from the lake and pump drinking water up to them or to develop some of the springs along the shore.

With increased shoreline vegetation and the development of additional access roads, private citizens would be encouraged to build cabins along the shores. In the past, cabin owners have shown great initiative in stabilizing the shorelines, and this initiative could be encouraged in the future.

The conspicuous band of submergent vegetation surrounding the lake should not be removed except in limited areas. This band in full development absorbs up to 75 percent of the energy of incoming waves.

The critical areas of bank erosion are easily identified. They are the large shale banks with little or no till mantle. Reduction of erosion rates there will require extensive riprapping. Field boulders could be used for this riprapping.

SEDIMENT SOURCES OTHER THAN SHORELINES

Sheyenne River

Flow

The Sheyenne River discharges an average of 100 cubic feet of water a second into Lake Ashtabula (U. S. Geol. Survey, 1969). Discharges greater than 1,000 cubic feet per second commonly occur during spring melt. An extreme of 7,830 cubic feet per second was recorded on 17 April, 1950. Flow gradually decreases during the summer and fall, when discharges of 5 to 20 cubic feet per second are common. Flow does not increase again until the following spring.

Sediment traps

A 10-foot-high dam on the Sheyenne River is located in the NW 1/4 section 26, T. 146 N., R. 58 W., about 1/4 mile south of North Dakota State Highway 7. This dam may trap some coarser sediment but is not believed to be an important sediment trap.

Transported sediment

Suspended sediment is moved in varying amounts during the ice-free season. Suspended sediment in the Sheyenne River below Highway 7 on 24 March, 1970, ranged from 20 to 50 parts per million. By 11 April suspended sediment ranged from 140 to 150 parts per million. During this time the flow of the Sheyenne River increased from 5 cubic feet per second to 750 cubic feet per second (U. S. Geol. Survey, provisional data, personal communication). No suspended sediment was found during August of 1970 in the Sheyenne River immediately upstream from Lake Ashtabula. The brownish coloration of the river water is probably due to microscopic organisms. A more complete evaluation of total sediment transported into Lake Ashtabula by the Sheyenne River will require detailed measurement of suspended sediment over a number of years, particularly during spring melt.

The bedload transported by the Sheyenne River moves during spring melt. There is little downcutting of the river channel and the bulk of the transported sediment comes from channel banks and from small tributaries. The bedload probably is a small fraction of the total sediment transported.

The dominant minerals in the Sheyenne River sediment are quartz (40 percent), cristobalite (30 to 40 percent), and the clay minerals (40 percent), illite, montmorillonite, and chlorite.

Baldhill Creek

Flow

The Baldhill Creek discharges into Lake Ashtabula an average of 14 cubic feet of water per second (U. S. Geol. Survey, 1969). Discharges greater than 50 cubic feet per second commonly occur during spring melt. An extreme of 2,510 cubic feet per second was recorded on 11 April, 1969. Flow gradually decreases during the summer and fall, when discharges of 2 to 7 cubic feet per second are common.

Sediment traps

Two 10-foot-high dams (Figure 1), one located in the SE 1/4 section 36, T. 143 N., R. 59 W. and the other in the SW 1/4 section 19, T. 143 N., R. 59 W., form small reservoirs on the Baldhill Creek. These dams were originally built during the 1930's. The second dam has since undergone some repair. Their role as sediment traps is unknown but coarse bedload is probably trapped.

Transported sediment

Suspended sediment ranged from 20 to 30 parts per million in Baldhill Creek on 11 April, 1970, when the flow was estimated to be less than 20 cubic feet per second. As in the Sheyenne River, a more complete evaluation of total sediment transported into Lake Ashtabula by Baldhill Creek will require suspended sediment measurements over a number of years.

Quartz, feldspar, clay minerals, dolomite, and cristobalite are the dominant minerals transported by the Baldhill Creek. The main particle sizes transported are sand and silt.

Ephemeral Streams

Flow

Many small ephemeral streams empty into Lake Ashtabula during spring melt and during heavy thunderstorms. Discharges may be high during these periods, and considerable sediment from gully erosion is transported into Lake Ashtabula.

Transported sediment

After a 2-inch rainfall in June of 1970, a suspended-sediment concentration of 80 parts per million was found in the ephemeral stream whose junction with Lake Ashtabula is located in the NE 1/4 section 6, T. 141 N., R. 58 W. The temperature of this stream water was 25 degrees centigrade. The surface of the lake was covered with turbid water, having a temperature of 24 degrees centigrade and a concentration of 20 parts per million suspended material. The warm water from ephemeral streams appears to have flowed without mixing over the surface of the cooler lake water. This condition persisted for at least 24 hours.

The sediment yields from small tributaries are dependent on many factors, such as land use, stage of development of crops, intensity of thunderstorm activity, amount of snow cover, and rapidity of snow melt. The amount is difficult to obtain.

TRANSPORT OF SEDIMENT WITHIN THE LAKE

Longshore Movements

The bays of Lake Ashtabula are being filled with sand and larger particles transported by longshore currents from adjacent headlands. Storm waves have built high beach berms across the mouths of some bays, which results in the formation of small lagoons (fed by groundwater discharge) behind the berms. These lagoons drain when the berm is breached by water spilling out of the lagoon. Wave action during high winds rebuilds the berm and the lagoon then refills.

Heavy thunderstorm runoff breached many bay-mouth beaches during June of 1970. The berm material was carried as much as 50 feet into the lake and built into a subaqueous, fan-shaped deposits. Because of the large amount of sediment removed, the beach berms were not rebuilt, and the lagoons remained dry for the rest of the summer.

Density Currents

Prolonged

Silt, clay, and fine sand are transported in suspension by density flows. On 11 April, 1970, water beneath Keys Bridge had two distinct layers. Water 1 to 3 feet from the bottom had a temperature of 1 degree centigrade and a suspended load of 80 parts per million. Water 4 to 6 feet from the bottom had a temperature of 2 degrees centigrade and a suspended load of 100 parts per million. The boundary between the two layers was very sharp with a vertical temperature change of 1 degree centigrade within a few inches. The specific electrical conductance of the lower water layer was 520 micromhos while the upper layer of water had a specific electrical conductance of 340 micromhos. The upper layer of water is believed to be Sheyenne River water flowing over the underlying lake water. Suspended material in Sheyenne River water is therefore carried at least beyond Keys Bridge, probably within the pre-lake river channel.

Water sampled at Ashtabula Bridge on the same day had no detectable suspended sediment. The temperature ranged from 0.5 degree centigrade at the bottom to 1 degree centigrade at the surface, with no sharp gradients. The lake still had an ice cover at this time.

Intermittent

Wave action during periods of high winds erodes the shore sediment, creating a zone of turbid water. This turbid water then moves into the lake by one of three possible routes.

When air temperature is higher than lake-water temperature, water along the shore is heated. This heated, less dense, turbid water then flows outward over the top of the cooler lake water. The flow is usually an inch or less in thickness. When air temperature is lower than lake-water temperature, water along the shore is cooled. This cool, more dense, turbid water then flows outward along the lake bottom. Interflows may develop under special conditions when lake-water temperature and air temperature are similar.

All three types of turbid-water flows were observed during the summers of 1969 and 1970. The bottom flows of turbid water were first detected using a Kempler water sampler. These flows were found to depths of 30 feet along the bottom during high winds. Pools of turbid water were found, while diving, in shallow depressions on the lake bottom at depths of 10 to 20 feet, several days after a strong, cool wind generated large waves in the lake.

While diving in the pre-lake Baldhill Creek channel where it enters Lake Ashtabula, a layer of turbid water was encountered with a sharp upper boundary. There was a hint of clearer water beneath the layer as evidenced by greater visibility. This judgement was very subjective, however, since light penetration was low and illumination levels were comparable to a cloudy, moonless night.

Lake Basin Currents

Method of monitoring

Four pool-level recorders were used to monitor pool-elevation changes. Two were placed along the east side of the lake in section 5, T. 141 N., R. 58 W. The other two were installed on the west side of the lake, one at the end of coring range C (Appendix A) and the other 1/4 mile south, off the large shale banks. All recorders located in 4 to 5 feet of water were designed to measure average water levels over a few minutes rather than each incoming wave.

Observations

The development of strong winds, 10 to 35 miles per hour, initially raised or lowered the pool elevation as much as 4 inches at a given station. Northerly winds raised pool elevation while southerly winds lowered pool elevation in the south part of the lake basin. Pool elevation differences between recorders seldom exceeded 0.25 inches at any given time. This indicated that water in the lake basin moved along the entire length of the basin rather than piling up on one shore or the other. With time, even under continuing wind, the pool elevation returned to pre-wind positions. This indicates some return of water by underflows.

During a short severe thunderstorm in September, 1970, the continuous depth recorder at Baldhill Dam registered a series of high pool elevations (Mel Reidman, Baldhill Dam operator, personal communication). It appeared that a seiche developed in the lake basin because of the tornadic winds that crossed the lake in section 5, T. 141 N., R. 58 W.

Man-made Currents

A distinct drop in high-speed motor pitch on a 21-foot pontoon boat was noted whenever water shallower than 11 feet was encountered. This drop in pitch meant the boat was slowing and some form of interference with the bottom was occurring.

The maxium speed of a low-powered boat is attained when the wavelength of the bow-generated wave equals the water-line length of the boat hull (Tucker, 1969). At this speed the boat is in a trough between two wave crests running at the same speed as the boat. This wave form influences the bottom to a depth of 1/2 wavelength or, for the pontoon boat, to a depth of 10.5 feet. With additional power the boat can climb out of this trough and hydroplane. A hydroplaning boat generates a bow wave with a wavelength twice the water-line hull length (Tucker, 1969). A hydroplaning 24-foot boat influences the lake bottom to depths of 24 feet.

There are many watercraft on Lake Ashtabula, and reworking of the bottom sediments by bow waves, to depths of at least 25 feet, may be expected.

Effect of Currents

Water currents carry large amounts of silt and clay into low areas on the lake bottom. Evidence for this is the average of 26 pounds per square foot of sediment in the old river channel compared to the average of 6.4 pounds per square foot of sediment on the floodplain. If pelagic sedimentation was the dominant form of sedimentation a more uniform accumulation would be expected. These flows will eventually fill the low areas and reduce the lake bottom to a planar surface like most lake bottoms.

The sawed surfaces of submerged tree stumps, in water depths of as much as 20 feet, had no sediment accumulation. Projecting boulders, cobbles, and shell fragments were clean of accumulated sediment. Scour pits were observed around many of these objects. This indicates that currents sweep the lake bottom.

ACCUMULATED SEDIMENT

Appearance of Sediment in Place

The accumulating sediment has a spongy surface covered with numerous dead organisms. Many collapse features are found; they are probably the result of differential compaction. The viscosity is similar to that of a mixture of water and montmorillonitic clays. The sediment can be torn free in blocks 3 to 5 inches on edge. These blocks can be set down (underwater) and retain their original shape. Exposure of these blocks to a hand-generated water current results in their disintegration.

In some areas the sediment-water interface in the pre-lake river channel does not reflect the signal from the depth recorder. Recovered cores show less sediment thickness than indicated by mud on the outside of the corer. No distinct water-sediment boundary was noticed while lowering the corer. A gradational transition from water to compacted sediment is believed to have developed in these areas.

Sediment Sampling

<u>Method</u>

A specially built corer, which uses a plastic golf tube as a liner, was driven through the accumulated lake sediment and into the pre-lake soil. The recovered cores were sealed in the plastic liners and transported to the laboratory for examination.

An Ekman dredge was used to collect samples in the upper reservoirs on the Baldhill Creek and in the Sheyenne River above the foot bridge located in the SW 1/4 section 30, T. 145 N., R. 57 W.

Location

Cores were taken along range lines (Figure 6) located at approximately 1-mile intervals during the summer of 1970. A continuous profile of the lake bottom along each range line was made using a Bendix Chart Depth Recorder. Identifiable features were noted on the profile, and 4 to 5 cores were taken at or near these features at intervals across the lake. The first depth of 13 to 15 feet from either shore along the range was considered an identifiable feature. In all cases the deepest part of the pre-lake river channel was cored. The position of these cores along the various lines is given in Appendix A. Additional special cores were taken at selected sites along the margin of the lake and in major tributaries (Figure 7). Special cores 24, 25, 26, and 38 were taken along a line perpendicular to shoreline banks of shale. Special cores 21, 22, and 23 were taken along a line perpendicular to shoreline banks of till. Special cores 14 and 15 were taken on the topographic high in the center of an inundated oxbow lake.

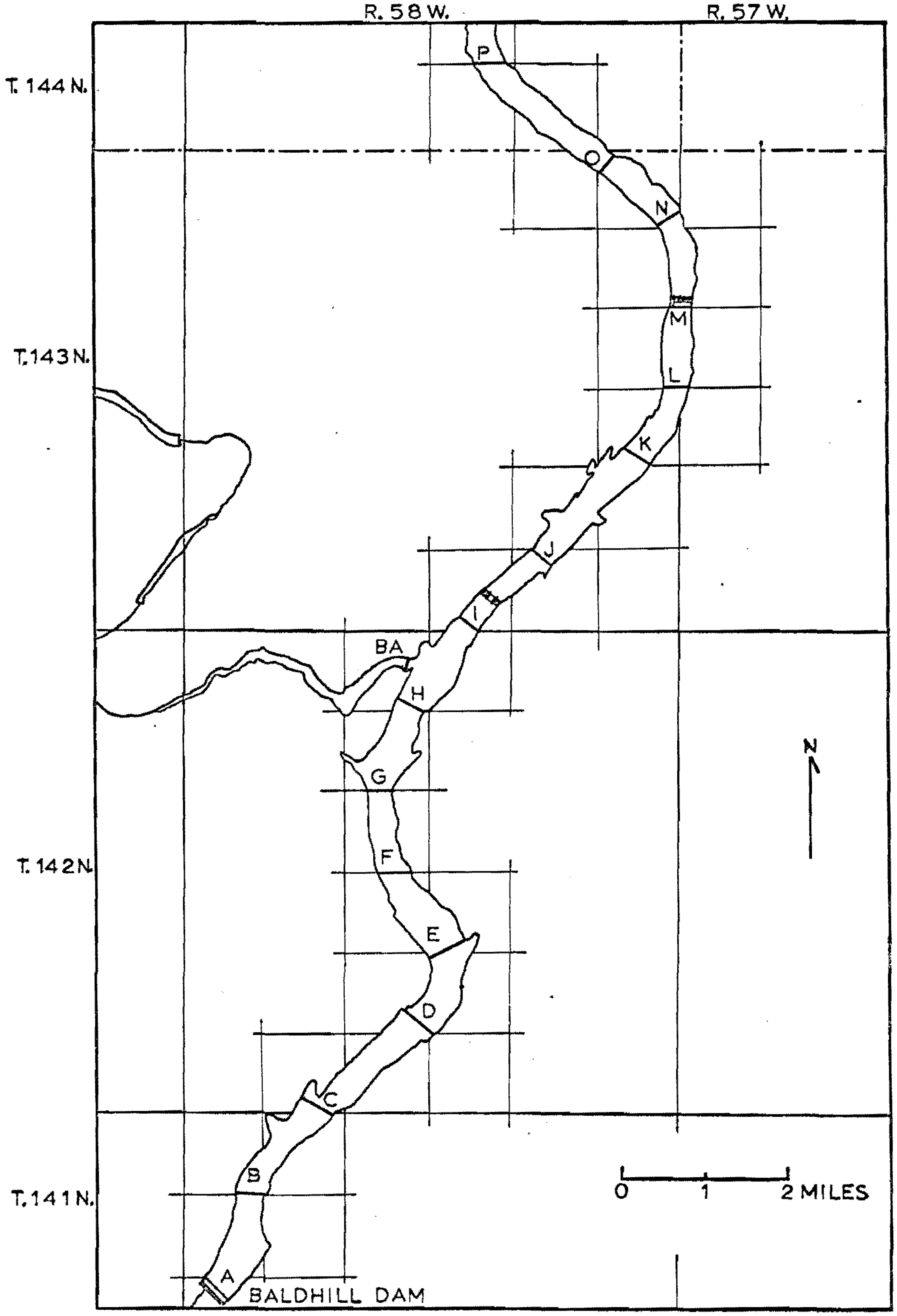

Figure 6.--Map showing location of coring ranges on Lake Ashtabula

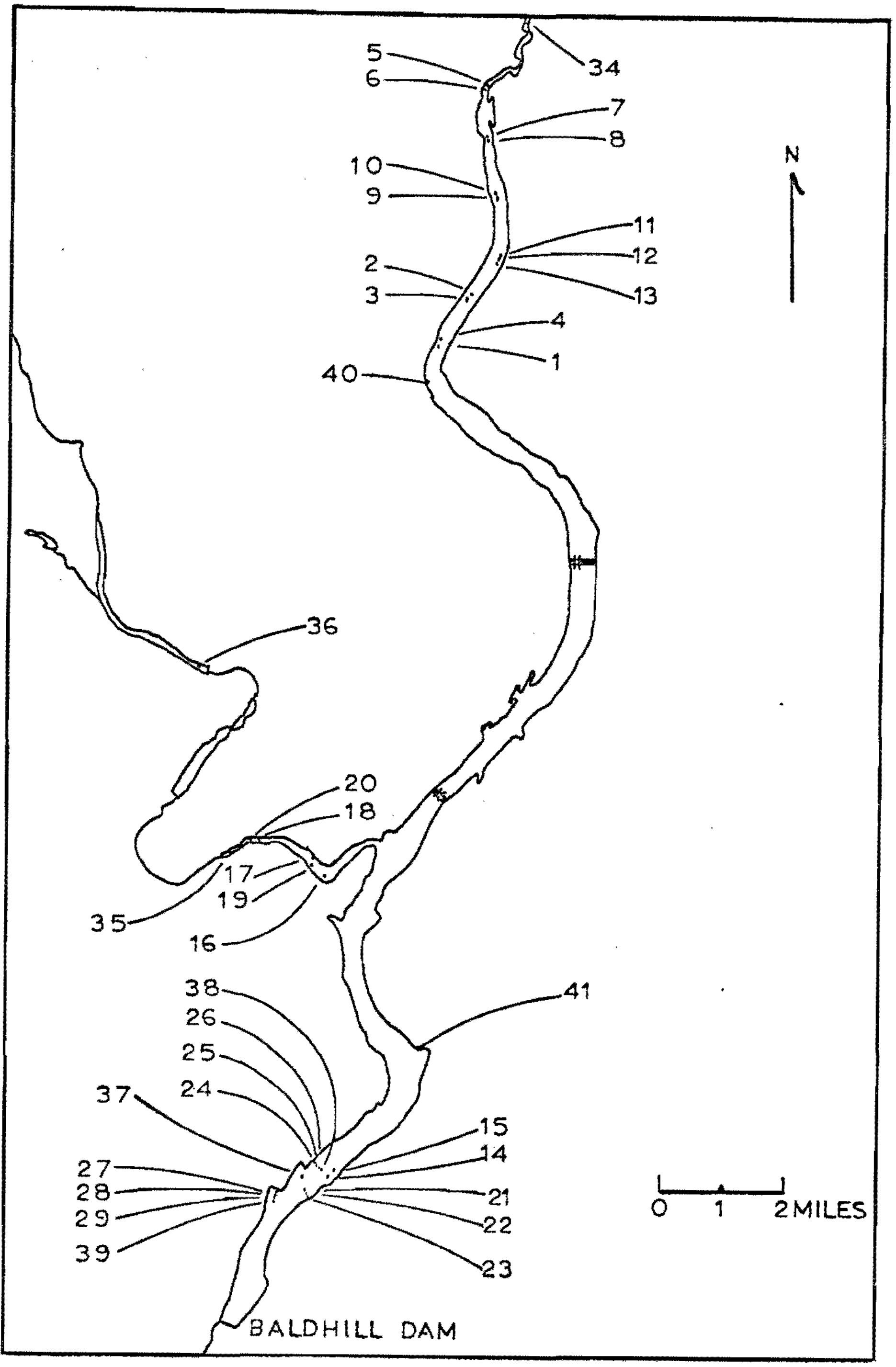

Figure 7.--Map showing location of special cores

Primary Sedimentary Structures

Shore environment

Wave action on shorelines develops zones of similar primary sedimentary structures. Pederson and Reid (1969, p. 25) divided a beach profile into zones of lagoon, backbeach, top beach, forebeach, and shallow nearshore on the basis of primary sedimentary structures. Lake Ashtabula has poorly developed beaches with no offshore bars (Figure 8). The forebeach has planar parallel bedding with dips of a few degrees toward the lake. The individual beds are well sorted with particle size dependent on the energy of waves during their deposition. A thin lag of cobbles and boulders underlies the entire beach deposit. Straight, symmetrical ripples with few bifurcations are found in 1 to 6 feet of water along the shoreline. The primary sedimentary structures found in these ripple deposits appear to be small-scale trough-shaped cross bedding.

A persistent surface crust was found in the submergent vegetation band that parallels the shoreline. The corer broke through this crust and sank 4 to 8 inches by its own weight. No sediment was recovered from this easily penetrated area because the surface crust served as a plug preventing material in this soft layer from entering. The significance of this crust is unknown.

Deep-water environment

No primary sedimentary structure was found in deep-water sediment (water depth greater than 7 feet). No other physical zoning was found. The lake has an ice cover for 5 to 6 months of the year but no evidence for varves was found. This lack of

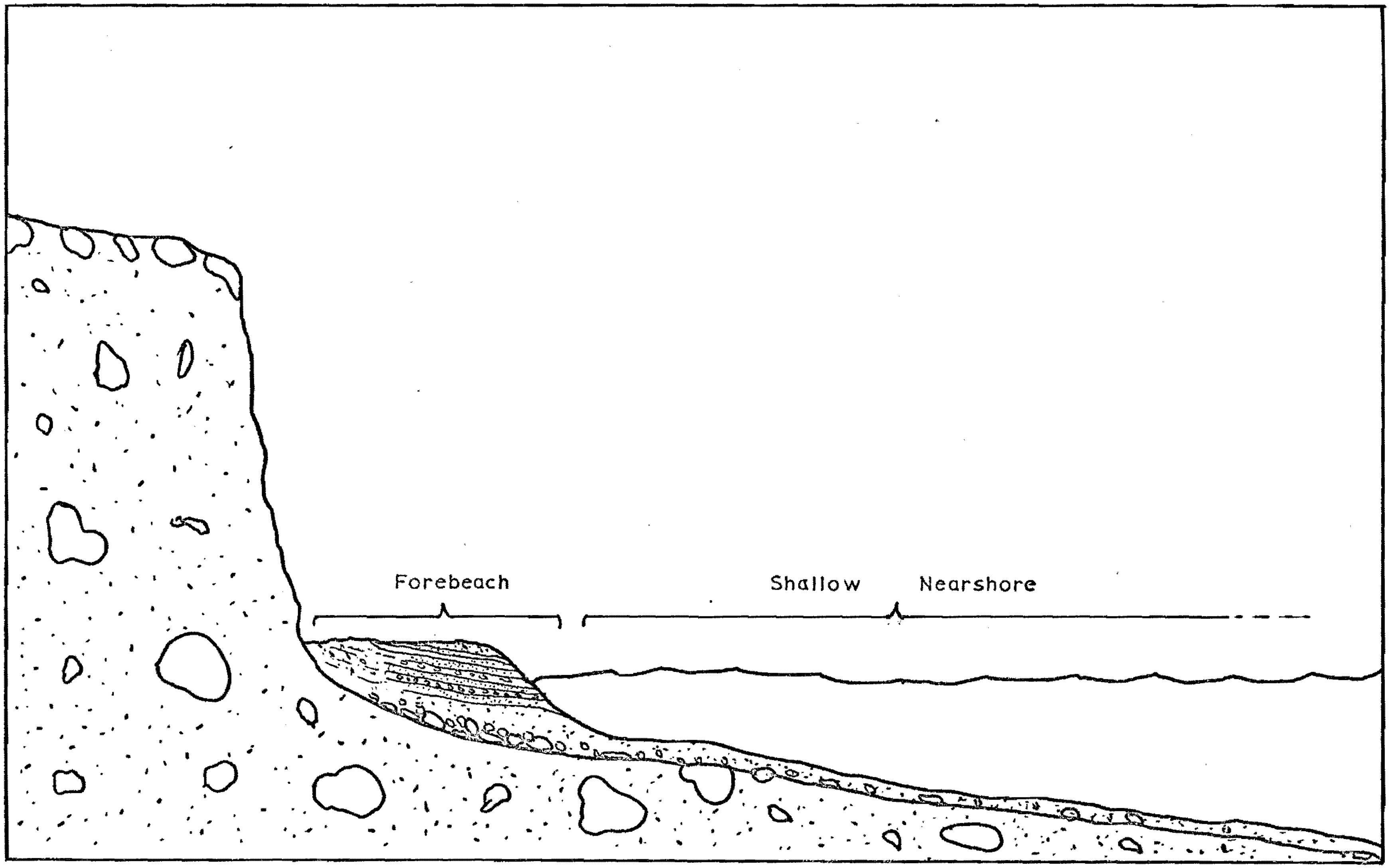

Figure 8.--Cross section through a headland beach

primary sedimentary structure may be due to the churning of bottom sediment by the larvae of water insects.

Compaction of Sediment

Compaction studies were carried out on a number of cores taken in 30 to 35 feet of water in the SE 1/4 section 32, T. 142 N., R. 58 W., during December of 1970. The recovered cores were allowed to freeze to prevent desiccation. The frozen cores were cut into 1-inch sections and the depth of each section below the sediment-water interface noted. The frozen sections were weighed and their volume measured by water displacement techniques. Each section was allowed to thaw and was air dried for several weeks. The sections were then weighed to determine the weight loss due to water evaporation. The weight per unit volume of the wet sediment and the weight-percent loss was determined for each section.

Weight percent of water for each 1-inch section was plotted against the depth of that section (Figure 9). An equation (Figure 9) was derived, using the least squares method, that describes the percentage of water in sediment with depth.

The weight of accumulated sediment for a cubic foot ranged from 70 to 78 pounds per cubic foot with a mean of 74 pounds per cubic foot. Lara and Pemberton (1963, p. 845) derived an equation for reservoirs whose sediment is always submerged:

$$\gamma = 26 \cdot p_c + 70 \cdot p_m = 97 \cdot p_s$$

where p_c, p_m, and p_s are the weight fraction of clay, silt, and sand. γ is the initial weight of accumulated sediment for a cubic

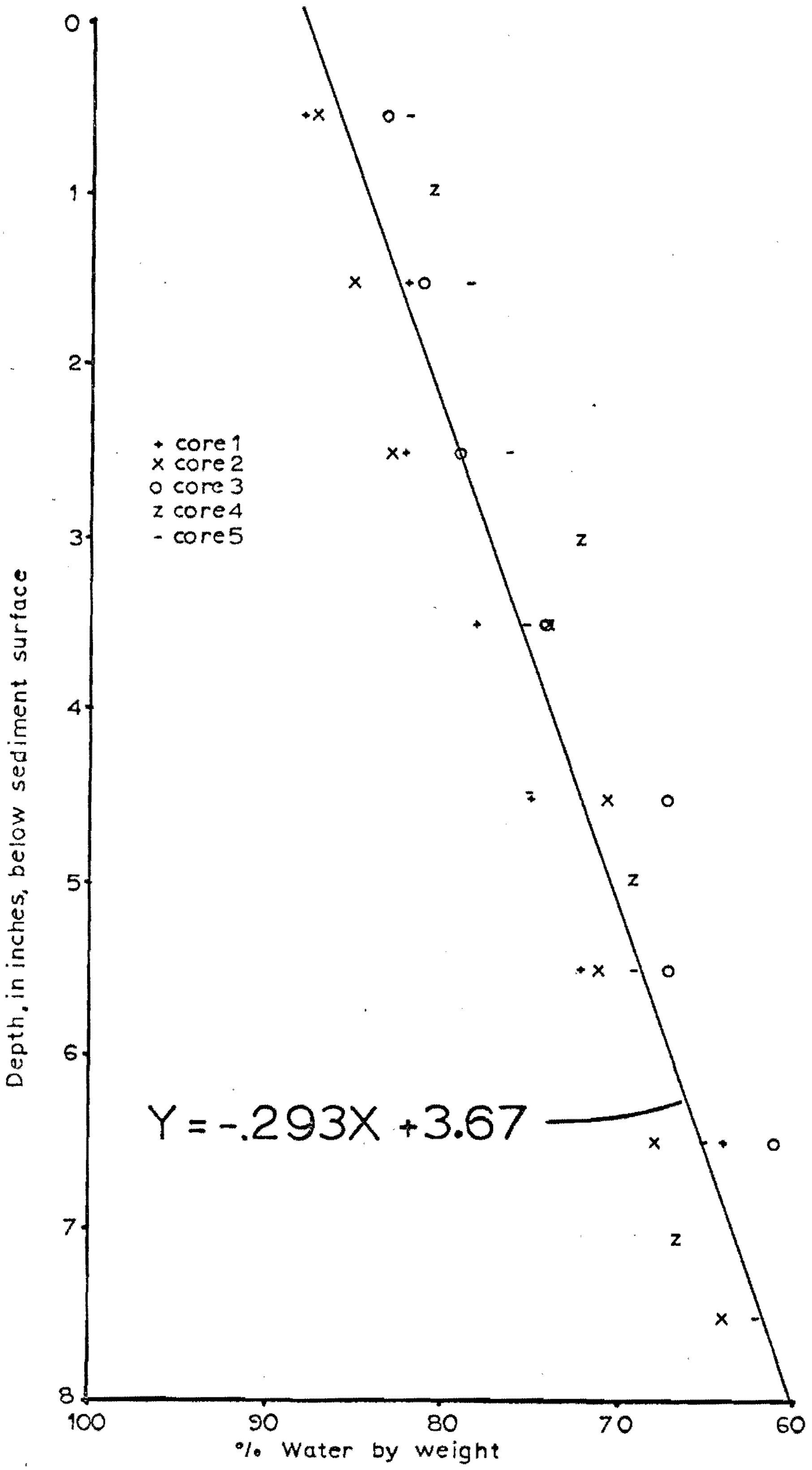

Figure 9.--Plot of compaction of lake sediment with depth

foot. Weight-percent means for sand, silt, and clay accumulating in Lake Ashtabula are 4.6, 47.0, and 47.0 with standard deviations of 4.3, 9.6, and 12. Substituting these means into Lara and Pemberton's equation gives an initial sediment weight of 60 pounds per cubic foot, which is too low because material of this weight would float. The calculated (60 pounds per cubic foot) and observed initial (70 pounds per cubic foot) sediment weights lie within one standard deviation of Lara and Pemberton's equation (1963, p. 841).

The depths of reservoirs considered in Lara and Pemberton's study are greater than Lake Ashtabula water depths. It is probable that reworking of sediment by wave action and power-boat activity has resulted in greater compaction of bottom sediment on Lake Ashtabula.

The compaction equation (Figure 9) was used with the mean initial weight of Lake Ashtabula sediment (74 pounds per cubic foot) to calculate the weight of dry sediment per square foot of bottom area for a given layer thickness (Table 5). The compaction equation (Figure 9) was used to a layer thickness of 11 inches. N. B. Vassoevich (1960, in Klubova, 1965, p. 64) found several magnitudes of greater pressure were required to compact organic-clay sediment with porosities less than 50 percent. Lack of field data and Vassoevich's findings require the assumption that compaction does not increase significantly beyond 50 percent in sediment accumulation in Lake Ashtabula.

TABLE 5

WEIGHT OF SEDIMENT PER SQUARE FOOT OF BOTTOM

Layer Thickness in Inches	Pounds	Layer Thickness In Inches	Pounds
1	0.86	11	21.0
2	2.0	12	24.0
3	3.3	13	27.0
4	4.7	14	30.0
5	6.5	15	33.0
6	8.4	16	36.0
7	11.0	17	39.0
8	13.0	18	42.0
9	16.0	19	45.0
10	18.0		

Organic Material in Sediment

Source

Lake Ashtabula has large phytoplankton blooms. The phytoplankton die and settle to the bottom and are incorporated into the accumulating sediment. Additional organic materials are added from the water discharging into the lake and from vegetation growing along the shoreline.

Amount

No significant change in oxidizable matter was found with areal location or with depth in the accumulating sediment. Oxidizable-matter content ranged between 7 and 12 percent with an average of about 10 percent. Analysis of oxidizable matter in the accumulated sediment was made using the procedure described by Royse (1970, p. 126-136).

Mineralogy of Sediment

Procedure

The core-range and Ekman-dredge samples were prepared, X-rayed, and analyzed using procedures described in Appendix B.

Minerals present

Minerals found in Lake Ashtabula sediments are dolomite, calcite, plagioclase, potassium feldspar, quartz, cristobalite, and the clay minerals (montmorillonite, chlorite, illite, kaolinite (?), and mixed-layer clays (?)). The identification of the clays was made using techniques described by Schultz (1964).

Source of minerals

Minerals found in Lake Ashtabula are derived largely from the glacial drift, shale, and organic remains; there was no evidence for diagenesis. X-ray evidence indicated no change of high magnesium calcite to low magnesium calcite and dolomite, as described by Berner (1966). No aragonite was found. No change in the characteristics of the 29.4 degree X-ray peak (calcite) for samples tested was found. This indicates a uniform source of calcite and a uniform particle size.

Distribution of minerals

Cristobalite has the greatest variation in concentration with the greatest concentration, 30 to 40 percent (Table 6), found above Keys Bridge in sediment contributed mainly by the Sheyenne River. The concentration of cristobalite decreases to 10 percent or less in the lower reservoir.

foot. Weight-percent means for sand, silt, and clay accumulating in Lake Ashtabula are 4.6, 47.0, and 47.0 with standard deviations of 4.3, 9.6, and 12. Substituting these means into Lara and Pemberton's equation gives an initial sediment weight of 60 pounds per cubic foot, which is too low because material of this weight would float. The calculated (60 pounds per cubic foot) and observed initial (70 pounds per cubic foot) sediment weights lie within one standard deviation of Lara and Pemberton's equation (1963, p. 841).

The depths of reservoirs considered in Lara and Pemberton's study are greater than Lake Ashtabula water depths. It is probable that reworking of sediment by wave action and power-boat activity has resulted in greater compaction of bottom sediment on Lake Ashtabula.

The compaction equation (Figure 9) was used with the mean initial weight of Lake Ashtabula sediment (74 pounds per cubic foot) to calculate the weight of dry sediment per square foot of bottom area for a given layer thickness (Table 5). The compaction equation (Figure 9) was used to a layer thickness of 11 inches. N. B. Vassoevich (1960, <u>in</u> Klubova, 1965, p. 64) found several magnitudes of greater pressure were required to compact organic-clay sediment with porosities less than 50 percent. Lack of field data and Vassoevich's findings require the assumption that compaction does not increase significantly beyond 50 percent in sediment accumulation in Lake Ashtabula.

TABLE 5

WEIGHT OF SEDIMENT PER SQUARE FOOT OF BOTTOM

Layer Thickness in Inches	Pounds	Layer Thickness In Inches	Pounds
1	0.86	11	21.0
2	2.0	12	24.0
3	3.3	13	27.0
4	4.7	14	30.0
5	6.5	15	33.0
6	8.4	16	36.0
7	11.0	17	39.0
8	13.0	18	42.0
9	16.0	19	45.0
10	18.0		

Organic Material in Sediment

Source

Lake Ashtabula has large phytoplankton blooms. The phytoplankton die and settle to the bottom and are incorporated into the accumulating sediment. Additional organic materials are added from the water discharging into the lake and from vegetation growing along the shoreline.

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Source of minerals

Minerals found in Lake Ashtabula are derived largely from the glacial drift, shale, and organic remains; there was no evidence for diagenesis. X-ray evidence indicated no change of high magnesium calcite to low magnesium calcite and dolomite, as described by Berner (1966). No aragonite was found. No change in the characteristics of the 29.4 degree X-ray peak (calcite) for samples tested was found. This indicates a uniform source of calcite and a uniform particle size.

Distribution of minerals

Cristobalite has the greatest variation in concentration with the greatest concentration, 30 to 40 percent (Table 6), found above Keys Bridge in sediment contributed mainly by the Sheyenne River. The concentration of cristobalite decreases to 10 percent or less in the lower reservoir.

TABLE 6

X-RAY MINERALOGICAL ANALYSES IN TENS OF PERCENT OF SELECTED CORE AND BANK SAMPLES. L REPRESENTS 5 PERCENT. ND REPRESENTS X-RAY PEAK PATTERN NOT DETECTED FOR THAT MINERAL.

Sample Location	Dolo.	Cal.	Plag.	K-feld.	Qtz.	Cris.	Clay	Oxidizable Matter[a]
Known	1	1	1	1	4	L	3	L
A-3	L	1	L	L	3	1	3	1
B-3	L	1	L	L	2	1	3	1
C-3	L	1	L	L	1	1	3	1
D-1	L	1	1	1	2	1	3	1
D-2	L	1	L	L	2	1	3	1
D-3	L	1	L	L	2	1	4	1
D-3 (4" down)	L	1	L	L	2	1	4	1
D-3 (8" down)	L	1	L	L	2	1	4	1
D-4	L	1	1	L	2	1	4	1
D-5	1	1	L	L	2	1	3	1
E-3	1	2	L	L	1	1	3	1
F-3	1	2	L	L	1	1	3	1
G-3	ND	2	L	L	1	L	5	1
H-1	L	2	L	L	2	L	4	1
H-2	L	1	L	L	1	1	4	1
H-3	L	2	L	L	1	1	4	1
H-3 (6" down)	L	1	L	L	1	1	4	1
H-3 (12" down)	ND	1	L	L	2	2	5	1
H-4	L	2	L	L	1	1	3	1
H-5	L	2	L	L	1	1	4	1
J-3	L	2	L	L	1	1	3	1
K-3	L	2	L	L	1	1	3	1
L-1	L	2	L	L	1	1	3	1
L-2	L	1	1	L	2	2	3	1
L-2 (8" down)	L	1	1	1	2	1	3	1
L-3	L	2	L	L	2	1	3	1
L-4	L	1	1	L	2	1	3	1
M-3	L	2	L	L	1	1	3	1
N-3	L	1	L	L	2	2	3	1
O-3	L	1	L	L	2	2	5	1
P-1	L	1	L	L	2	2	3	1
P-2	L	1	L	L	1	3	4	1
Sp-1	L	L	L	L	2	4	3	1
Sp-5	ND	L	L	L	2	4	3	1
Sp-8	L	L	L	L	2	4	4	1
Sp-34	L	L	L	L	1	4	4	1
BA-2	L	1	L	L	1	1	4	1
BB-1	1	1	1	1	3	1	2	1
Sp-35	L	1	1	L	4	2	2	L
Sp-36	L	1	L	L	2	2	3	1

TABLE 6--Continued

Sample Location	Dolo.	Cal.	Plag.	K-feld.	Qtz.	Cris.	Clay	Oxidizable Matter[a]
Sp-27	L	2	L	L	1	1	2	1
Sp-28	L	1	1	5	3	ND	2	L
Sp-29	L	1	1	L	3	1	3	L
Sp-21	1	1	1	1	5	L	1	L
Sp-22	1	1	1	1	5	L	1	L
Sp-23	L	L	1	2	6	ND	1	L
Sp-24	1	1	1	1	5	ND	1	L
Sp-25	L	1	1	L	3	1	2	L
Sp-26	L	1	L	L	2	ND	1	L
Sp-37	L	1	L	L	1	L	3	1
Sp-38	L	1	1	L	2	1	3	1
Sp-14	L	1	L	L	1	1	4	1
Sp-39	L	1	L	L	2	1	3	1
Sp-40	1	1	1	1	3	1	2	L
Sp-41	L	L	2	2	6	L	1	L
Sp-42	ND	8	ND	ND	1	L	2	L

[a] Analyzed using procedure described by Royse (1970, p. 127-135).

Clay minerals are most abundant (30 to 50 percent, Table 6) in the deeper areas of the lake, particularly in the pre-lake river channel.

Dolomite, feldspar, and quartz are most abundant along the shores of the lake and along Baldhill Creek (Table 6).

Calcite is the only mineral that varies in concentration with vertical position in the accumulating sediment layer. The slight change is detected in the 19.4 degree peak height. Cores taken at locations D-3, H-3, and L-2 all show decreasing peak height with depth in the sediment layer (Table 7). Two possible explanations for this change are (1) more shale is being exposed by shoreline erosion increasing the amount of available detrital calcite and (2) increasingly heavier phytoplanktonic blooms are precipitating larger amounts of calcite. No distinction of calcite from these two sources could be made.

TABLE 7

DIFFRACTED X-RAY INTENSITY OF SELECTED SAMPLES

Sample Location	X-ray Peak Heights in Counts Per Second X 10^3						
	Dolo. (31.0°)	Cal. (29.4°)	Plag. (28.0°)	K-feld. (27.5°)	Qtz. (26.6°)	Cris. (21.8°)	Clay (19.9°)
Known	38	46	18	12	225	1	3
A-3	8	19	9	5	73	2	6
B-3	5	18	9	4	77	3	6
C-3	2	16	6	4	64	2	5
D-1	5	30	25	21	81	4	6
D-2	11	22	11	9	83	3	5
D-3	5	33	5	4	82	2	8
D-3 (4" down)	8	31	8	8	76	3	7
D-3 (8" down)	8	20	13	8	98	3	8
D-4	10	18	21	10	110	2	7
D-5	15	26	14	7	102	3	7
E-3	3	48	5	4	52	2	6
F-3	2	45	5	4	55	3	6
G-3	ND[a]	48	6	4	61	1	9
H-1	2	40	10	5	85	1	7
H-2	2	36	5	4	52	3	6
H-3	5	40	7	4	58	2	7
H-3 (6" down)	4	36	7	4	64	3	7
H-3 (12" down)	1	19	8	3	80	4	9
H-4	4	41	7	5	50	2	6
H-5	3	38	7	6	53	2	7
J-3	3	45	9	6	76	3	6
K-3	2	60	7	5	73	3	6
L-1	4	45	7	5	62	2	5
L-2	5	29	21	5	94	4	5
L-2 (8" down)	3	25	27	10	103	3	6
L-3	4	42	8	6	92	3	5
L-4	3	37	24	6	98	3	5
M-3	2	46	7	3	66	2	5
N-3	3	32	10	5	90	3	5
O-3	2	20	12	7	100	6	9
P-1	5	13	12	6	96	6	7
P-2	3	15	8	9	74	9	8
Sp-1	4	9	18	6	90	10	7

TABLE 7--Continued

Sample Location	X-ray Peak Heights in Counts Per Second X 10^3						
	Dolo. (31.0°)	Cal. (29.4°)	Plag. (28.0°)	K-feld. (27.5°)	Qtz. (26.6°)	Cris. (21.8°)	Clay (19.9°)
Sp-5	ND[a]	3	12	6	80	12	9
Sp-8	3	4	15	10	90	12	8
Sp-34	4	5	4	2	56	10	7
BA-2	2	36	6	5	62	3	7
BB-1	13	15	32	15	160	3	6
Sp-14	4	26	10	6	71	2	4
Sp-35	10	27	30	12	195	4	4
Sp-36	6	24	18	6	102	4	6
Sp-27	4	57	10	6	71	2	4
Sp-28	7	26	57	116	164	ND[a]	4
Sp-29	8	21	19	9	140	3	5
Sp-21	15	23	33	22	270	1	3
Sp-22	34	15	46	32	250	1	3
Sp-23	7	14	50	35	305	1	2
Sp-24	20	15	48	18	240	ND[a]	2
Sp-25	10	22	38	11	175	2	4
Sp-26	9	30	18	4	106	ND[a]	3
Sp-37	4	22	10	8	72	1	6
Sp-38	14	26	20	7	120	2	5
Sp-39	6	20	8	4	90	2	5
Sp-40	25	28	41	14	170	2	1
Sp-41	4	4	81	55	350	1	3

[a] ND represents X-ray peak not detected.

Quantity of Accumulating Sediment

The lake was divided into regions, bounded by coring ranges, for calculating sediment accumulation. The surface area of each region was found by planimetry using 7.5 minute quadrangle maps. The area of the pre-lake river channel in each region was found by using Army Corps of Engineers acquisition maps and profiles of coring ranges.

The average length of cores taken on the floodplain along the boundary coring ranges was assumed to be the thickness of the accumulating floodplain sediment in the region under consideration. The accumulation in the pre-lake river channel was calculated in the same manner. All thicknessess were converted to pounds per square foot using Table 5. The averages for each region are listed in Figure 10. Multiplication by appropriate areas yields total weight of dry sediment accumulation for a given region.

The total dry weight of sediment which has accumulated in Lake Ashtabula is 1.5×10^9 pounds. Of this total 1.2×10^9 pounds is on the floodplain areas and 3.0×10^8 pounds is in the pre-lake river channel. The pre-lake river channel makes up only 6 percent of the total area of the lake but has 19 percent of the total sediment. This indicates the significant role that turbid-water currents play in transporting sediment. Many inundated oxbow lakes and other low areas exist but their role as sediment traps was not studied. At least 1/3 or 5×10^8 pounds of the total accumulated sediment has come from shoreline erosion. Comparison of the amount of shoreline erosion (2.3×10^7 pounds) above Keys Bridge to the amount of sediment (3.5×10^8 pounds) in the lake above Keys Bridge indicates the Sheyenne River is building a deltaic deposit into Lake Ashtabula. The greatest accumulation of this deposit is in the pre-lake Sheyenne River channel. During the early part of April 1969 the Sheyenne River was confined, while flowing into the lake, to its previous channel for several miles below the Burlington Northern Railway Bridge. This was the result of a pool elevation of 1,257 feet or 9 feet below normal. The confinement of the river to its channel

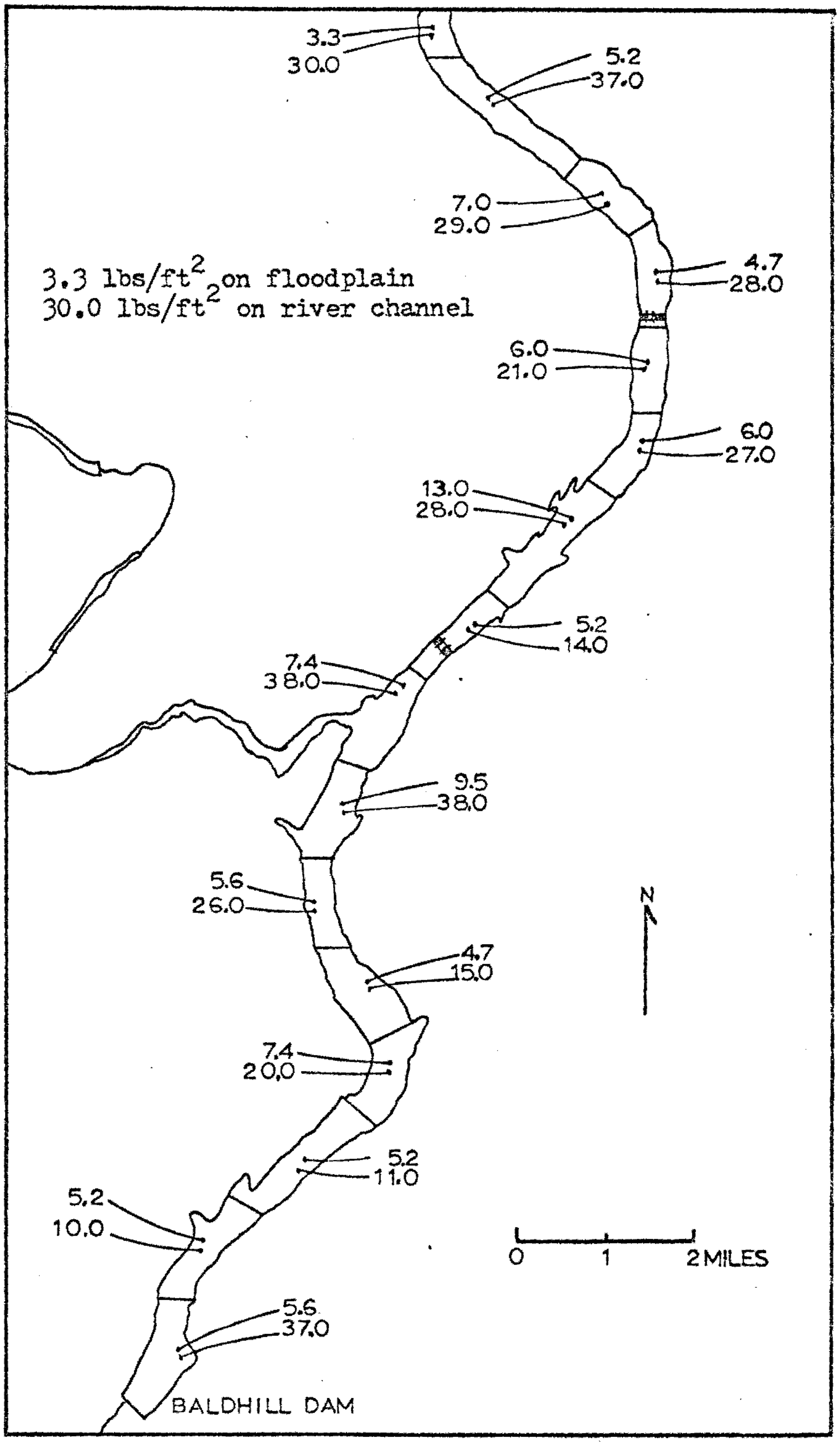


Figure 10.--Map showing accumulated sediment for selected areas of Lake Ashtabula

almost certainly resulted in the scouring of some sediment deposited in the channel during higher pool elevations. The bulk of sediment accumulating in the lower parts of the lake is from shoreline erosion.

Sediment Bypass

The amount of suspended sediment passing out through the outlets of Baldhill Dam is unknown. Some suspended sediment concentrations measured 1/2 mile below the dam ranged from 30 to 80 parts per million. Significant amounts of fine-grained sediment may be removed from the lake by this process. No accurate data is available at this time.

CONCLUSIONS

Summary of Conclusions

The results of the study support the following interpretations.

(1) Erosion is greater where livestock have access to the lake because of the trampling of vegetation.

(2) Groundwater is triggering intermittent slumping along the shorelines.

(3) Frost weathering, block separation, collapse by undercutting, and slumping are the main erosional processes along the shoreline.

(4) Collapse of the bank of the inundated Sheyenne River has caused some slumping along Lake Ashtabula.

(5) The swelling action of montmorillonitic clays is important in shoreline erosion.

(6) The conspicuous band of submergent vegetation paralleling the shore, in full development, absorbs up to 75 percent of the incoming wave energy.

(7) Flood storage capacity of Lake Ashtabula is being increased by shoreline erosion.

(8) Ice push has little effect on Lake Ashtabula because of the size of the lake and the operation of the reservoir.

(9) Over a third of the accumulating sediment is derived from shoreline erosion.

(10) Present erosion of Lake Ashtabula shorelines is 6 percent of projected stable-shelf erosion.

(11) The areas of greatest shoreline erosion are the large shale banks. Riprapping will be required if they are to be stabilized in the near future.

(12) Groundwater, from springs along the margin of the lake, has chemical characteristics similar to the base flow of the Sheyenne River above the lake.

(13) The vertical position of turbid-water currents is determined by temperature.

(14) Turbid-water currents are pooling in depressions. As a result, sediment accumulation is greatest in the depressions.

(15) Fine-grained sediment in suspension is discharged through Baldhill Dam.

(16) Thunderstorm runoff may contribute large amounts of fine-grained sediment to the lake.

(17) The water in Lake Ashtabula is stratified only during the winter months.

(18) The large animal and plant populations are removing nutrients from the water. On the death of these organisms the nutrients are incorporated into the accumulating sediment.

(19) The Sheyenne River is building a fine-grained blanket deposit into Lake Ashtabula above Keys Bridge.

(20) Wave action on shallow areas of the lake bottom has resulted in the formation of a lag.

(21) The mineralogy of the accumulating sediment reflects the source areas. There has been no apparent diagenesis.

(22) Watercraft on Lake Ashtabula are generating waves which rework bottom sediment to a water depth of at least 25 feet.

(23) The turbid appearance of the water around Keys Bridge during the summer is the result of wave action and is not caused by water of the inflowing Sheyenne River.

Sediment Budget

The dry sediment budget for Lake Ashtabula is represented by the following equation:

> sediment eroded from shorelines (5 X 10^8 pounds) + Baldhill Creek sediment (unknown) + Sheyenne River sediment (4 to 9 X 10^5 pounds) + small-tributary sediment (unknown) + slope-wash sediment (unknown) - sediment discharged through Baldhill Dam (unknown) = sediment accumulated in the lake (1.5 X 10^9 pounds or 350 acre-feet).

Reservoir Life

The reservoir will be completely filled with sediment in 5,000 years based on the present rate of sediment accumulation. This estimate is probably minimal because processes such as discharge of sediment through Baldhill Dam will increase in importance and the present rate of filling will decrease. Erosional processes along the shoreline will become less efficient as stable shorelines are approached. These considerations suggest a reservoir life of 10,000 years.

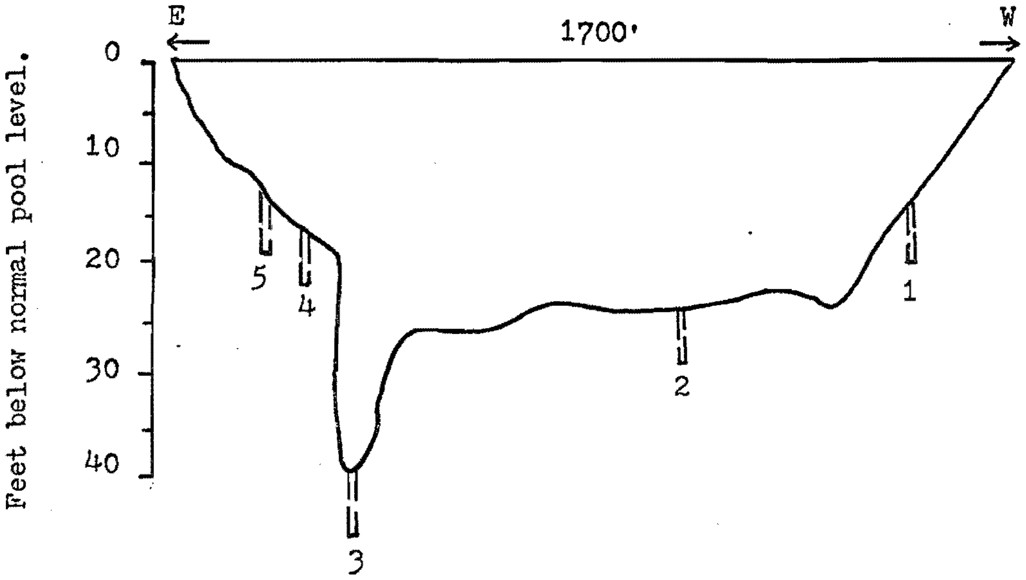
Future man's activity may alter the present situation and processes such as organic filling, because of pollution, will measurably shorten the reservoir usefulness.

APPENDICES

Appendix A

CORE LOCATIONS AND DESCRIPTIONS

The mechanical rotation of the recording arm on the depth recorder has resulted in a slight asymmetry of the range profiles.

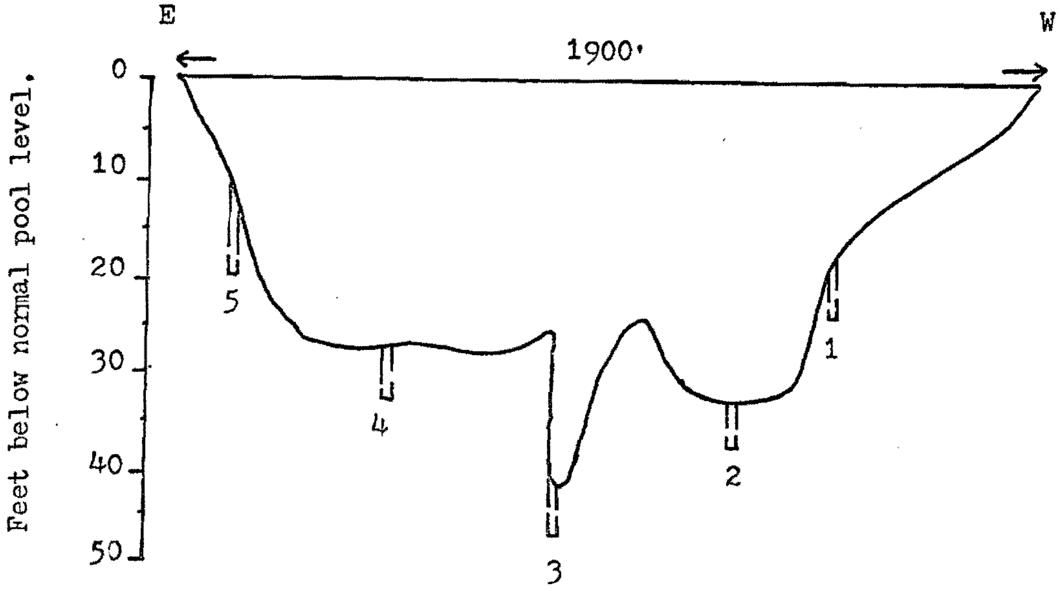


Shore coordinates of profile A

East side: The terminus is the greatest projection of the first headland north of the Baldhill Dam recreational area. At the present time there is a public fishing dock located a few feet south of the point.

West side: The terminus is the intersection with the lake of the fence line separating sections 7 and 18.

Figure 11.--Cross section along Range A showing core locations.

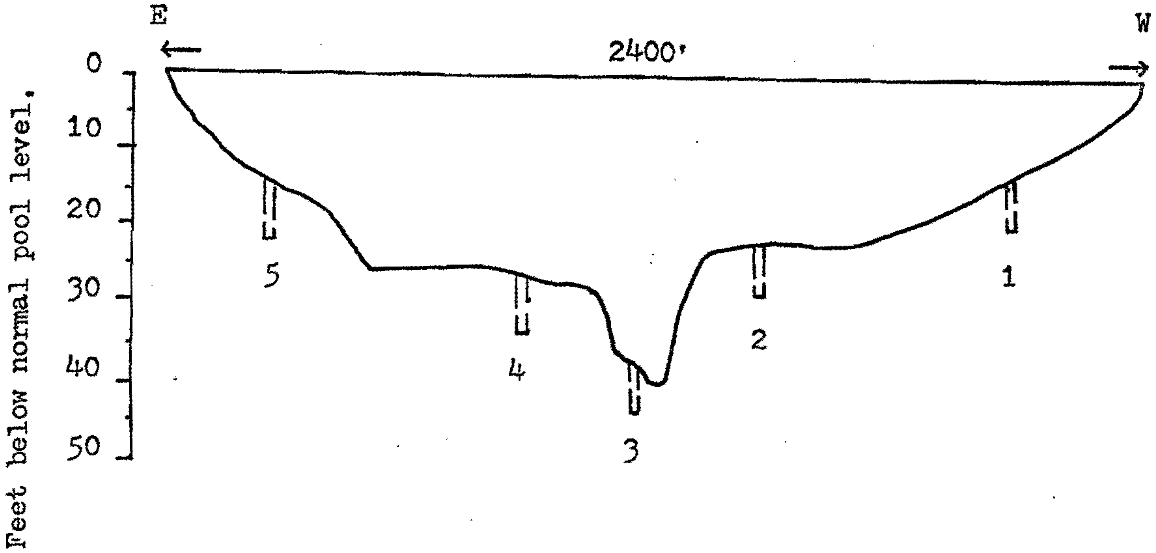


Shore coordinates of profile B

East side: The terminus is the intersection with the lake of the fence line separating sections 5 and 8.

West side: The terminus is the first cabin to the south of the access road.

Figure 12.--Cross section along Range B showing core locations.

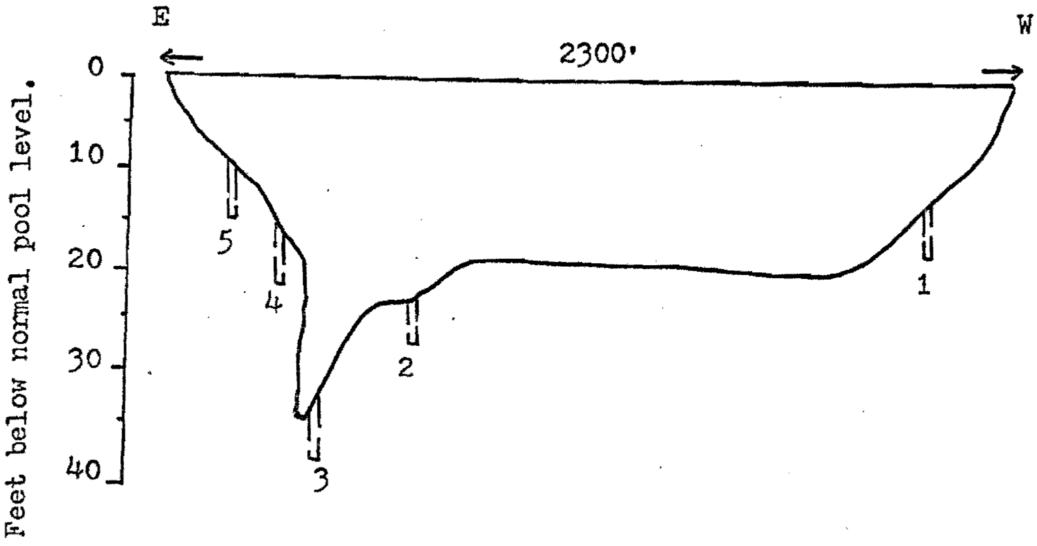


Shore coordinates of profile C

East side: The terminus is the greatest projection of the first headland to the north of the public bathing areas. Lake View Resort is located on this headland.

West side: The terminus is the position where the pre-lake road intersects the lake and where the major Y is in the present access road.

Figure 13.--Cross section along Range C showing core locations.

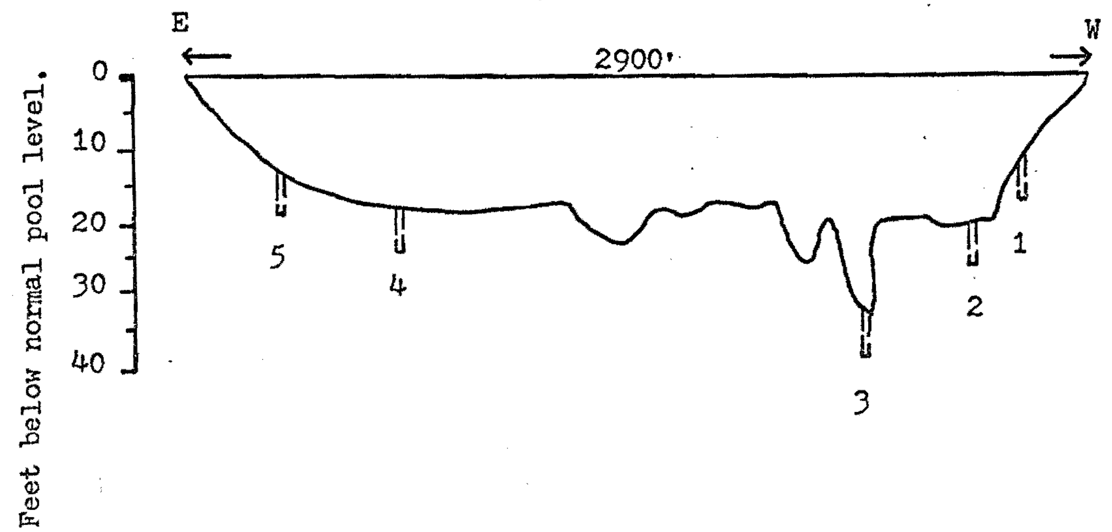


Shore coordinates of profile D

East side: The terminus is the intersection with the lake of the fence line separating sections 27 and 34.

West side: The terminus is the greatest projection of the headland on which Sadek's farm is located. The area is just south of a bay with numerous cabins.

Figure 14.--Cross section along Range D showing core locations.

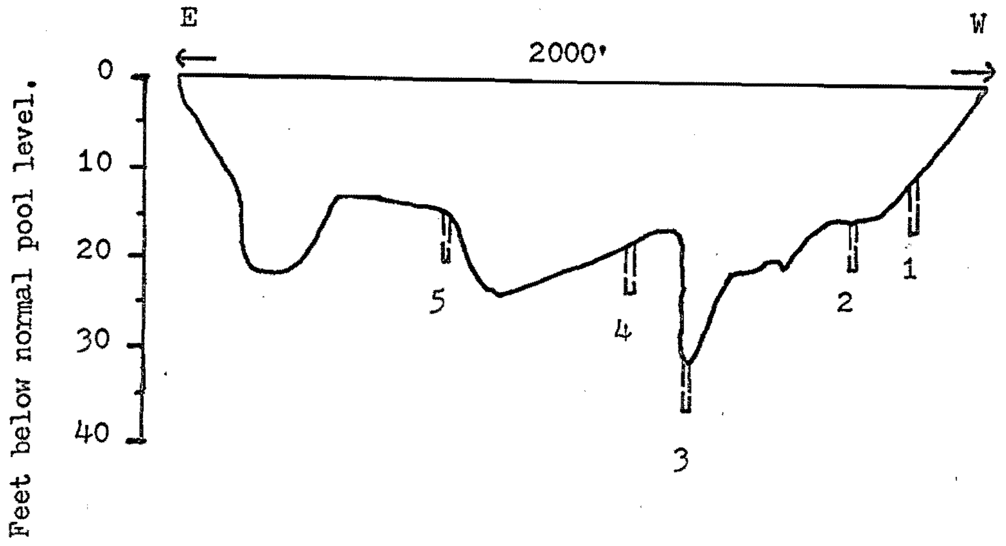


Shore coordinates of profile E

East side: The terminus is the south edge of the major shelter belt in this area. The headland is across the bay from Bayshore Resort.

West side: The terminus is the greatest projection of the headland just to the south of the cabins located on the Katie Olson property.

Figure 15.--Cross section along Range E showing core locations.

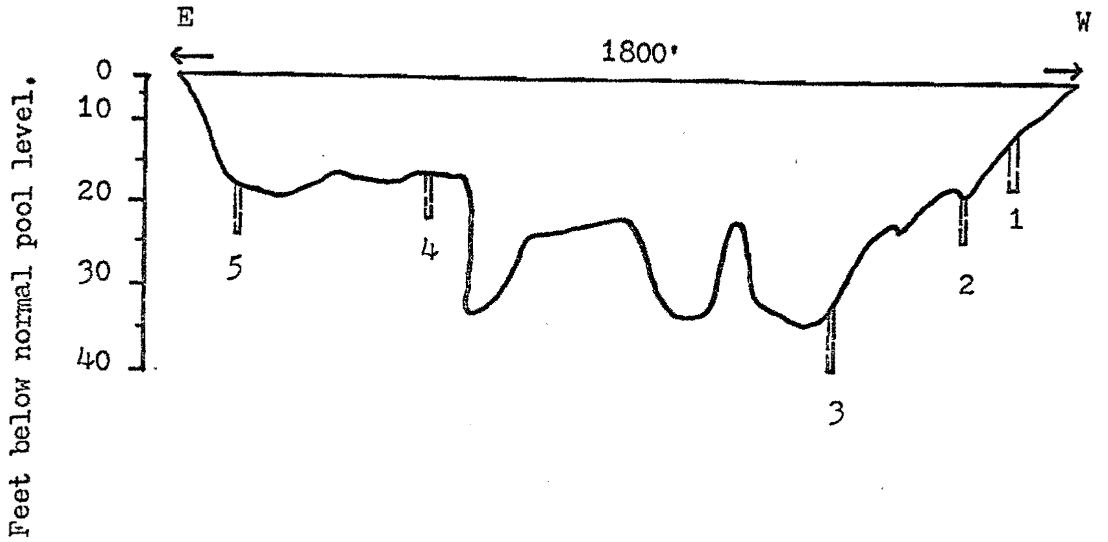


Shore coordinates of profile F

East side: The terminus is the intersection with the lake of the fence line separating sections 16 and 21.

West side: The terminus is the intersection with the lake of the fence line separating sections 16 and 21.

Figure 16.--Cross section along Range F showing core locations.

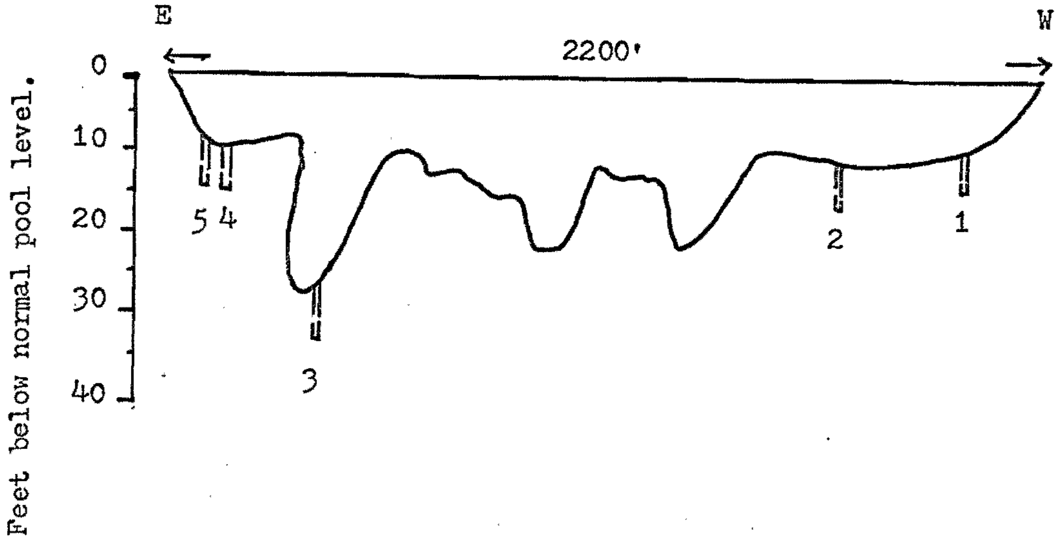


Shore coordinates of profile G

East side: The terminus is the intersection with the lake of the fence line separating sections 9 and 16.

West side: The terminus is the intersection with the lake of the fence line separating sections 9 and 16.

Figure 17.--Cross section along Range G showing core locations.

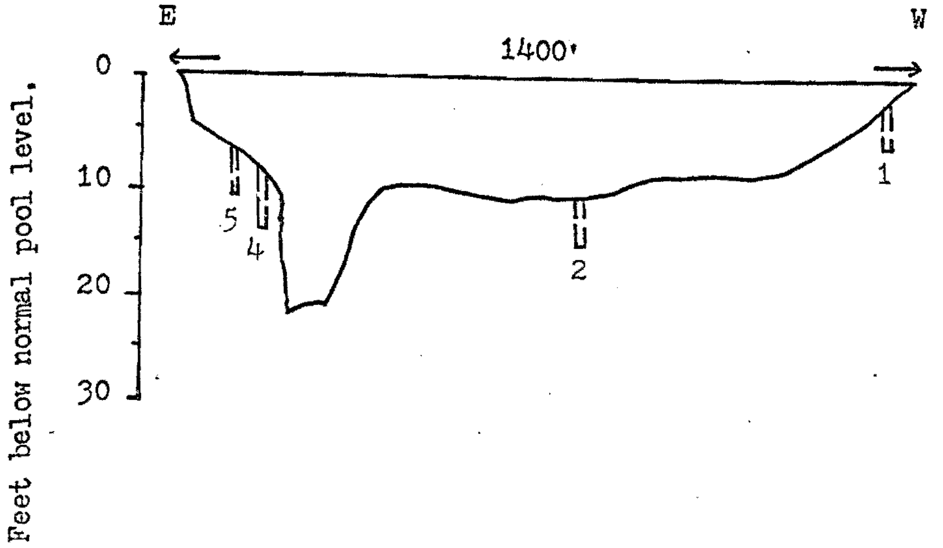


Shore coordinates of profile H

East side: The terminus is the greatest projection of the first headland south of the fence line separating sections 3 and 10. The south end of the major shale banks is in this area.

West side: The terminus is the greatest projection of the first headland north of the intersection with the lake of the line separating sections 4 and 9.

Figure 18.--Cross section along Range H showing core locations.

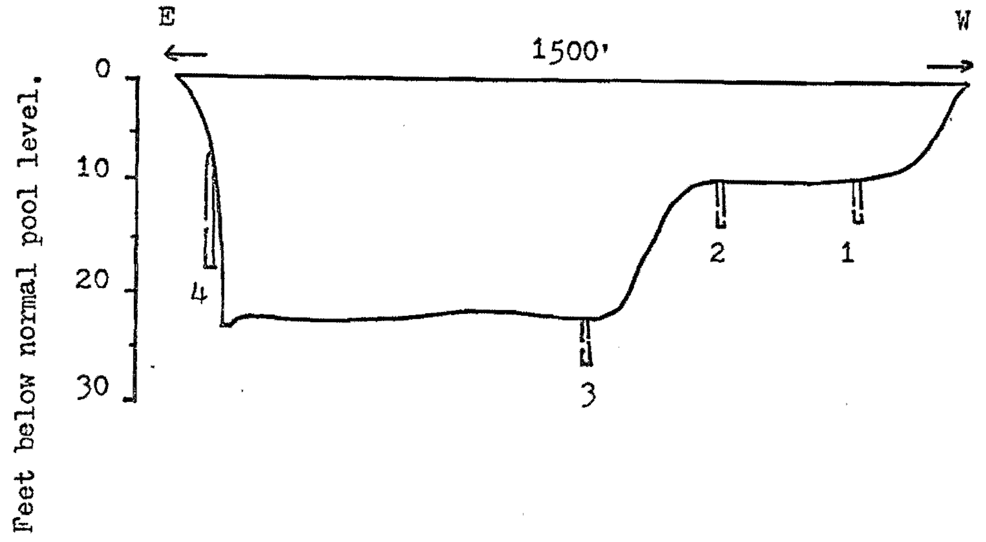


Shore coordinates of profile I

East side: The terminus is the greatest projection of the first headland north of the intersection with the lake of the pre-lake road or the second headland to the north of the line separating sections 34 and 3.

West side: The terminus is the greatest projection of the first headland to the south of the intersection with the lake of the pre-lake road.

Figure 19.--Cross section along Range I showing core locations.

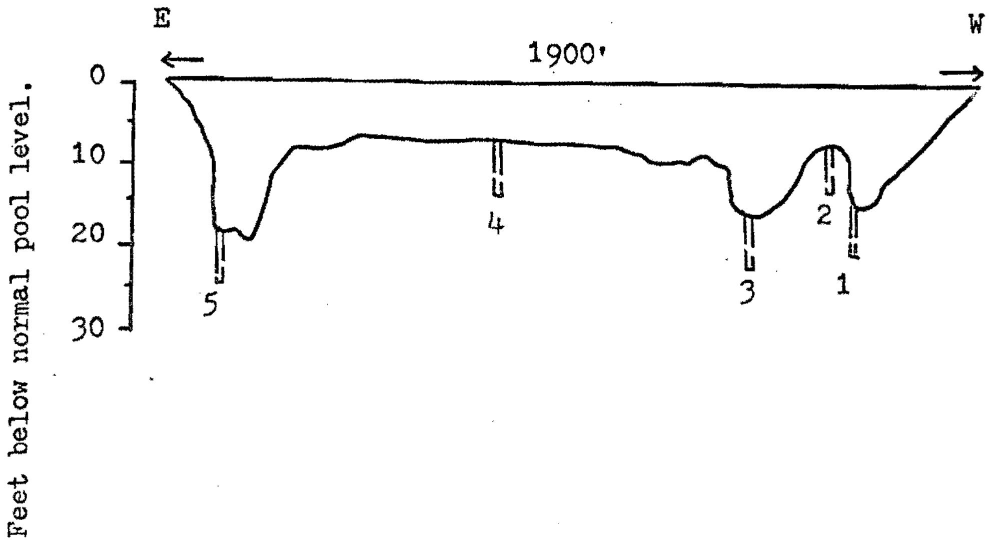


Shore coordinates of profile J

East side: The terminus is the greatest projection of the major headland to the south of the line separating sections 26 and 35. This headland is a fan built out in front of a ravine.

West side: The terminus is the intersection with the lake of the fence line separating sections 26 and 35.

Figure 20.--Cross section along Range J showing core locations.

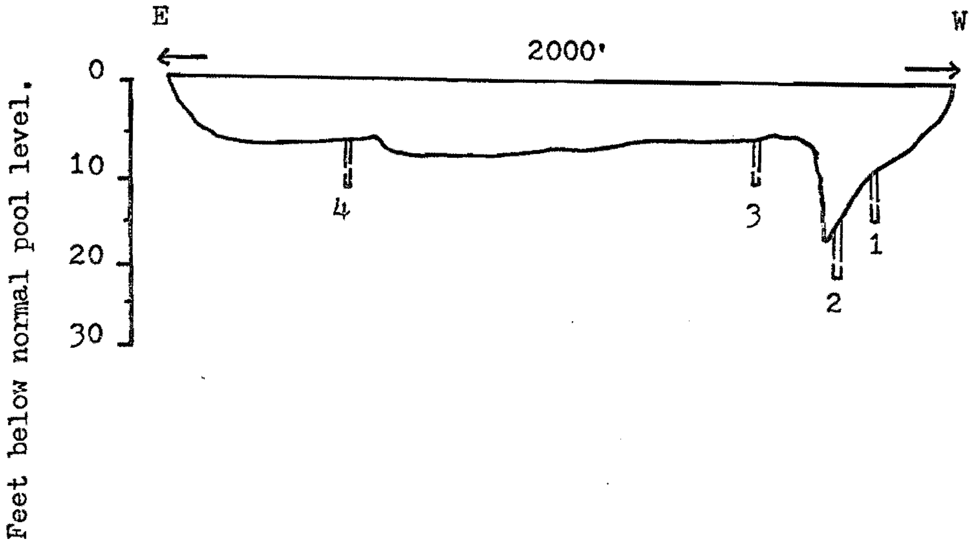


Shore coordinates of profile K

East side: The terminus is the cabin at the end of the major access road (old Highway 26).

West side: The terminus is the south end of the large shelter belt in this area.

Figure 21.--Cross section along Range K showing core locations.

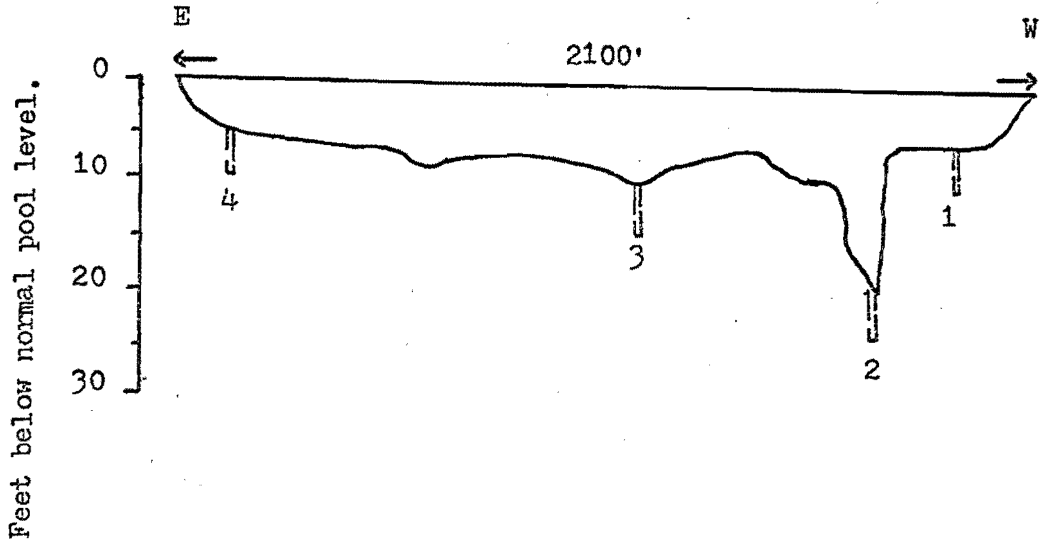


Shore coordinates of profile L

East side: The terminus is the intersection with the lake of the fence line separating sections 18 and 19.

West side: The terminus is the intersection with the lake of the fence line separating sections 13 and 24.

Figure 22.--Cross section along Range L showing core locations.

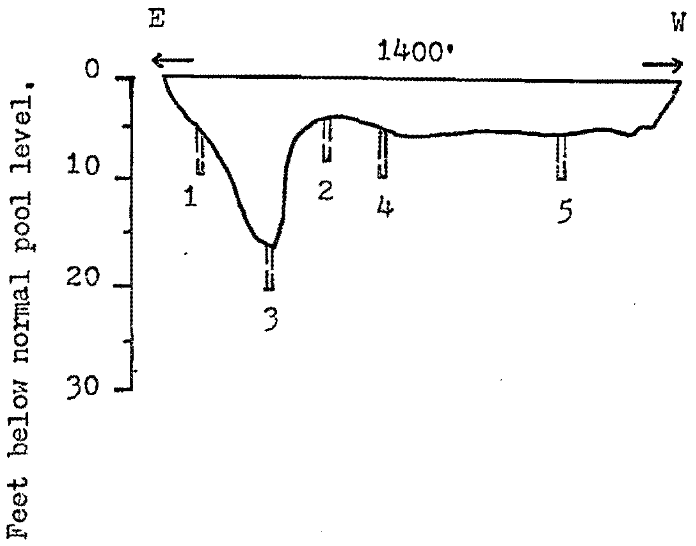


Shore coordinates of profile M

East side: The terminus is the intersection with the lake of the fence line separating sections 7 and 8.

West side: The terminus is the intersection with the lake of the line separating sections 12 and 13.

Figure 23.--Cross section along Range M showing core locations.

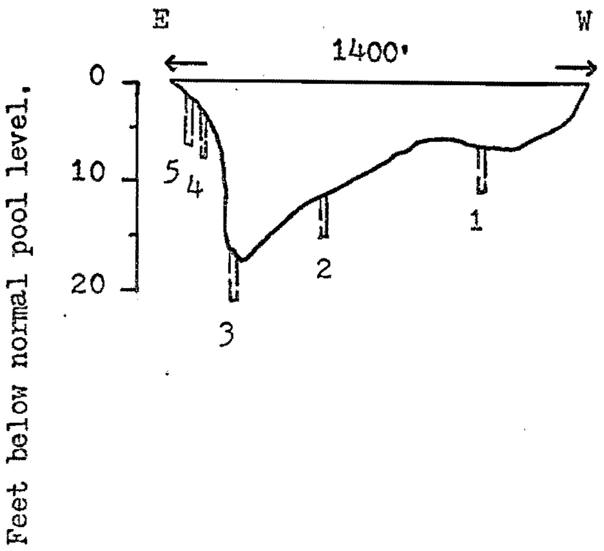


Shore coordinates of profile N

East side: The terminus is the greatest projection of the headland on which the farm is located.

West side: The terminus is the intersection with the lake of the line separating sections 1 and 12.

Figure 24.--Cross section along Range N showing core locations.

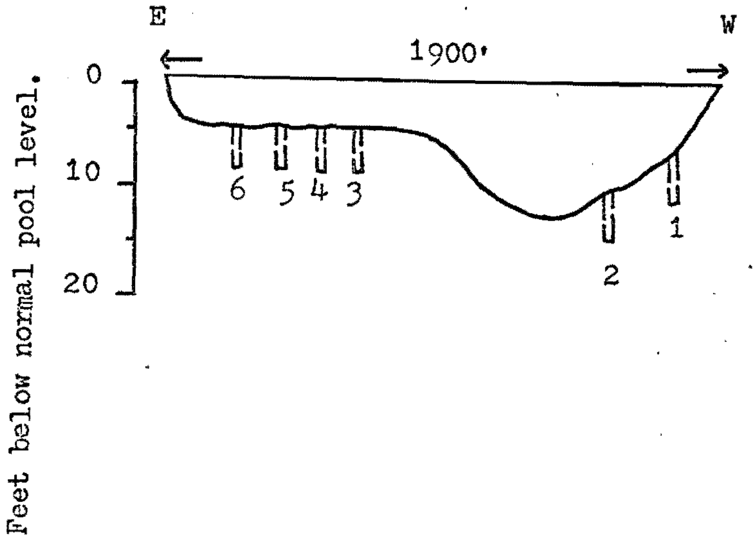


Shore coordinates of profile 0

East side: The terminus is the greatest projection of the major headland located on the boundary of Griggs and Barnes Counties.

West side: The terminus is the intersection with the lake of the fence line separating sections 2 and 1.

Figure 25.--Cross section along Range 0 showing core locations.

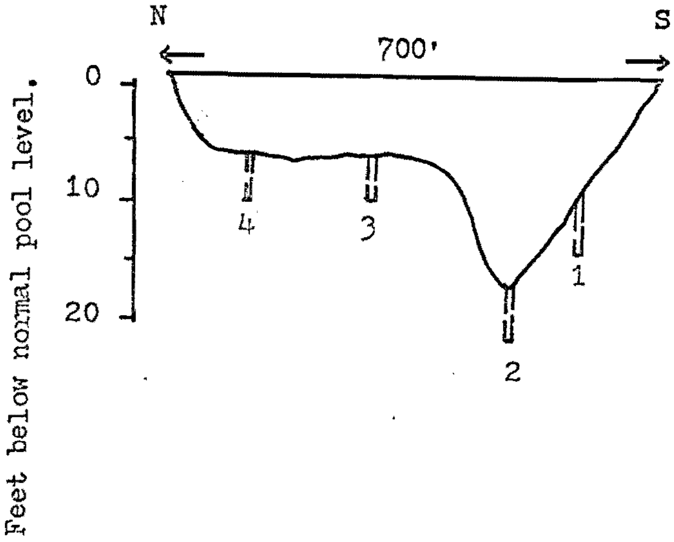


Shore coordinates of profile P

East side: The terminus is the intersection with the lake of the fence line separating sections 27 and 34.

West side: The terminus is the intersection with the lake of the fence line separating sections 27 and 34.

Figure 26.--Cross section along Range P showing core locations.



Shore coordinates of profile BA

South side: The terminus is the middle of a shallow bay just inside the entrance to Baldhill Creek.

North side: The terminus is located at the trees near a curve in the shoreline.

Figure 27.--Cross section along Range BA showing core locations.

TABLE 8

DESCRIPTION OF CORES TAKEN IN LAKE ASHTABULA

Core Location	Water Depth in Feet	Unit Thickness in Inches	Main Particle Sizes	1:5 HCl Test[a]	Organic Material Present	Origin of Unit
A-1a	15	3.5	Silt-clay	+	. .	Lake
b		5.5	Sand	+	Root Hairs	Soil
A-2a	25	1.5	Silt	+	. .	Lake
b		2.5	Sandy-silt	++	Root Hairs	Soil
c		2.5	Sandy-silt	0	Root Hairs	Soil
A-3a	42	10.0	Silt	++	Plant Frag.	Lake
b		3.0	Silt-clay	0	. .	River
A-4a	20	2.25	Silt	++	. .	Lake
b		9.0	Sand	0	Root Hairs	Soil
A-5a	15	4.5	Silt-clay	++	Plant Frag.	Lake
b		1.5	Sand	0	. .	Soil
c		4.5	Sandy-silt	0	Root Hairs	Soil
B-1a	16	7.0	Silt	++	. .	Lake
b		3.0	Sandy-silt	0	Root Hairs	Soil
B-2a	35	8.0	Silt	++	. .	Lake
b		3.5	Sandy-silt	0	Root Hairs	Soil
B-3a	40	9.0	Silt	+	Plant Frag.	Lake
b		5.0	Sand	++	Snail Shells	River
B-4a	30	1.0	Silt	+	. .	Lake
b		6.0	Sandy-silt	+	Root Hairs	Soil
B-5a	13	8.0	Silt	++	. .	Lake
b		2.5	Sandy-silt	+	Root Hairs	Soil
C-1a	15	4.0	Silt	++	. .	Lake
b		7.0	Sandy-silt	0	Grain Hulls	Soil
C-2a	25	0.5	Silt-clay	++	. .	Lake
b		6.0	Sandy-silt	+	Root Hairs	Soil
C-3a	40	4.5	Silt-clay	++	. .	Lake
b		2.5	Sandy-silt	+	. .	River
c		2.0	Gravel	++	. .	River
C-4a	30	3.0	Silt-clay	++	. .	Lake
b		7.0	Sandy-silt	+	Grain Hulls	Soil
C-5a	16	3.0	Silt-clay	++	. .	Lake
b		6.5	Sandy-silt	0	Rootlets	Soil
D-1a	18	7.5	Silt	++	. .	Lake
b		7.5	Sandy-silt	0	Root Hairs	River
D-2a	25	6.0	Silt	++	. .	Lake
b		1.0	Sandy-silt	+	Trashy Layer	Soil
c		4.0	Sandy-silt	0	Rootlets	Soil
D-3a	35	9.5	Silt	++	. .	Lake
b		3.5	Sand	+	Shell Frag.	River
D-4a	20	3.5	Silt	++	. .	Lake
b		7.0	Sandy-silt	0	Rootlets	Soil

TABLE 8--Continued

Core Location	Water Depth in Feet	Unit Thickness in Inches	Main Particle Sizes	1:5 HCl Test[a]	Organic Material Present	Origin of Unit
D-5a	13	6.5	Silt	++	. .	Lake
b		8.0	Silt	+	Rootlets	Soil
E-1a	14	6.0	Silt	++	Stems	Lake
b		3.0	Silt	++	Plant Frag.	Soil
c		7.0	Sandy-silt	0	Rootlets	Soil
E-2a	21	7.0	Silt	++	Plant Frag.	Lake
b		2.5	Silt	+	Roots, Stems	Soil
c		2.0	Sandy-silt	0	Rootlets	Soil
E-3a	37	12.0	Silt	++	Plant Frag.	Lake
b		3.0	Sand	++	Shell Frag.	River
E-4a	20	4.5	Silt	++	Plant Frag.	Lake
b		4.0	Sand	++	Root Hairs	Soil
c		4.5	Sandy-silt	++	. .	Soil
E-5a	13	3.5	Silt	++	Plant Frag.	Lake
b		13.0	Sand	0	. .	Soil
F-1a	10	1.0	Silt	++	Clam Shell	Lake
b		5.0	Sand	++	Roots	Soil
F-2a	17	7.5	Silt	++	. .	Lake
b		6.0	Sandy-silt	0	Root Hairs	Soil
F-3a	35	6.0	Silt	++	. .	Lake
b		8.0	Sand	0	Clams	River
F-4a	20	1.0	Silt	++	. .	Lake
b		6.5	Sandy-silt	++	Wood Frag.	Soil
F-5a	15	3.5	Silt	++	. .	Lake
b		8.5	Sandy-silt	+	Root Hairs	Soil
G-1a	10	5.0	Silt	++	Clams	Lake
b		3.0	Sandy-silt	0	Root Hairs	Soil
G-2a	20	4.5	Silt	++	Worms, Reed Frag.	Lake
b		5.0	Sandy-silt	0	Root Hairs	Soil
G-3a	30	19.0	Silt-clay	++	. .	Lake
b		4.0	Sand	++	Shell Frag.	River
G-4a	15	4.5	Silt	++	. .	Lake
b		7.5	Sandy-silt	+	Root Hairs	Soil
G-5a	17	12.0	Silt	++	Worms, Plant Frag.	Soil
b		4.0	Sandy-silt	0	Root Hairs	Soil
H-1a	12	8.5	Sand	++	Root Hairs	Lake
b		4.5	Silt	0	Root Hairs	Soil
H-2a	12	3.5	Silt	++	Plant Frag.	Lake
b		5.0	Silt	0	Root Hairs	Soil
H-3a	30	16.5	Clay	++	. .	Lake
b		7.0	Silt	++	Root Hairs	Soil
c		1.0	Sand	+	Shell Frag.	River
H-4a	12	6.5	Clay	++	Plant Frag.	Lake
b		4.0	Silt	0	. .	Soil

TABLE 8--Continued

Core Location	Water Depth in Feet	Unit Thickness in Inches	Main Particle Sizes	1:5 HCl Test[a]	Organic Material Present	Origin of Unit
H-5a	9	8.0	Clay	++	Root Hairs	Lake
b		3.5	Silt	0	Root Hairs	Soil
I-1a	7	9.5	Silt	++	Plant Frag.	Lake
b		4.0	Sandy-silt	0	Plant Frag.	Soil
I-2a	15	4.0	Silt	++	Root Hairs	Lake
b		5.5	Sandy-silt	0	Root Hairs	Soil
I-4a	12	3.0	Silt	++	. .	Lake
b		8.0	Sandy-silt	0	Roots	Soil
I-5a	8	5.0	Silt	++	. .	Lake
b		6.0	Sandy-silt	0	. .	Soil
J-1a	11	5.5	Silt	++	Plant Frag.	Lake
b		6.5	Sandy-silt	+	Rootlets	Soil
J-2a	12	3.0	Silt	++	Plant Frag.	Lake
b		10.0	Sandy-silt	+	Root Hairs	Soil
J-3a	25	7.5	Silt	++	Plant Frag.	Lake
b		12.0	Sandy-silt	+	Clams	River
J-4a	8	4.0	Sand	++	. .	Lake
b		1.0	Sandy-silt	++	. .	Soil
K-1a	18	19.0	Silt	++	Plant Frag.	Lake
b		9.0	Silt	0	Shells, Roots	Slough
K-2a	7	3.5	Silt	++	. .	Lake
b		4.0	Silt	+	Root Hairs	Soil
K-3a	19	7.5	Silt	++	. .	Lake
b		8.0	Sandy-silt	0	Root Hairs	Soil
K-4a	9	2.0	Silt	++	. .	Lake
b		8.5	Sandy-silt	0	Root Hairs	Soil
K-5a	23	9.0	Silt	++	. .	Lake
b		6.5	Sandy-silt	+	Plant Frag.	River
L-1a	13	8.0	Silt	++	Plant Frag.	Lake
b		6.0	Sandy-silt	0	Plant Frag.	Soil
L-2a	20	6.5	Silt	++	. .	Lake
b		9.5	Silt	+	Roots	Soil
L-3a	10	4.0	Silt	++	. .	Lake
b		7.0	Silt	++	. .	Soil
L-4a	10	7.0	Silt	++	. .	Lake
b		6.0	Sandy-silt	++	Roots	Soil
M-1a	5	4.5	Silt	++	Clams	Lake
b		4.5	Sandy-silt	++	Roots	Soil
M-2a	18	15.0	Silt-clay	++	. .	Lake
b		1.5	Sand	+	. .	Soil
M-3a	10	6.5	Silt-clay	++	. .	Lake
b		10.0	Sandy-silt	0	. .	Soil
M-4a	4	1.5	Sand	++	Clams	Lake
b		4.0	Sandy-silt	++	Roots	Soil

TABLE 8--Continued

Core Loca-tion	Water Depth in Feet	Unit Thickness in Inches	Main Particle Sizes	1:5 HCl Test[a]	Organic Material Present	Origin of Unit
N-1a	5	0.0	. .	0	1 Clam	. .
b		12.0	Sand	++	Snails	Soil
N-2a	9	12.0	Silt	++	Snails, Clams	Lake
b		10.0	Sand	0	Roots	Soil
N-3a	15	11.5	Silt	++	Snails	Lake
b		6.5	Sand	0	Clams	River
N-4a	4	2.0	Silt	++	. .	Lake
b		9.0	Sand	0	. .	Soil
N-5a	4	1.0	Silt	++	Stems	Lake
b		13.0	Sandy-silt	++	. .	Soil
O-1a	6	10.5	Silt	++	Snails, Clams	Lake
b		6.0	Sandy-silt	0	Straw Frag.	Soil
O-2a	13	16.5	Silt	++	Shells	Lake
b		9.5	Sandy-silt	0	Roots, Shells	Soil
O-3a	15	19.0	Silt	++	Plant Frag.	Lake
b		4.0	Sand	+	Wood Frag.	Soil
O-4a	6	1.0	Silt	++	. .	Lake
b		8.0	Sand	0	Wood Chips	Soil
O-5a	6	2.0	Sand	++	Shells	Lake
b		7.0	Sandy-silt	++	Roots	Soil
P-1a	10	15.0	Silt	++	Clams	Lake
b		7.0	Sandy-silt	0	Wood Chips	Soil
P-2a	13	16.0	Silt	++	. .	Lake
b		4.0	Sand	++	Shells, Roots	Soil
P-3a	5	1.5	Silt	++	Snails	Lake
b		9.0	Sandy-silt	0	Straw Frag.	Soil
P-4a	6	9.0	Silt	++	Plant Frag.	Lake
b		3.0	Sandy-silt	0	Root Hairs	Soil
P-5a	4	1.0	Sand	++	. .	Lake
b		8.5	Sandy-silt	0	Roots	Soil
P-6a	5	1.0	Silt	++	Snails, Clams	Lake
b		8.5	Sandy-silt	0	Roots, Leaves	Soil
BA-1a	9	13.0	Silt	++	Shells	Lake
b		6.0	Sandy-silt	0	Root Mat.	Soil
BA-2a	18	21.0	Silt	++	Plant Frag.	Lake
b		0.5	Sand	0	. .	Creek
BA-3a	7	5.0	Silt	++	. .	Lake
b		4.0	Sand	++	. .	Soil
BA-4a	7	8.0	Silt	++	. .	Lake
b		5.0	Sand	0	. .	Soil
BB-1a	14	10.5	Silt	++	Snails, Clams	Lake
b		9.0	Sand	++	Shell Frag.	Creek
BB-2a	8	5.0	Silt	++	. .	Lake
b		5.5	Sandy-silt	0	Root Hairs	Soil

TABLE 8--Continued

Core Location	Water Depth in Feet	Unit Thickness in Inches	Main Particle Sizes	1:5 HCl Test[a]	Organic Material Present	Origin of Unit
Sp 1-1a	17	13.0	Silt	+	Stems	Lake
b		7.0	Sand	+	Shells	River
Sp 2-1a	2	12.0	Silt	+	Clams	Lake
b		0.5	Sandy-silt	0	Rootlets	Soil
Sp 3-1a	6	7.0	Silt	+	Plant Frag.	Lake
b		7.0	Sand	+	Shells	Soil
Sp 4-1a	3	1.5	Sand	++	Shells	Lake
b		10.0	Sand	+	. .	Soil
Sp 5-1a	12	10.5	Silt	+	Shells	Lake
b		11.5	Sandy-silt	+	Wood Frag.	River
Sp 6-1a	7	2.0	Silt	+	Shells	Lake
b		16.0	Sand	+	Shells	River
Sp 7-1a	7	1.0	Silt	+	Clams	Lake
b		19.0	Sandy-silt	+	Clams	River
Sp 8-1a	13	6.5	Silt	++	. .	Lake
b		5.0	Sand	. .	Shells	River
Sp 9-1a	14	12.0	Silt	+	Clams	Lake
b		8.5	Sandy-silt	+	. .	River
Sp 10-1a	4	1.0	Silt	++	. .	Lake
b		9.0	Sandy-silt	+	Shell Frag.	River
Sp 11-1a	5	8.0	Silt	+	Clams	Lake
b		4.0	Sandy-silt	+	Root Hairs	Soil
Sp 12-1a	9	5.0	Silt	++	Clams, Snails	Lake
b		6.0	Sandy-silt	0	Roots	Soil
Sp 13-1a	15	18.0	Clay	++	Clams	Lake
b		1.0	Gravel	0	. .	River
Sp 14-1a	21	4.0	Silt-clay	++	. .	Lake
b		7.0	Sandy-silt	0	Root Hairs	Soil
Sp 15-1a	21	3.0	Silt-clay	++	. .	Lake
b		7.5	Sandy-silt	0	Root Hairs	Soil
Sp 16-1a	11	7.5	Silt	++	. .	Lake
b		3.0	Sandy-silt	0	Roots	Soil
Sp 17-1a	9	0.5	Silt	++	. .	Lake
b		5.0	Sand	++	Shells	Creek
Sp 18-1a	7	0.5	Silt	++	. .	Lake
b		6.0	Sand	++	Clams	Creek
Sp 19-1a	8	1.0	Silt	++	. .	Lake
b		4.0	Sandy-silt	++	Root Hairs	Soil
Sp 20-1a	6	7.5	Sand	++	. .	Lake
b		4.0	Sand	++	. .	Creek
Sp 21-1a	3	1.5	Sand	++	. .	Lake
b		5.0	Sandy-silt	0	. .	Soil
Sp 22-1a	4	3.0	Sand	++	. .	Lake
b		4.0	Sandy-silt	0	Straw Frag.	Soil

TABLE 8--Continued

Core Location	Water Depth in Feet	Unit Thickness in Inches	Main Particle Sizes	1:5 HCl Test[a]	Organic Material Present	Origin of Unit
Sp 23-1a	6	7.5	Sand	++	. .	Lake
b[b]						
Sp 24-1a	3	7.0	Sand	++	. .	Lake
b[b]						
Sp 25-1a	3	13.0	Sand	++	Shells	Lake
b[b]						
Sp 26-1a	6	12.0	Sand	++	Snails	Lake
b		2.0	Sandy-silt	0	Root Hairs	Soil
Sp 27-1a	3	1.5	Sand	++	Snails	Lake
b		2.0	Sand	++	. .	Lag
Sp 28-1a	4	2.0	Sand	++	. .	Lake
b		3.0	Gravel	++	. .	Lag
Sp 29-1a	6	6.5	Sand	++	Plant Frag.	Lake
b		2.0	Silt	++	Root Hairs	Soil
Sp 39-1a	10	5.0	Silt	++	Plant Frag.	Lake
b		9.0	Sandy-silt	+	. .	Soil
Sp 37-1a	14	4.5	Silt	++	Plant Frag.	Lake
b		11.0	Sandy-silt	+	Root Hairs	Soil
Sp 38-1a	12	13.0	Silt	++	Snails	Lake
b		6.0	Gravel	0	. .	Soil
Sp 35-1a	7	1.5	Sand	++	. .	Creek
b		12.0	Sandy-silt	++	Clams	Creek

[a] HCl test: 0, no reaction; +, slight reaction; ++, strong reaction

[b] Soil lost during core recovery.

Appendix B

MINERALOGICAL ANALYSES

Sample Preparation

All sediment samples were taken from the top 1 inch of the core unless otherwise indicated. The air-dried sediment was ground in a mortar to sand-sized particles. The sediment was then placed in a Spex 8000 Mixer Mill for 5 minutes. A pressed pellet using 1 gram of sediment sample backed by 2 grams of Avicel was formed using a maximum of 8 tons of force.

X-ray Procedure

The rotating pellet was exposed to Cu $K\alpha$ radiation, generated by a Machlett copper tube, at 38 kilovolts and 19 milliamps (Philips X-ray generator). Intensity of radiation was calibrated before each run using a quartz standard. The settings for the pulse-height analyzer were width 6 and level 5.5. A detector (Philips scintillation-transistorized 52572) scan speed of 1 degree per minute was coupled with a Bristol recorder chart speed of 30 inches per hour. A detector scan speed of 1/4 degree per minute was used on selected sediment samples at the 29.4 degree calcite peak position.

The following principal peak positions were used: total clay 19.9 degrees, cristobalite 21.8 degrees, quartz 26.6 degrees, potassium feldspar 27.5 degrees, plagioclase 28.0 degrees, calcite 29.4 degrees, and dolomite 31.0 degrees. Reported peak height (in counts per second) was found by subtracting background radiation from total peak height.

Quantitative procedure

The concept of 100 percent intensity factor as described by Schultz (1964, p. C2) was used in calculations of the weight fractions of each mineral present. A known sample was prepared using 10 percent dolomite (UND 4228), 10 percent calcite (UND 1120), 10 percent perthite (UND 2230), 40 percent quartz (UND 1901), and 30 percent clay minerals extracted from Lake Ashtabula sediment. This sample was X-rayed and the principle peak heights measured. The perthite was composed of 47 percent albite by optical measurements (Karner, 1968, sample 272). Converting to weight fractions, the perthite is 50 percent plagioclase and 50 percent potassium feldspar.

A proportionality constant to describe the relationship between the weight fraction of a mineral present and its X-ray peak height (in counts per second times 10^3) was derived for each mineral considered. The calculation for dolomite is

$$\frac{38 \text{ peak height, known}}{0.1 \text{ weight fraction, known}} =$$

$$\frac{\text{peak height, unknown}}{\text{weight fraction, unknown}} .$$

Rearranging and dividing,

$$\text{weight fraction, unknown} = 0.0026 \cdot \text{peak height, unknown.}$$

Similar calculations were made for all minerals except cristobalite. The cristobalite weight fraction was found by assuming that the unaccounted-for weight fraction in selected cores was cristobalite. The multiplying constant was derived using peak heights in these selected cores.

Total reactive carbonate in selected sediment samples was determined using the procedure described by Royse (1970, p. 119-126). These values were plotted against the sum of the dolomite and calcite values found by quantitative X-ray analysis (Figure 28). Because no other carbonate minerals were considered in the X-ray analysis the dolomite and calcite values were adjusted to reflect the total carbonate present according to the derived equation (Figure 28).

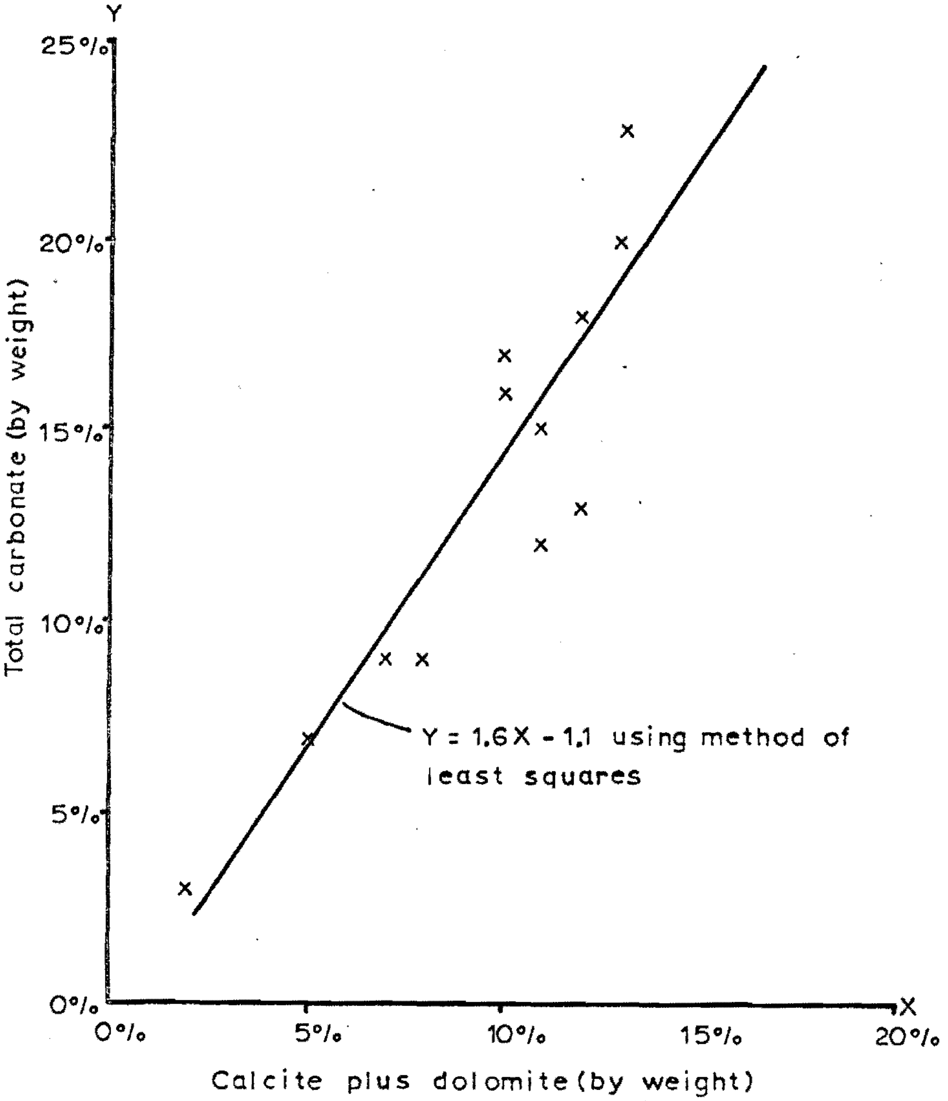


Figure 28.--Comparison of total carbonate to dolomite plus calcite of selected samples.

Appendix C

COMPUTER PROGRAM DESCRIPTIONS

Four computer programs were written to calculate and sort data (Table 10).

Program 1 calculates bank erosion, means and standard deviations for selected bank categories, and total erosion amounts for selected bank categories.

Program 2 calculates means, standard deviations, correlation coefficients, and total erosion amounts for land use, bank material, groundwater, and orientation categories. The program was modified in various ways to handle percentage development and projected shoreline erosion. One subprogram, STAT, for calculating mean, standard deviation and error of the mean was used.

Program 3 sorted data and plotted histograms of bank-erosion amounts for various selected categories.

Program 4 calculated projected bank erosion under various assumed conditions.

TABLE 9

LIST OF MAIN COMPUTER PROGRAM VARIABLES (- INDICATES SPACE HOLDER)

Parameter	Definition	Program 1	2	3	4
LOC	Station number	X	X		
MATR	Bank material at a station	X	X	X	
L	Valley-wall slope	X	X		
LOR	Orientation class	X	X		
BKH	Bank height	X	X		
LAND	Land use category	X	X	X	
LIQ	Evidence for groundwater	X	X		
BKE or SBE	Calculated bank erosion	X	X	X	
LL	Averaged valley-wall slope angle	X	X		X
OR-	Orientation (class)		X		
SH or -S-	Shale	X	X		
TILL- or -T-	Till	X	X		
GRL- or -A-	Other bank material	X	X		
E--	Eroded	X			
WET or ---W	Groundwater Evidence		X		
DRY or ---D	No groundwater evidence		X		
CAB or --D	Recreational areas	X	X		
VIR or --U	Reserved or hayland areas	X	X		
COW or --C	Livestock access to shore	X	X		
SD- or ---SD	Standard deviation	X	X		
---M or ---AV or AVG	Mean	X	X		
---EM	Error of the mean		X		
T- or --T	Total count	X	X		
---2	Squared term	X	X		
SUMBXL	Product bank erosion and slope angle		X		
SUM	Sum		X		
B	Bank erosion		X		
R	Correlation coefficient		X		
Z	Significance of R		X		
EMEAN	Error of the mean		X		
INTV	Interval of bank erosion			X	
MAT(I,K)	Graphing matrix			X	
AMT(I)	Projected bank erosion			X	
AMTL(J)	Projected sediment yield to lake			X	
A-,B-,C-,D-	Coordinates				X
B-	Intercepts				X
LL,LW,LR,LS	Valley-wall slope angle, wave response angle, repose angle, stable-slope angle				X
A,B,C,X,Y,Z	Sides of triangles (Figure 2)				X
SHORE	Width of berm				X
BERM	Height of berm				X

```
C PROGRAM 1
      DIMENSION COT(60),LOC(500),MATR(500),L(500),BKH(500),LAND(500),
     1LOR(500),LIQ(500),SBE(500),LL(500)
      READ (1,10,) (COT(I)=2,51)
   10 FORMAT(10F8.5)
C INITIAL VALUES ZERO
      READ(1,11) SDT,SDTC,SDTD,SDTU,SDS,SDSC,SDSD,SDSU,SDA,SDAC,SDAD,
     1 SDAU,ETM,ETCM,ETDM,ETUM,ESM,ESCM,ESDM,ESUM,EAM,EACM,EADM,EAUM
      READ(1,11) ET2,ETC2,ETD2,ETU2,ES2,ESC2,ESD2,ESU2,EA2,EAC2,EAD2,
     1EAU2,SDT,SDTC,SDTD,SDTU,SDS,SDSC,SDSD,SDSU,SDA,SDAC,SDAD,SDAU
      READ (1,11) ET,TT,ETC,TCT,ETD,TDT,ETU,TUT,ES,ST,ESC,SCT,ESD,SDT,
     1ESU,SUT,EA,AT,EAC,ACT,EAD,ADT,EAU,AUT
   11 FORMAT(24F2.0)
C READING IN DATA
      I=0
   14 I=I+1
      READ (1,13) LOC(I),MATR(I),L(I),LOR(I),BKH(I),LAND(I),LIQ(I)
   13 FORMAT(I5,I3,I4,I3,F6.1,I3,I3)
      IF (LOC(I)) 15,15,14
   15 CONTINUE
      MV=I-2
      DO 35   I=2,MV
      BKA=(BKH(I-1)+4*BKH(I)+BKH(I+1))/6
      M=(L(I-1)+4*L(I)+L(I+1))/6
C CALCULATED BANK EROSION
      BKE=(BKA**2)*COT(M)/2
      BKE2=BKE**2
      SBE(I)=BKE
      LL(I)=M
C SORTING AND SUMING
      IF(MATR(I)-2) 40,30,20
C TILL EROSION
   20 ET=ET+BKE
      ET2=ET2+BKE2
      TT=TT+1
      IF (LAND(I)-2) 21,22,23
   21 ETC=ETC+BKE
      ETC2=ETC2+BKE2
      TCT=TCT+1
      GO TO 34
   22 ETD=ETD+BKE
      ETD2=ETD2+BKE2
      TDT=TDT+1
      GO TO 34
   23 ETU=ETU+BKE
      ETU2=ETU2+BKE2
      TUT=TUT+1
      GO TO 34
C SHALE EROSION
   30 ES=ES+BKE
      ES2=ES2+BKE2
      ST=ST+1
      IF (LAND(I)-2) 31,32,33
```

```
   31 ESC=ESC+BKE
      ESC2=ESC2+BKE2
      SCT=SCT+1
      GO TO 34
   32 ESD=ESD+BKE
      ESD2=ESD2+BKE2
      SDT=SDT+1
      GO TO 34
   33 ESU=ESU+BKE
      ESU2=ESU2+BKE2
      SUT=SUT+1
      GO TO 34
C GRAVEL EROSION
   40 EA=EA+BKE
      EA2=EA2+BKE2
      AT=AT+1
      IF (LAND(I)-2) 41,42,43
   41 EAC=EAC+BKE
      EAC2=EAC2+BKE2
      ACT=ACT+1
      GO TO 34
   42 EAD=EAD+BKE
      EAD2=EAD2+BKE2
      ADT=ADT+1
      GO TO 34
   43 EAU=EAU+BKE
      EAU2=EAU2+BKE2
      AUT=AUT+1
      GO TO 34
   34 CONTINUE
   35 CONTINUE
C TILL EROSION PRINT
      WRITE (3,53)
   53 FORMAT (' ','TILL EROSION')
      WRITE (3,50) ET,TT,ETC,TCT,ETD,TDT,ETU,TUT
   50 FORMAT (' ','ET=',F8.0,1X,'TT=',F4.0,1X,'ETC=',F7.0,1X,'TCT=',F4.0
     1,1X,'ETD=',F7.0,1X,'TDT=',F4.0,1X,'ETU=',F7.0,1X,'TUT=',F4.0)
C SHALE EROSION PRINT
      WRITE (3,54)
   54 FORMAT(' ','SHALE EROSION')
      WRITE (3,51) ES,ST,ESC,SCT,ESD,SDT,ESU,SUT
   51 FORMAT (' ','ES=',F8.0,1X,'ST=',F4.0,1X,'ESC=',F7.0,1X,'SCT=',F4.0
     1      ,1X,'ESD=',F7.0,1X,'SDT=',F4.0,1X,'ESU=',F7.0,1X,'SUT=',F4.0)
C GRAVEL EROSION PRINT
      WRITE (3,55)
   55 FORMAT (' ','GRAVEL EROSION')
      WRITE (3,52) EA,AT,EAC,ACT,EAD,ADT,EAU,AUT
   52 FORMAT (' ','EA=',F8.0,1X,'AT=',F4.0,1X,'EAC=',F7.0,1X,'ACT=',F4.0
     1,1X,'EAD=',F7.0,1X,'ADT=',F4.0,1X,'EAU=',F7.0,1X,'AUT=',F4.0)
C STANDARD DEVIATIONS CALCULATIONS
      IF(TT-2.)87,87,80
   80 SDT=SQRT((ET2-ET**2/TT)/(TT-1.))
      ETM=ET/TT
```

```
 81 IF(TCT-2.)83,83,82
 82 SDTC=SQRT((ETC2-ETC**2/TCT)/(TCT-1.))
    ETCM=ETC/TCT
 83 IF(TDT-2.)85,85,84
 84 SDID=SQRT((ETD2-ETD**2/TDT)/(TDT-1.))
    ETDM=ETD/TDT
 85 IF(TUT-2.)87,87,86
 86 SDTU=SQRT((ETU2-ETU**2/TUT)/(TUT-1.))
    ETUM=ETU/TUT
 87 IF(ST-2.)95,95,88
 88 SDS=SQRT((ES2-ES**2/ST)/(ST-1.))
    ESM=ES/ST
 89 IF(SCT-2.)91,91,90
 90 SDSC=SQRT((ESC2-ESC**2/SCT)/(SCT-1.))
    ESCM=ESC/SCT
 91 IF(SDT-2.)93,93,92
 92 SDSD=SQRT((ESD2-ESD**2/SDT)/(SDT-1.))
    ESDM=ESD/SDT
 93 IF(SUT-2.)95,95,94
 94 SDSU=SQRT((ESU2-ESU**2/SUT)/(SUT-1.))
    ESUM=ESU/SUT
 95 IF(AT-2.)103,103,96
 96 SDA=SQRT((EA2-EA**2/AT)/(AT-1.))
    EAM=EA/AT
 97 IF(ACT-2.) 99,99,98
 98 SDAC=SQRT((EAC2-EAC**2/ACT)/(ACT-1.))
    EACM=EAC/ACT
 99 IF(ADT-2.) 101,101,100
100 SDAD=SQRT((EAD2-EAD**2/ADT)/(ADT-1.))
    EADM=EAD/ADT
101 IF(AUT-2.) 103,103,102
102 SDAU=SQRT((EAU2-EAU**2/AUT)/(AUT-1.))
    EAUM=EAU/AUT
103 CONTINUE
    MT=MV+1
    WRITE(3,130) MT
130 FORMAT(' ','THE NUMBER OF STATIONS =',I5,/)
    WRITE(3,105)
105 FORMAT(' ','ET2',7X,'ETC2',6X,'ETD2',6X,'ETU2',6X,'ES2';7X,'ESC2',
   16X,'ESD2',6X,'ESU2',6X,'EA2',7X,'EAC2',6X,'EAD2',6X,'EAU2')
    WRITE(3,104) ET2,ETC2,ETD2,ETU2,ES2,ESC2,ESD2,ESU2,EA2,EAC2,EAD2,
   1EAU2
104 FORMAT(' ',12F10.0)
    WRITE(3,110)
110 FORMAT(' ','MEAN AND STANDARD DEVIATION')
    WRITE(3,112)
112 FORMAT(' ','TILL STATISTICS')
    WRITE(3,111) ETM,SDT,ETCM,SDTC,ETDM,SDTD,ETUM,SDTU
111 FORMAT(' ','MEAN=',F6.1,'SD=',F4.1,'MEANC=',F6.1,'SD=',F4.1,
   1'MEAND='F6.1,'SD=', F4.1,'MEANU=',F6.1,'SD=',F4.1,/)
    WRITE(3,113)
```

```
  113 FORMAT(' ','SHALE STATISTICS')
      WRITE(3,111)ESM,SDS,ESCM,SDSC,ESDM,SDSD,ESUM,SDSU
      WRITE(3,114)
  114 FORMAT(' ','GRAVEL STATISTICS')
      WRITE(3,111) EAM,SDA,EACM,SDAC,EADM,SDAD,EAUM,SDAU
C DATA PRINT OUT
      DO 60   I=2,MV
      WRITE (2,61) LOC(I),MATR(I),LL(I),LOR(I),SBE(I),LAND(I),LIQ(I)
     1,L(I),BKH(I)
   61 FORMAT(' ',I4,2X,I3,2X,I3,2X,I3,2X,F8.2,2X,I3,2X,I3
     1   ,I3,2X,F4.1)
   60 CONTINUE
      STOP
      END
```

```
C PROGRAM 2
C INITIALIZING AT ZERO
      TPAGE=28
      READ(1,11) OR6,OR62,OR6T,OR7,OR72,OR7T,OR8,OR82,OR8T,OR9,OR92,OR9T
     1,OR5,OR52,OR5T,OR4,OR42,OR4T,OR3,OR32,OR3T,OR2,OR22,OR2T,OR1,OR12,
     1OR1T
   11 FORMAT(30F2.0)
      READ(1,11)DRY,WET,VIR,VIR2,VIRT,CAB,CAB2,CABT,COW,COW2,COWT,GRL,
     1GRL2,GRLT,GRLD,GRLD2,GRLDT,GRLW,GRLW2,GRLWT,SH,SH2,SHT,SHD,SHD2,
     2SHDT,SHW,SHW2,SHWT
      READ(1,11)TIL,TIL2,TILT,TILD,TILD2,TILDT,TILW,TILW2,TILWT,SUM,SUMB
     1,SUMBXL,SUMLL,SUMB2,SUMLL2,TLOC,GRLL,GRLL2,GRLLT,SHL,SHL2,SHLT
      READ(1,11)DRY2,DRYT,WET2,WETT,GRLL,GRLL2,GRLLT,SHL,SHL2,SHLT,TILL,
     1TILL2,TILLT,TLOC
      WRITE(3,888)
C READING DATA FROM CARDS
   12 READ(1,13) LOC,MATR,LL,LOR,SBE,LAND,LIQ,L,BKH
   13 FORMAT(4I5,F10.2,2I5,I3,F6.1)
      LL=LL*1.0D0
      SBE=SBE*1.0D0
      SBE2=SBE*SBE*1.0D0
      LL2=LL*LL
      IF(LOC) 60,60,14
   14 CONTINUE
C ORIENTATION SORTING AND SUMMING
      IF(LOR-6)75,70,71
   70 OR6=OR6+SBE
      OR62=OR62+SBE2
      OR6T=OR6T+1
      GO TO 82
   71 IF(LOR-8) 72,73,74
   72 OR7=OR7+SBE
      OR72=OR72+SBE2
      OR7T=OR7T+1
      GO TO 82
   73 OR8=OR8+SBE
      OR82=OR82+SBE2
      OR8T=OR8T+1
      GO TO 82
   74 OR9=OR9+SBE
      OR92=OR92+SBE2
      OR9T=OR9T+1
      GO TO 82
   75 IF(LOR-4)78,77,76
   76 OR5=OR5+SBE
      OR52=OR52+SBE2
      OR5T=OR5T+1
      GO TO 82
   77 OR4=OR4+SBE
      OR42=OR42+SBE2
      OR4T=OR4T+1
      GO TO 82
   78 IF(LOR-2)81,80,79
```

```
   79 OR3=OR3+SBE
      OR32=OR32+SBE2
      OR3T=OR3T+1
      GO TO 82
   80 OR2=OR2+SBE
      OR22=OR22+SBE2
      OR2T=OR2T+1
      GO TO 82
   81 OR1=OR1+SBE
      OR12=OR12+SBE2
      OR1T=OR1T+1
   82 CONTINUE
C GROUNDWATER SORTING AND SUMMING
      IF(LIQ)130,130,131
  130 DRY=DRY+SBE
      DRY2=DRY2+SBE2
      DRYT+DRYT+1
      GO TO 132
  131 WET=WET+SBE
      WET2=WET2+SBE2
      WETT=WETT+1
  132 CONTINUE
C LAND SORTING AND SUMMING
      IF(LAND-2)142,141,140
  140 VIR=VIR+SBE
      VIR2=VIR2+SBE2
      VIRT=VIRT+1
      GO TO 143
  141 CAB=CAB+SBE
      CAB2=CAB2+SBE2
      CABT=CABT+1
      GO TO 143
  142 COW=COW+SBE
      COW2=COW2+SBE2
      COWT=COWT+1
  143 CONTINUE
C BANK MATERIAL SORTING AND SUMMING WITH GROUNDWATER
      IF(MATR-2)150,153,156
  150 GRL=GRL+SBE
      GRL2=GRL2+SBE2
      GRLT=GRLT+1
      GRLL=GRLL +LL
      GRLL2=GRLL2 +LL2
      GRLLT=GRLLT+1
      IF(LIQ)151,151,152
  151 GRLD=GRLD+SBE
      GRLD2=GRLD2+SBE2
      GRLDT=GRLDT+1
      GO TO 159
  152 GRLW=GRLW+SBE
      GRLW2=GRLW2+SBE2
      GRLWT=GRLWT+1
      GO TO 159
```

```
  153 SH=SH+SBE
      SH2=SH2+SBE2
      SHT=SHT+1
      SHL=SHL+LL
      SHL2=SHL2+LL2
      SHLT=SHLT+1
      IF(LIQ)154,154,155
  154 SHD=SHD+SBE
      SHD2=SHD2+SBE2
      SHDT=SHDT+1
      GO TO 159
  155 SHW=SHW+SBE
      SHW2=SHW2+SBE2
      SHWT=SHWT+1
      GO TO 159
  156 TIL=TIL+SBE
      TIL2=TIL2+SBE2
      TILT=TILT+1
      TILL=TILL+LL
      TILL2=TILL2+LL2
      TILLT=TILLT+1
      IF(LIQ)157,157,158
  157 TILD=TILD+SBE
      TILD2=TILD2+SBE2
      TILDT=TILDT+1
      GO TO 159
  158 TILW=TILW+SBE
      TILW2=TILW2+SBE2
      TILWT=TILWT+1
  159 CONTINUE
C CORRELATION OF BANK EROSION TO SLOPE
      SUM=SUM+1
      SUMBXL=SUMBXL+SBE*LL
      SUMB=SUMB+SBE
      SUMLL=SUMLL+LL
      SUMB2=SUMB2+SBE2
      SUMLL2=SUMLL2+LL**2
      GO TO 12
   60 CONTINUE
C DATA WRITE OUT
C CORRELATION BANK/SLOPE
      R=(SUM*SUMBXL-SUMB*SUMLL)/ SQRT((SUM*SUMB2-(SUMB)**2)*(SUM*SUMLL2-
     1(SUMLL)**2))
      Z=R*SQRT(SUM-1.)
      WRITE(3,170) R,Z
  170 FORMAT('1',' ','CORRELATION OF BANK EROSION AND SLOPE',/,2X,'CORRE
     1LATION R=',F6.3,/,2X,'SIGNIFICANCE OF R Z=',F6.3,/)
C STANDARD DEVIATION CALCULATION AND PRINT OUT
  172 FORMAT(' ',F4.0,'=NUMBER OF STATIONS',F7.2,'=MEAN',F7.2,'=STANDARD
     1DEVIATION',/,2X,F7.2,'=ERRMEAN',F8.0,'=SUM',F8.0,'=SUM2',/)
      WRITE(3,171)
  171 FORMAT(' ','CLASS 1')
      CALL STAT (OR1,OR12,OR1T,OR1SD,OR1AV,OR1EM)
```

```
    WRITE(3,172)OR1T,OR1AV,OR1SD,OR1EM,OR1,OR12
    WRITE(3,173)
173 FORMAT(' ','CLASS 2')
    CALL STAT (OR2,OR22,OR2T,OR2SD,OR2AV,OR2EM)
    WRITE(3,172)OR2T,OR2AV,OR2SD,OR2EM,OR2,OR22
    WRITE(3,174)
174 FORMAT(' ','CLASS 3')
    CALL STAT (OR3,OR32,OR3T,OR3SD,OR3AV,OR3EM)
    WRITE(3,172)OR3T,OR3AV,OR3SD,OR3EM,OR3,OR32
    WRITE(3,175)
175 FORMAT(' ','CLASS 4')
    CALL STAT (OR4,OR42,OR4T,OR4SD,OR4AV,OR4EM)
    WRITE(3,172)OR4T,OR4AV,OR4SD,OR4EM,OR4,OR42
    WRITE(3,176)
176 FORMAT(' ','CLASS 5')
    CALL STAT (OR5,OR52,OR5T,OR5SD,OR5AV,OR5EM)
    WRITE(3,172)OR5T,OR5AV,OR5SD,OR5EM,OR5,OR52
    WRITE(3,177)
177 FORMAT(' ','CLASS 6 ')
    CALL STAT (OR6,OR62,OR6T,OR6SD,OR6AV,OR6EM)
    WRITE(3,172)OR6T,OR6AV,OR6SD,OR6EM,OR6,OR62
    WRITE(3,178)
178 FORMAT(' ','CLASS 7 ')
    CALL STAT (OR7,OR72,OR7T,OR7SD,OR7AV,OR7EM)
    WRITE(3,172)OR7T,OR7AV,OR7SD,OR7EM,OR7,OR72
    WRITE(3,179)
179 FORMAT(' ','CLASS 8 ')
    CALL STAT (OR8,OR82,OR8T,OR8SD,OR8AV,OR8EM)
    WRITE(3,172)OR8T,OR8AV,OR8SD,OR8EM,OR8,OR82
    WRITE(3,180)
180 FORMAT(' ','CLASS 9 ')
    CALL STAT (OR9,OR92,OR9T,OR9SD,OR9AV,OR9EM)
    WRITE(3,172)OR9T,OR9AV,OR9SD,OR9EM,OR9,OR92
    WRITE(3,181)
181 FORMAT(' ','NO GROUNDWATER EVIDENCE')
    CALL STAT ( DRY,DRY2,DRYT,DRYSD,DRYAV,DRYEM)
    WRITE(3,172)DRYT,DRYAV,DRYSD,DRYEM,DRY,DRY2
    WRITE(3,182)
182 FORMAT(' ','GROUNDWATER EVIDENCE')
    CALL STAT (WET,WET2,WETT,WETSD,WETAV,WETEM)
    WRITE(3,172)WETT,WETAV,WETSD,WETEM,WET,WET2
    WRITE(3,382)
382 FORMAT(' ','UNDISTURBED LAND')
    CALL STAT (VIR,VIR2,VIRT,VIRSD,VIRAV,VIREM)
    WRITE(3,172)VIRT,VIRAV,VIRSD,VIREM,VIR,VIR2
    WRITE(3,183)
183 FORMAT(' ','CABIN AND RECREATION AREAS')
    CALL STAT (CAB,CAB2,CABT,CABSD,CABAV,CABEM)
    WRITE(3,172)CABT,CABAV,CABSD,CABEM,CAB,CAB2
    WRITE(3,184)
184 FORMAT(' ','CATTLE HAVE ACCESS TO SHORE')
    CALL STAT (COW,COW2,COWT,COWSD,COWAV,COWEM)
    WRITE(3,172)COWT,COWAV,COWSD,COWEM,COW,COW2
```

```
      WRITE(3,185)
  185 FORMAT(' ','GRAVEL ALLUVIUM BANKS')
      CALL STAT (GRL,GRL2,GRLT,GRLSD,GRLAV,GRLEM)
      WRITE(3,172)GRLT,GRLAV,GRLSD,GRLEM,GRL,GRL2
      WRITE(3,186)
  186 FORMAT(' ','SLOPE ANGLES OF GRAVEL BANKS')
      CALL STAT (GRLL, GRLL2,GRLLT,GRLLSD,GRLLAV,GRLLEM)
      WRITE(3,172)GRLLT,GRLLAV,GRLLSD,GRLLEM,GRLL,GRLL2
      WRITE(3,187)
  187 FORMAT(' ','GRAVEL BANKS NO GROUNDWATER')
      CALL STAT (GRLD,GRLD2,GRLDT,GRLDSD,GRLDAV,GRLDEM)
      WRITE(3,172)GRLDT,GRLDAV,GRLDSD,GRLDEM,GRLD,GRLD2
      WRITE(3,688)
  688 FORMAT(' ','GRL BANKS WITH GROUNDWATER')
      CALL STAT (GRLW,GRLW2,GRLWT,GRLWSD,GRLWAV,GRLWEM)
      WRITE(3,172)GRLWT,GRLWAV,GRLWSD,GRLWEM,GRLW,GRLW2
      WRITE(3,188)
  188 FORMAT(' ','SHALE BANKS')
      CALL STAT (SH,SH2,SHT,SHSD,SHAV,SHEM)
      WRITE(3,172)SHT,SHAV,SHSD,SHEM,SH,SH2
      WRITE(3,189)
  189 FORMAT(' ','SLOPE ANGLES OF SHALE BANKS')
      CALL STAT (SHL,SHL2,SHLT,SHLSD,SHLAV,SHLEM)
      WRITE(3,172)SHLT,SHLAV,SHLSD,SHLEM,SHL,SHL2
      WRITE(3,190)
  190 FORMAT(' ','SHALE BANKS NO GROUNDWATER')
      CALL STAT (SHD,SHD2,SHDT,SHDSD,SHDAV,SHDEM)
      WRITE(3,172)SHDT,SHDAV,SHSDS,SHDEM,SHD,SHD2
      WRITE(3,191)
  191 FORMAT(' ','SHALE BANKS WITH GROUNDWATER')
      CALL STAT (SHW,SHW2,SHWT,SHWSD,SHWAV,SHWEM)
      WRITE(3,172)SHWT,SHWAV,SHWSD,SHWEM,SHW,SHW2
      WRITE(3,192)
  192 FORMAT(' ','TILL BANKS')
      CALL STAT (TIL,TIL2,TILT,TILSD,TILAV,TILEM)
      WRITE(3,172)TILT,TILAV,TILSD,TILEM,TIL,TIL2
      WRITE(3,193)
  193 FORMAT(' ','SLOPE ANGLES OF TILL BANKS')
      CALL STAT (TILL,TILL2,TILLT,TILLSD,TILLAV,TILLEM)
      WRITE(3,172)TILLT,TILLAV,TILLSD,TILLEM,TILL,TILL2
      WRITE(3,194)
  194 FORMAT(' ','TILL BANKS NO GROUNDWATER')
      CALL STAT (TILD,TILD2,TILDT,TILDSD,TILDAV,TILDEM)
      WRITE(3,172)TILDT,TILDAV,TILDSD,TILDEM,TILD,TILD2
      WRITE(3,195)
  195 FORMAT(' ','TILL BANKS WITH GROUNDWATER')
      CALL STAT (TILW,TILW2,TILWT,TILWSD,TILWAV,TILWEM)
      WRITE(3,172)TILWT,TILWAV,TILWSD,TILWEM,TILW,TILW2
      WRITE(3,333) TLOC
  333 FORMAT (' ','NUMBER OF STATIONS USED IN THIS PROGRAM',F5.0)
      STOP
      END
```

```
C SUBROUTINE STAT
      SUBROUTINE STAT (X,X2,COUNT,SD,AVG,EMEAN)
      IF(COUNT-2) 201,201,200
C CALCULATING MEAN AND STANDARD DEVIATION
  200 SD=SQRT((X2-((X*X)/COUNT))/(COUNT-1.))
      AVG=X/COUNT
      EMEAN=SD/(COUNT)**.5
      GO TO 202
  201 SD=0.
      AVG=0
      EMEAN=0
  202 CONTINUE
      RETURN
      END
```

```
C PROGRAM 3
      DIMENSION MATR(1600),SBE(1600),LAND(1600),MAT(40,100)
      N=0
   11 N=N+1
      READ(1,1) MATR(N),SBE(N),LAND(N)
    1 FORMAT(5X,I5,10X,F10.2,I5,14X)
      IF(MATR(N)-1) 12,11,11
   12 CONTINUE
      NN=N-1
      DO 100 NMATR=1,3
      DO 20 I=1,40
      DO 20 J=1,100
      MAT(I,J)=0
   20 CONTINUE
      NUMT=0
      DO 98 INTV=10,400,10
      UNIT=INTV
      NUM=0
      DO 97 JJ=1,NN
      IF(MATR(JJ)-NMATR)97,23,97      or  IF(LAND(JJ)-NMATR)97,23,97
   23 IF(SBE(JJ)-UNIT)24,24,97
   24 NUM=NUM+1
   97 CONTINUE
      NUMC=0
      NUMC=NUM-NUMT
      NUMT=NUM
      IR=INTV/10
      IF(NUMC-200) 26,26,27
   27 MAT(IR,1)=4
      GO TO 98
   26 IC=NUMC/2
      IF(IC) 98,98,25
   25 MAT(IR,IC)=1
   98 CONTINUE
      WRITE(3,50)NMATR
   50 FORMAT('1',' ','BANK MATERIAL CODE =',I3)
      WRITE(3,51)((MAT(I,K)K=1,100),I=1,40)
   51 FORMAT(' ',100I1)
  100 CONTINUE
      STOP
      END
```

```
C PROGRAM 4
      DIMENSION TAN(50),AMT(50),BANK(50),AMTL(50)
      TAN(1)=.01746
      TAN(2)=.03492
      READ(1,2) (TAN(J),J=3,50)
    2 FORMAT(8F10.5)
  111 READ(1,3)PER,DEPTH,BERM,SHORE,LS,LW,LR,LM,SED,SED2,ITABLE
    3 FORMAT(4F5.1,4I5,2A4,I2)
      IF(PER)101,101,4
    4 DO 1 J=1,50
      AMT(J)=0
      AMTL(J)=0
      BANK(J)=0
    1 CONTINUE
      A2=0.
      C2=DEPTH
      C1=C2/(-1.*TAN(LW))
      BR=C2+TAN(LR)*C1
      DO 100 LL=4,29
   98 A2=A2+.1
      A1=A2/(-1.*TAN(LS))
      BL=A2+TAN(LL)*A1
      B1=BL/(TAN(LL)-TAN(LW))
      B2=-1.*TAN(LW)*B1
      D1=(BR-BL)/(TAN(LR)-TAN(LL))
      D2=-1.*TAN(LL)*D1+BL
      Y=SQRT(B1*B1+B2*B2)
      Z=SQRT(A1*A1+A2*A2)
      X=SQRT((B1-A1)*(B1-A1)+(B2-A2)*(B2-A2))
      A=SQRT((C1-B1)*(C1-B1)+(C2-B2)*(C2-B2))
      B=SQRT((D1-C1)*(D1-C1)+(D2-C2)*(D2-C2))
      C=SQRT((D1-B1)*(D1-B1)+(D2-B2)*(D2-B2))
      S1=(Y+Z+X)/2.
      S2=(A+B+C)/2.
      AREA1=SQRT(S1*(S1-X)*(S1-Y)*(S1-Z))
      AREA2=SQRT(S2*(S2-A)*(S2-B)*(S2-C))
      AREAB=SHORE*BERM
      CHECK=AREA1*PER*.01-(AREA2+AREAB)
      IF(CHECK) 99,40,40
   99 GO TO 98
   40 AMT(LL)=AREA1
      KPER=PER
      AMTL(LL)=AREA1-(AREAB+AREA2)
      BANK(LL)=A1
      WRITE(3,777)A2
  777 FORMAT(' ',F7.2)
  100 CONTINUE
      DO 300 LL= 30,33
      B2=DEPTH
      B1=B2/(-1.*TAN(LW))
      BL=B2+TAN(LL)*B1
      A1=BL/(TAN(LL)-TAN(LS))
      A2=-1.*TAN(LS)*A1
```

```
      X=SQRT((B1-A1)*(B1-A1)+(B2-A2)*(B2-A2))
      Y=SQRT(B1*B1+B2*B2)
      Z=SQRT(A1*A1+A2*A2)
      S1=(Y+Z+X)/2.
      AREA1=SQRT(S1*(S1-X)*(S1-Y)*(S1-Z))
      AREAB=SHORE*BERM
      AMTL(LL)=AREA1-AREAB
      AMT(LL=AREA1
      BANK(LL)=A1
  300 CONTINUE
      WRITE(2,667) (AMT(KK),KK=1,48)
  667 FORMAT(1X,8F9.2)
      WRITE(3,10)ITABLE
   10 FORMAT('1',//////,14X,33X,'TABLE ',I2,/)
      WRITE(3,11) DEPTH,KPER,LW,LR,LS,SED,SED2
   11 FORMAT(' ',16X,'BEACH EROSION ASSUMING WAVE ACTION TO ',F4.1,'FEET
     1-',/,17X,I2,' PERCENT SAND SIZED OR GREATER BANK-LITTORAL',/,17X,'
     2SLOPE OF ',I2,' DEGREES-REPOSE ANGLE OF ',I2,' DEGREES-',/,17X,'BA
     3NK OF ',I2,' DEGREES AND BANK MATERIAL COMPOSED OF ',2A4,//)
      WRITE(3,12)
   12 FORMAT(14X,3('SA  AMT   AMTL  '))
      DO 113 N=1,16
      NL1=N
      NL2=N+16
      NL3=N+32
      WRITE(3,13)NL1,AMT(N),AMTL(N),NL2,AMT(N+16),AMTL(N+16),NL3
     1, AMT(N+32),AMTL(N+32)
   13 FORMAT(14X,3(I2,2F6.0,2X))
  113 CONTINUE
      GO TO 111
  101 CONTINUE
      STOP
      END
```

Appendix D

BANK EROSION MEASUREMENTS

Shoreline Stations

To aid the reader in locating the key stations along the shoreline of Lake Ashtabula the following listing was prepared. The west shoreline stations (numbered from 1001 to 2089) are as follows:

1001	fenceline north of Baldhill Dam
1055-1075	John Heimes' cabins
1136-1154	Howard Martin's cabins
1245-1261	Sadek's cabins
1293-1306	Kattie Olson's landing and cabins
1530-1561	Baldhill Creek
1617-1618	Ashtabula Bridge
1701-1727	Highway 26 Recreational Area
1840-1841	Keys Bridge
2085-2086	Burlington Northern Railway Bridge.

The key station locations on the east shoreline of Lake Ashtabula (numbered from 3000 to 3950) are as follows:

3000	powerlines south of Burlington Northern Railway Bridge
3235-3236	Keys Bridge

3307-3334	cabins, across from Highway 26 Recreational Area
3471-3472	Ashtabula Bridge
3526-3546	large shale banks across from Baldhill Creek
3682-3683	Bayshore Resort
3732-3743	National Guard Camp
3830-3847	Camp Ritchie and Lakeview Resort
3950	Baldhill Dam.

Shoreline Material
(Bank Material)

The dominent shoreline material was noted. If till over shale, or some other combination was present, an estimate of which type of sediment had the greater erosion was made. This sediment was recorded as the bank material for that station. The material was numerically coded as follows:

(1) all bank material except shale and till
(2) shale
(3) till.

Land Use

Shoreline land use was numerically classified into three groups:

(1) livestock have access to shore
(2) recreational areas (includes private cabin areas)
(3) refuge and hayland areas.

Slope of Valley Wall
(Bank Slope)

The slope of the valley wall immediately above the shoreline was measured in degrees, using a Brunton compass.

Orientation

The orientation of a beach was determined by facing parallel to the shoreline with the right shoulder toward the lake. The degree heading which one is facing is the orientation. As an example, assume the beach runs northwest to southeast and you are on the southwest shore of the lake. With your right shoulder to the lake you would be facing northwest for an orientation of 315 degrees. With the same beach trend but on the northeast shore of the lake the orientation would be 135 degrees.

The orientation values were grouped in the following classes:

Class 1	1 -40°	Class 5	161 -200°
Class 2	41 -80°	Class 6	201 -240°
Class 3	81 -120°	Class 7	241 -280°
Class 4	121 -160°	Class 8	281 -320°
		Class 9	321 -360°.

Groundwater

Evidence for groundwater was flowing springs, saturated bank material, spongy beaches, lagoonal development, and mud flows. The presence or absence of groundwater evidence was numerically coded as 1 or 0.

Bank Height

Bank height was defined as the vertical separation (in feet) from normal pool elevation (1,266.0) to the lowest undisturbed valley wall section along the shoreline. The surface of a slump block was assumed to be undisturbed.

TABLE 10

LISTING OF MEASURED AND CALCULATED SHORELINE VALUES

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1001	3	1	10	1	0	3.9	37.	436.	8.
1002	3	1	18	1	0	3.3	17.	1398.	1.
1003	3	1	13	1	0	2.8	30.	709.	4.
1004	3	1	16	4	0	7.8	56.	1077.	5.
1005	1	1	17	5	0	0.0	8.	1093.	1.
1006	3	1	16	1	0	5.7	45.	1077.	4.
1007	3	1	16	9	0	7.8	86.	1077.	8.
1008	3	1	17	2	0	5.3	54.	1224.	4.
1009	3	1	13	1	0	5.5	65.	709.	9.
1010	3	1	9	1	0	5.5	90.	358.	25.
1011	3	1	10	1	0	4.6	68.	436.	16.
1012	3	1	11	1	0	5.5	75.	516.	14.
1013	3	1	11	1	0	5.7	71.	516.	14.
1014	1	1	11	9	0	3.3	49.	461.	11.
1015	3	1	13	2	0	7.3	81.	709.	11.
1016	3	1	12	1	1	4.3	64.	609.	11.
1017	3	1	14	9	1	6.9	74.	819.	9.
1018	3	1	14	1	1	4.5	78.	819.	10.
1019	3	1	16	1	1	12.6	181.	1077.	17.
1020	3	1	19	2	1	6.2	77.	1595.	5.
1021	3	1	18	1	0	6.3	61.	1398.	4.
1022	3	1	16	1	0	6.3	62.	1077.	6.
1023	3	1	14	1	0	4.3	40.	819.	5.
1024	3	1	11	1	0	3.3	46.	516.	9.
1025	3	1	13	1	0	7.8	95.	709.	13.
1026	3	1	12	1	0	5.3	81.	609.	13.
1027	3	1	7	1	1	6.2	119.	222.	53.
1028	1	1	6	1	1	2.3	31.	144.	22.
1029	1	1	6	1	1	0.0	4.	144.	3.
1030	3	1	9	1	0	3.3	27.	358.	7.
1031	3	1	10	1	0	4.3	60.	436.	14.
1032	3	1	13	9	0	7.1	78.	709.	11.
1033	3	1	10	9	0	3.3	46.	436.	10.
1034	3	1	10	1	0	3.8	41.	436.	9.
1035	2	1	11	1	0	4.3	49.	1721.	3.
1036	3	1	12	1	0	5.3	66.	609.	11.
1037	3	1	12	1	0	6.3	84.	609.	14.
1038	3	1	12	1	0	5.3	75.	609.	12.
1039	3	1	12	1	0	6.3	88.	609.	15.
1040	3	1	12	9	1	6.3	75.	609.	12.
1041	1	1	13	1	1	2.3	22.	627.	4.
1042	3	1	10	2	1	3.7	43.	436.	10.
1043	3	1	9	1	0	6.2	83.	358.	23.
1044	1	1	8	1	0	2.2	28.	255.	11.
1045	1	1	8	1	0	1.7	17.	255.	7.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1046	3	1	8	1	0	4.2	65.	289.	23.
1047	3	1	9	1	0	7.2	121.	358.	34.
1048	1	1	7	9	0	4.2	96.	202.	48.
1049	3	1	12	1	0	5.2	70.	609.	11.
1050	3	1	14	9	0	7.7	77.	819.	9.
1051	1	1	11	1	0	1.2	37.	461.	8.
1052	2	1	11	1	0	10.2	156.	1721.	9.
1053	2	1	11	1	0	4.7	84.	1721.	5.
1054	2	2	11	1	0	5.2	76.	1721.	4.
1055	2	2	11	1	0	7.2	104.	1721.	6.
1056	2	2	14	9	0	4.2	51.	2571.	2.
1057	2	2	15	1	0	6.2	61.	2905.	2.
1058	2	2	15	1	0	5.2	54.	2905.	2.
1059	2	2	14	1	0	5.2	47.	2571.	2.
1060	2	2	11	1	0	3.2	32.	1721.	2.
1061	2	2	12	1	0	3.2	41.	1973.	2.
1062	2	2	15	9	0	9.2	99.	2905.	3.
1063	2	2	14	1	1	3.7	43.	2571.	2.
1064	2	2	14	1	1	3.7	34.	2571.	1.
1065	2	2	14	1	1	6.2	60.	2571.	2.
1066	2	2	14	1	1	4.2	61.	2571.	2.
1067	2	2	14	1	1	10.2	135.	2571.	5.
1068	2	2	11	1	1	4.2	52.	1721.	3.
1069	1	2	12	1	1	0.0	6.	541.	1.
1070	2	2	11	2	0	5.7	59.	1721.	3.
1071	2	1	7	2	0	6.0	162.	836.	19.
1072	2	1	10	2	0	8.2	149.	1478.	10.
1073	2	1	11	1	0	4.7	67.	1721.	4.
1074	2	1	10	1	0	3.7	30.	1478.	2.
1075	1	1	10	1	0	0.0	1.	389.	0.
1076	1	1	9	1	0	0.0	6.	318.	2.
1077	2	1	8	2	0	8.2	150.	1041.	14.
1078	2	1	8	2	1	6.2	119.	1041.	11.
1079	2	1	8	1	1	1.7	26.	1041.	2.
1080	2	1	7	2	1	3.2	39.	836.	5.
1081	2	1	6	1	1	4.0	85.	646.	13.
1082	2	1	10	1	1	6.2	102.	1478.	7.
1083	2	1	12	1	0	7.2	100.	1973.	5.
1084	2	1	10	1	0	4.2	92.	1478.	6.
1085	2	1	7	1	0	10.2	320.	836.	38.
1086	3	1	14	1	0	8.2	106.	819.	13.
1087	3	1	11	1	0	0.7	19.	516.	4.
1088	3	1	10	2	0	5.2	65.	436.	15.
1089	3	1	10	1	0	7.2	117.	436.	27.
1090	3	1	7	2	0	4.5	91.	222.	41.
1091	3	1	4	3	0	3.2	59.	53.	111.
1092	1	1	4	1	0	0.0	2.	47.	4.
1093	1	1	5	1	0	0.0	5.	97.	5.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1094	3	1	5	1	0	5.7	129.	104.	124.
1095	3	3	5	1	0	5.7	186.	104.	179.
1096	3	3	5	1	0	5.7	158.	104.	152.
1097	3	3	7	1	0	3.0	47.	222.	21.
1098	3	3	8	1	1	2.7	36.	289.	12.
1099	3	3	9	1	1	5.2	83.	358.	23.
1100	3	3	12	1	1	7.2	100.	609.	16.
1101	3	3	9	1	1	5.2	106.	358.	29.
1102	3	3	8	9	0	6.7	106.	289.	37.
1103	3	3	9	9	0	0.7	9.	358.	3.
1104	3	3	10	9	0	0.7	4.	436.	1.
1105	3	3	10	9	0	3.7	23.	436.	5.
1106	3	3	12	9	0	1.5	8.	609.	1.
1107	3	3	15	9	0	1.2	5.	942.	0.
1108	3	3	12	9	0	3.2	17.	609.	3.
1109	3	3	12	9	0	2.2	12.	609.	2.
1110	3	3	12	9	0	1.7	7.	609.	1.
1111	3	3	12	9	0	1.7	6.	609.	1.
1112	3	3	12	9	0	1.2	7.	609.	1.
1113	3	3	13	1	0	4.0	23.	709.	3.
1114	3	3	14	1	0	2.2	11.	819.	1.
1115	3	3	13	1	0	1.2	4.	709.	1.
1116	3	1	12	1	0	1.0	3.	609.	0.
1117	3	1	12	3	0	1.0	3.	609.	1.
1118	3	1	13	3	0	2.0	19.	709.	3.
1119	2	1	17	3	0	9.0	96.	3680.	3.
1120	2	1	19	3	0	8.0	82.	4629.	2.
1121	1	1	20	3	0	4.0	42.	1629.	3.
1122	2	1	24	3	0	9.0	72.	8401.	1.
1123	3	1	24	3	0	8.0	69.	3253.	2.
1124	3	1	20	3	0	6.0	61.	1825.	3.
1125	2	1	20	2	0	8.0	77.	5185.	1.
1126	2	1	20	2	0	7.0	64.	5185.	1.
1127	2	1	20	2	0	5.0	39.	5185.	1.
1128	3	1	20	2	0	5.0	34.	1825.	2.
1129	3	1	20	2	0	5.0	32.	1825.	2.
1130	3	1	20	2	0	4.0	24.	1825.	1.
1131	3	1	20	2	0	4.0	26.	1825.	1.
1132	2	1	19	2	0	6.0	32.	4629.	1.
1133	3	1	17	2	0	0.0	5.	1224.	0.
1134	1	1	15	2	0	4.0	21.	839.	2.
1135	1	2	15	2	0	4.0	29.	839.	3.
1136	1	2	15	2	0	3.5	24.	839.	3.
1137	1	2	15	2	0	3.5	23.	839.	3.
1138	1	2	15	2	0	3.5	23.	839.	3.
1139	1	2	15	2	0	3.5	23.	839.	3.
1140	1	2	15	2	0	3.5	23.	839.	3.
1141	1	2	15	2	0	3.5	23.	839.	3.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1142	1	2	15	2	0	3.5	23.	839.	3.
1143	1	2	15	2	0	3.5	23.	839.	3.
1144	1	2	15	2	0	3.5	23.	839.	3.
1145	1	2	15	2	0	3.5	22.	839.	3.
1146	1	2	15	1	0	3.0	18.	839.	2.
1147	1	2	15	1	0	3.0	17.	839.	2.
1148	1	2	15	1	0	3.0	17.	839.	2.
1149	1	2	15	1	1	3.0	17.	839.	2.
1150	1	2	15	1	1	3.0	17.	839.	2.
1151	1	2	15	1	1	3.0	17.	839.	2.
1152	1	2	15	1	0	3.0	17.	839.	2.
1153	1	2	15	1	0	3.0	17.	839.	2.
1154	1	1	15	1	0	3.0	17.	839.	2.
1155	1	1	15	1	0	3.0	15.	839.	2.
1156	1	1	15	2	0	2.0	9.	839.	1.
1157	1	1	15	2	0	2.0	7.	839.	1.
1158	1	1	15	2	0	2.0	7.	839.	1.
1159	1	1	15	2	0	2.0	7.	839.	1.
1160	1	1	15	2	0	2.0	7.	839.	1.
1161	1	1	15	2	0	2.0	7.	839.	1.
1162	1	1	15	2	0	2.0	9.	839.	1.
1163	3	1	15	5	0	3.0	15.	942.	2.
1164	3	1	15	5	0	3.0	17.	942.	2.
1165	3	1	15	5	0	3.0	17.	942.	2.
1166	3	1	15	5	0	3.0	17.	942.	2.
1167	3	1	15	5	0	3.0	19.	942.	2.
1168	3	2	15	5	0	4.0	32.	942.	3.
1169	3	2	18	5	0	6.0	55.	1398.	4.
1170	3	2	25	5	0	8.0	69.	3853.	2.
1171	3	2	34	5	0	10.0	74.	--	--
1172	2	2	36	5	0	12.0	76.	--	--
1173	3	2	26	3	0	5.0	37.	4643.	1.
1174	3	2	20	2	0	4.0	24.	1825.	1.
1175	3	1	20	2	0	4.0	18.	1825.	1.
1176	3	1	20	2	0	2.0	10.	1825.	1.
1177	1	1	18	2	0	4.0	16.	1245.	1.
1178	1	1	12	2	0	1.5	9.	541.	2.
1179	1	1	12	2	0	1.5	13.	541.	2.
1180	1	1	13	2	0	6.5	51.	627.	8.
1181	1	1	13	1	1	1.5	13.	627.	2.
1182	1	1	10	1	1	2.0	8.	389.	2.
1183	1	1	7	2	1	0.5	4.	202.	2.
1184	1	1	15	2	1	2.0	14.	839.	2.
1185	2	1	16	1	1	8.0	74.	3270.	2.
1186	2	1	21	1	1	5.0	44.	5821.	1.
1187	2	1	23	1	1	7.0	50.	7394.	1.
1188	2	1	28	1	1	6.0	55.	15388.	0.
1189	2	1	24	2	1	15.0	160.	8401.	2.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1238	3	1	12	1	0	4.0	32.	609.	5.
1239	3	1	12	1	0	4.0	32.	609.	5.
1240	3	1	10	1	0	2.0	13.	436.	3.
1241	3	1	6	1	0	1.0	6.	165.	4.
1242	3	1	5	1	0	1.0	6.	104.	5.
1243	3	1	5	1	0	1.0	8.	104.	7.
1244	3	1	5	1	0	2.0	36.	104.	34.
1245	1	1	6	2	0	6.0	104.	144.	72.
1246	1	1	6	2	0	2.0	43.	144.	30.
1247	1	1	6	2	0	4.0	43.	144.	30.
1248	1	1	6	2	0	0.0	6.	144.	4.
1249	1	1	6	2	0	3.0	19.	144.	13.
1250	1	2	6	2	0	0.0	1.	144.	1.
1251	1	2	8	2	0	0.0	2.	255.	1.
1252	1	2	9	2	0	5.0	55.	318.	17.
1253	1	2	10	2	0	5.0	66.	389.	17.
1254	1	2	10	1	0	4.0	45.	389.	12.
1255	1	2	10	1	0	3.0	28.	389.	7.
1256	1	2	10	1	0	3.0	26.	389.	7.
1257	1	2	10	1	0	3.0	26.	389.	7.
1258	1	2	10	5	0	3.0	26.	389.	7.
1259	1	2	10	5	0	3.0	23.	389.	6.
1260	1	2	10	3	0	2.2	14.	389.	4.
1261	1	2	10	3	0	1.7	9.	389.	2.
1262	1	2	9	2	0	1.7	10.	318.	3.
1263	1	3	8	1	0	2.0	14.	255.	5.
1264	1	3	8	1	0	2.0	14.	255.	6.
1265	1	3	8	1	0	2.0	14.	255.	6.
1266	1	3	7	1	0	2.0	15.	202.	7.
1267	1	3	7	1	0	1.5	14.	202.	7.
1268	1	3	6	1	0	3.0	36.	144.	25.
1269	1	3	6	1	0	3.0	43.	144.	30.
1270	1	3	6	1	0	3.0	43.	144.	30.
1271	1	3	6	1	0	3.0	43.	144.	30.
1272	1	3	5	1	0	3.0	43.	97.	45.
1273	1	3	4	1	0	1.5	22.	47.	47.
1274	1	3	4	1	0	1.5	16.	47.	35.
1275	1	3	4	1	0	1.5	16.	47.	35.
1276	1	3	7	1	0	1.5	8.	202.	4.
1277	1	3	6	1	0	1.0	6.	144.	4.
1278	1	2	6	1	0	1.0	4.	144.	3.
1279	1	2	7	1	0	0.5	7.	202.	4.
1280	3	2	10	1	0	5.0	49.	436.	11.
1281	3	3	12	9	0	4.5	48.	609.	8.
1282	3	1	12	9	0	4.0	39.	609.	6.
1283	3	1	12	8	0	4.0	39.	609.	6.
1284	3	1	12	8	0	4.5	44.	609.	7.
1285	3	1	14	8	0	4.0	29.	819.	4.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1286	3	1	12	8	0	2.5	16.	609.	3.
1287	3	1	10	8	0	1.5	7.	436.	2.
1288	3	1	6	9	0	1.0	6.	165.	3.
1289	3	1	6	9	0	1.0	10.	165.	6.
1290	3	1	7	9	0	3.5	39.	222.	17.
1291	3	1	7	9	0	3.5	41.	222.	18.
1292	3	1	6	9	0	1.5	19.	165.	12.
1293	3	2	6	9	0	2.5	24.	165.	15.
1294	3	2	6	9	0	2.0	24.	165.	15.
1295	3	2	6	9	0	3.0	40.	165.	25.
1296	3	2	6	8	0	3.5	53.	165.	32.
1297	3	2	7	8	0	3.0	35.	222.	16.
1298	2	2	11	8	0	2.0	18.	1721.	1.
1299	2	2	12	8	0	5.0	76.	1973.	4.
1300	2	1	12	8	1	12.0	235.	1973.	12.
1301	2	1	13	8	1	7.0	127.	2259.	6.
1302	2	1	14	9	1	6.0	64.	2571.	3.
1303	2	1	14	9	1	3.0	25.	2571.	1.
1304	2	1	13	8	1	3.0	21.	2259.	1.
1305	2	1	11	8	0	3.5	30.	1721.	2.
1306	2	1	8	8	0	3.5	55.	1041.	5.
1307	2	1	7	8	0	6.0	135.	836.	16.
1308	2	1	6	8	0	7.0	201.	646.	31.
1309	2	1	8	9	0	5.0	95.	1041.	9.
1310	3	1	11	9	0	4.0	45.	516.	9.
1311	2	1	12	8	1	4.0	67.	1973.	3.
1312	2	1	19	8	1	12.0	239.	4629.	5.
1313	2	1	24	8	1	25.0	527.	8401.	6.
1314	2	1	25	8	1	18.0	360.	9588.	4.
1315	2	1	24	8	1	13.0	225.	8401.	3.
1316	2	1	19	8	1	15.0	291.	4629.	6.
1317	2	1	13	8	1	12.0	303.	2259.	13.
1318	2	1	10	8	1	8.0	152.	1478.	10.
1319	2	1	12	1	1	0.0	17.	1973.	1.
1320	2	1	15	1	1	8.0	67.	2905.	2.
1321	3	1	16	2	0	4.0	35.	1077.	3.
1322	3	1	13	9	0	3.0	19.	709.	3.
1323	2	1	7	8	0	2.0	14.	836.	2.
1324	2	1	2	1	0	0.0	14.	--	--
1325	2	1	7	5	0	4.0	55.	836.	7.
1326	2	1	10	9	0	6.0	126.	1478.	9.
1327	2	1	13	9	0	12.0	189.	2259.	8.
1328	2	1	10	9	0	2.0	42.	1478.	3.
1329	2	1	8	9	0	3.0	32.	1041.	3.
1330	2	1	10	9	0	4.0	28.	1478.	2.
1331	2	1	13	9	0	0.0	2.	2259.	0.
1332	2	1	14	9	0	2.0	6.	2571.	0.
1333	2	1	13	9	0	2.0	7.	2259.	0.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1334	1	1	9	9	0	1.0	4.	318.	1.
1335	1	1	8	9	0	1.0	8.	255.	3.
1336	3	1	12	9	0	4.0	21.	609.	3.
1337	3	1	11	9	0	1.0	6.	516.	1.
1338	3	1	10	9	0	1.5	7.	436.	2.
1339	3	1	11	9	0	2.5	15.	516.	3.
1340	3	1	12	9	0	3.0	22.	609.	4.
1341	3	1	14	9	0	4.0	26.	819.	3.
1342	3	1	14	9	0	2.5	12.	819.	1.
1343	2	1	15	9	0	0.6	17.	2905.	1.
1344	2	1	18	9	0	13.0	173.	4121.	4.
1345	2	1	17	9	0	11.0	166.	3680.	5.
1346	1	1	13	9	0	3.5	58.	627.	9.
1347	3	1	12	9	0	6.0	97.	609.	16.
1348	3	1	12	9	0	11.0	191.	609.	31.
1349	3	1	15	9	0	4.0	55.	942.	6.
1350	3	1	16	9	0	5.5	78.	1077.	7.
1351	2	1	14	9	0	14.0	254.	2571.	10.
1352	2	1	14	9	0	6.0	98.	2571.	4.
1353	3	1	13	9	0	4.0	35.	709.	5.
1354	3	1	14	9	0	2.0	13.	819.	2.
1355	3	1	14	9	0	3.0	25.	819.	3.
1356	3	1	14	9	0	7.0	103.	819.	13.
1357	3	1	16	9	0	12.0	205.	1077.	19.
1358	3	1	16	9	0	10.0	217.	1077.	20.
1359	3	1	16	9	0	15.0	287.	1077.	27.
1360	2	1	11	9	0	7.0	168.	1721.	10.
1361	2	1	11	9	0	5.5	75.	1721.	4.
1362	3	1	12	9	0	3.5	35.	609.	6.
1363	3	1	11	9	0	3.5	24.	516.	5.
1364	3	1	6	9	0	1.0	10.	165.	6.
1365	3	1	9	9	0	1.0	2.	358.	1.
1366	3	1	12	9	0	0.0	0.	609.	0.
1367	3	1	13	9	0	0.0	0.	709.	0.
1368	3	1	13	9	0	0.0	0.	709.	0.
1369	3	1	13	9	0	0.0	0.	709.	0.
1370	3	1	13	9	0	0.0	2.	709.	0.
1371	3	1	15	9	0	5.0	47.	942.	5.
1372	2	1	17	9	0	10.0	116.	3680.	3.
1373	2	1	14	9	0	5.5	72.	2571.	3.
1374	2	1	11	9	0	4.0	33.	1721.	2.
1375	1	1	11	9	0	0.0	4.	461.	1.
1376	1	1	12	9	0	3.0	19.	541.	3.
1377	3	1	13	9	0	5.0	52.	709.	7.
1378	3	1	11	9	0	6.5	109.	516.	21.
1379	2	1	14	9	0	8.0	136.	2571.	5.
1380	2	1	14	9	0	11.0	201.	2571.	8.
1381	2	1	13	9	0	8.0	150.	2259.	7.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1382	2	1	12	9	0	7.0	102.	1973.	5.
1383	3	1	13	9	0	3.5	38.	709.	5.
1384	3	1	11	9	0	4.0	38.	516.	7.
1385	1	1	9	9	0	3.5	48.	318.	15.
1386	1	1	10	9	0	5.5	64.	389.	16.
1387	1	1	11	9	0	3.0	41.	461.	9.
1388	3	1	9	9	0	6.5	101.	358.	28.
1389	1	1	10	9	0	5.0	73.	389.	19.
1390	3	1	12	9	0	4.0	36.	609.	6.
1391	3	1	11	9	0	2.5	27.	516.	5.
1392	3	1	14	9	0	5.5	55.	819.	7.
1393	3	1	17	9	0	7.0	51.	1224.	4.
1394	3	1	16	9	0	0.0	3.	1077.	0.
1395	3	1	15	9	0	1.0	1.	942.	0.
1396	3	1	14	9	0	1.0	4.	819.	0.
1397	1	1	12	9	0	3.0	19.	541.	3.
1398	1	1	12	9	0	4.0	33.	541.	6.
1399	1	1	12	9	0	3.5	32.	541.	6.
1400	1	1	12	9	0	4.0	36.	541.	7.
1401	3	1	12	9	0	4.0	33.	609.	5.
1402	3	1	11	9	0	2.5	19.	516.	4.
1403	3	1	8	9	0	2.5	24.	289.	8.
1404	3	1	8	9	0	3.0	32.	289.	11.
1405	3	1	11	9	0	3.5	29.	516.	6.
1406	3	1	10	9	0	3.0	28.	436.	7.
1407	3	1	10	9	0	3.5	42.	436.	10.
1408	3	1	13	9	0	6.0	60.	709.	8.
1409	2	1	14	9	0	4.0	48.	2571.	2.
1410	2	1	14	9	0	7.5	118.	2571.	5.
1411	2	1	17	9	0	12.0	150.	3680.	4.
1412	2	1	17	9	0	2.0	22.	3680.	1.
1413	2	1	13	9	0	2.0	19.	2259.	1.
1414	2	1	11	9	0	8.0	151.	1721.	9.
1415	2	1	10	9	0	12.0	313.	1478.	21.
1416	2	1	12	9	0	7.0	124.	1973.	6.
1417	3	1	13	9	0	3.5	35.	709.	5.
1418	3	1	13	9	0	3.0	21.	709.	3.
1419	3	1	12	9	0	3.0	17.	609.	3.
1420	3	1	12	8	0	1.0	4.	609.	1.
1421	3	1	12	8	0	1.0	2.	609.	0.
1422	3	1	12	8	0	1.0	2.	609.	0.
1423	3	1	12	8	0	1.0	4.	609.	1.
1424	3	1	12	8	0	3.0	15.	609.	2.
1425	3	1	12	8	0	2.0	11.	609.	2.
1426	3	1	13	8	0	2.0	9.	709.	1.
1427	3	1	13	8	0	2.0	9.	709.	1.
1428	3	1	13	8	0	2.0	9.	709.	1.
1429	3	1	13	8	0	2.0	10.	709.	1.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1430	3	1	14	8	0	3.0	16.	819.	2.
1431	3	1	15	8	0	3.0	13.	942.	1.
1432	3	1	15	8	0	1.0	3.	942.	0.
1433	3	1	15	8	0	1.0	2.	942.	0.
1434	3	1	15	8	0	1.0	2.	942.	0.
1435	3	1	15	8	0	1.0	2.	942.	0.
1436	3	1	15	8	0	1.0	2.	942.	0.
1437	3	1	15	1	0	1.0	2.	942.	0.
1438	3	1	15	4	0	1.0	2.	942.	0.
1439	3	1	15	4	0	1.0	2.	942.	0.
1440	3	3	15	4	0	1.0	2.	942.	0.
1441	3	3	15	4	0	1.0	2.	942.	0.
1442	3	3	15	4	0	0.5	1.	942.	0.
1443	3	3	17	4	0	1.0	2.	1224.	0.
1444	3	3	18	4	0	2.0	5.	1398.	0.
1445	3	3	18	4	0	2.0	4.	1398.	0.
1446	3	3	18	4	0	0.0	1.	1398.	0.
1447	3	3	19	4	0	1.5	3.	1595.	0.
1448	3	3	17	4	0	3.0	12.	1224.	1.
1449	3	3	15	4	0	3.0	19.	942.	2.
1450	2	3	14	4	0	4.0	22.	2571.	1.
1451	3	3	13	4	0	1.0	7.	709.	1.
1452	2	3	12	4	0	3.0	15.	1973.	1.
1453	3	3	10	4	0	2.0	13.	436.	3.
1454	3	3	10	4	0	2.0	23.	436.	5.
1455	3	3	11	4	0	7.0	98.	516.	19.
1456	3	3	12	4	0	7.0	115.	609.	19.
1457	3	3	12	4	0	7.0	115.	609.	19.
1458	3	3	11	3	0	7.0	109.	516.	21.
1459	3	3	10	2	0	4.0	57.	436.	13.
1460	3	3	10	1	0	4.0	42.	436.	10.
1461	3	3	11	1	0	3.0	26.	516.	5.
1462	3	3	15	1	1	3.0	13.	942.	1.
1463	3	3	26	1	1	1.0	6.	4643.	0.
1464	2	3	25	1	1	8.0	55.	9588.	1.
1465	2	3	25	1	1	10.0	100.	9588.	1.
1466	2	3	24	1	1	10.0	98.	8401.	1.
1467	2	3	20	1	1	6.0	57.	5185.	1.
1468	1	3	16	1	1	4.5	59.	960.	6.
1469	2	3	17	1	1	11.0	166.	3680.	5.
1470	2	3	18	1	0	12.0	209.	4121.	5.
1471	2	3	17	1	0	11.0	142.	3680.	4.
1472	2	3	16	1	0	0.0	19.	3270.	1.
1473	2	3	14	1	0	9.0	89.	2571.	3.
1474	2	3	13	1	0	4.0	51.	2259.	2.
1475	1	3	14	1	0	4.0	29.	730.	4.
1476	1	3	14	1	0	3.0	25.	730.	3.
1477	2	3	13	1	0	5.0	46.	2259.	2.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1478	2	3	10	1	0	4.5	60.	1478.	4.
1479	2	3	10	1	0	4.5	55.	1478.	4.
1480	2	3	12	1	0	4.0	36.	1973.	2.
1481	1	3	13	1	0	3.0	22.	627.	3.
1482	2	3	13	1	0	3.0	15.	2259.	1.
1483	3	3	12	1	0	1.0	5.	609.	1.
1484	1	3	11	1	0	2.0	6.	461.	1.
1485	1	3	11	1	0	0.0	0.	461.	0.
1486	1	3	10	1	0	0.0	0.	389.	0.
1487	1	3	10	1	0	2.5	8.	389.	2.
1488	1	3	10	1	0	0.0	0.	389.	0.
1489	1	3	10	1	0	0.0	0.	389.	0.
1490	1	3	10	1	0	0.0	1.	389.	0.
1491	3	3	11	1	0	3.0	12.	516.	2.
1492	3	3	10	1	0	1.0	5.	436.	1.
1493	3	3	9	1	0	1.0	2.	358.	1.
1494	3	3	9	1	0	0.0	0.	358.	0.
1495	3	3	8	1	0	1.0	2.	289.	1.
1496	3	3	9	1	0	1.0	2.	358.	1.
1497	3	3	10	1	0	0.0	0.	436.	0.
1498	3	3	12	1	0	1.0	2.	609.	0.
1499	3	3	13	1	0	1.5	5.	709.	1.
1500	3	3	10	1	0	2.0	10.	436.	2.
1501	3	3	10	1	0	2.0	10.	436.	2.
1502	3	3	14	1	0	1.0	2.	819.	0.
1503	3	3	15	1	0	0.0	0.	942.	0.
1504	3	3	15	1	0	0.0	0.	942.	0.
1505	3	3	15	1	0	2.0	6.	942.	1.
1506	3	3	14	1	0	3.0	18.	819.	2.
1507	3	3	12	1	0	4.0	33.	609.	5.
1508	3	3	12	1	0	3.5	36.	609.	6.
1509	3	3	12	1	0	5.5	57.	609.	9.
1510	3	3	10	1	0	4.0	40.	436.	9.
1511	3	3	10	1	0	1.0	8.	436.	2.
1512	3	3	10	1	0	2.0	15.	436.	4.
1513	3	3	13	1	0	5.0	44.	709.	6.
1514	3	3	14	1	0	5.0	35.	819.	4.
1515	3	3	14	1	0	0.0	1.	819.	0.
1516	3	3	13	1	0	0.0	1.	709.	0.
1517	2	3	12	1	0	4.0	24.	1973.	1.
1518	2	3	12	1	0	3.0	17.	1973.	1.
1519	2	3	12	1	0	0.0	5.	1973.	0.
1520	2	3	14	1	0	6.0	50.	2571.	2.
1521	2	3	15	1	0	6.0	58.	2905.	2.
1522	2	3	15	1	0	3.5	27.	2905.	1.
1523	3	3	14	1	0	3.0	19.	819.	2.
1524	3	3	14	1	0	3.0	18.	819.	2.
1525	3	3	15	1	0	3.0	17.	942.	2.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1526	3	3	14	1	0	3.0	25.	819.	3.
1527	3	3	14	1	0	6.0	59.	819.	7.
1528	3	3	13	1	0	5.5	52.	709.	7.
1529	3	3	10	1	0	1.5	13.	436.	3.
1530	3	3	10	1	0	1.5	21.	436.	5.
1531	3	3	13	9	0	9.0	136.	709.	19.
1532	2	3	13	9	0	10.0	209.	2259.	9.
1533	3	3	13	8	0	10.0	202.	709.	29.
1534	3	3	14	7	1	8.0	118.	819.	14.
1535	3	3	15	7	1	4.0	38.	942.	4.
1536	3	3	14	7	1	3.0	16.	819.	2.
1537	3	3	14	7	1	1.0	3.	819.	0.
1538	3	3	14	7	0	0.0	4.	819.	0.
1539	3	3	15	8	0	7.0	53.	942.	6.
1540	3	3	17	8	0	4.0	26.	1224.	2.
1541	3	3	17	8	0	1.0	7.	1224.	1.
1542	3	3	16	8	0	4.0	19.	1077.	2.
1543	3	3	15	8	0	3.0	13.	942.	1.
1544	3	3	15	8	0	0.0	9.	942.	1.
1545	3	3	15	7	0	10.0	100.	942.	11.
1546	2	1	15	3	0	4.0	47.	2905.	2.
1547	2	1	15	3	0	4.0	27.	2905.	1.
1548	3	1	15	3	0	3.0	17.	942.	2.
1549	3	1	14	2	0	2.0	11.	819.	1.
1550	3	1	14	2	0	3.0	13.	819.	2.
1551	3	1	13	2	0	1.5	9.	709.	1.
1552	3	1	13	2	0	3.0	16.	709.	2.
1553	3	1	13	2	0	3.0	19.	709.	3.
1554	3	1	12	2	0	3.0	21.	609.	3.
1555	3	1	12	2	0	3.0	21.	609.	3.
1556	3	1	12	2	0	3.0	22.	609.	4.
1557	3	1	12	2	0	3.5	27.	609.	5.
1558	3	1	12	2	0	3.5	22.	609.	4.
1559	3	1	8	2	0	1.0	7.	289.	3.
1560	3	1	8	2	0	1.2	7.	289.	2.
1561	3	1	9	2	0	2.5	16.	358.	5.
1562	3	1	9	2	0	2.5	24.	358.	7.
1563	2	1	5	1	0	4.0	80.	472.	17.
1564	2	1	5	1	0	4.0	70.	472.	15.
1565	2	1	5	1	0	1.0	13.	472.	3.
1566	2	1	5	1	0	1.0	6.	472.	1.
1567	2	1	5	9	0	1.0	6.	472.	1.
1568	2	1	5	9	0	1.0	6.	472.	1.
1569	2	1	5	9	0	1.0	6.	472.	1.
1570	2	1	5	1	0	1.0	6.	472.	1.
1571	2	1	5	1	0	1.0	6.	472.	1.
1572	2	1	5	1	0	1.0	8.	472.	2.
1573	2	1	5	1	0	2.0	19.	472.	4.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1574	2	1	5	2	0	2.0	29.	472.	6.
1575	2	1	9	2	0	3.5	28.	1247.	2.
1576	2	1	9	3	0	2.0	16.	1247.	1.
1577	1	1	6	3	0	2.0	19.	144.	13.
1578	1	1	6	2	0	2.0	19.	144.	13.
1579	1	1	6	2	0	2.0	13.	144.	9.
1580	1	1	6	2	0	0.0	1.	144.	1.
1581	1	1	6	2	0	1.0	5.	144.	3.
1582	3	1	9	2	0	2.0	10.	358.	3.
1583	3	1	10	2	0	1.5	7.	436.	2.
1584	3	1	10	2	0	1.5	6.	436.	1.
1585	3	1	10	2	0	1.5	6.	436.	1.
1586	3	1	10	2	0	1.5	6.	436.	1.
1587	3	1	10	2	0	1.5	6.	436.	1.
1588	3	1	10	2	0	1.5	6.	436.	1.
1589	3	1	10	2	0	1.5	6.	436.	1.
1590	3	1	10	2	0	1.5	6.	436.	1.
1591	3	1	10	2	0	1.5	6.	436.	1.
1592	3	1	10	2	0	1.5	6.	436.	1.
1593	3	1	10	2	0	1.5	6.	436.	1.
1594	3	1	10	2	0	1.5	6.	436.	1.
1595	3	1	10	2	0	1.5	7.	436.	2.
1596	3	1	11	2	0	2.0	9.	516.	2.
1597	3	1	13	2	0	2.0	9.	709.	1.
1598	3	1	14	2	0	2.0	8.	819.	1.
1599	3	1	14	2	0	2.0	8.	819.	1.
1600	3	1	15	2	0	2.0	7.	942.	1.
1601	3	2	15	2	0	2.0	7.	942.	1.
1602	3	2	15	2	0	2.0	7.	942.	1.
1603	3	2	15	2	0	2.0	7.	942.	1.
1604	3	2	15	2	0	2.0	7.	942.	1.
1605	3	2	15	2	0	2.0	7.	942.	1.
1606	3	2	15	2	0	2.0	7.	942.	1.
1607	3	2	15	2	0	2.0	7.	942.	1.
1608	3	2	15	2	0	2.0	7.	942.	1.
1609	3	2	15	2	0	2.0	7.	942.	1.
1610	3	2	15	2	0	2.0	7.	942.	1.
1611	3	2	15	2	0	2.0	7.	942.	1.
1612	3	2	15	2	0	2.0	7.	942.	1.
1613	3	2	15	2	0	2.0	7.	942.	1.
1614	3	2	15	2	0	2.0	7.	942.	1.
1615	3	2	15	2	0	2.0	7.	942.	1.
1616	3	2	15	2	0	2.0	7.	942.	1.
1617	3	2	15	2	0	2.0	7.	942.	1.
1618	3	2	15	2	0	2.0	7.	942.	1.
1619	3	2	15	2	0	2.0	7.	942.	1.
1620	3	2	15	2	0	2.0	7.	942.	1.
1621	3	2	15	2	0	2.0	7.	942.	1.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1622	3	2	15	2	0	2.0	7.	942.	1.
1623	3	2	15	2	0	1.5	5.	942.	0.
1624	3	2	15	2	0	1.5	4.	942.	0.
1625	3	2	15	2	0	1.5	4.	942.	0.
1626	3	2	15	2	0	1.5	4.	942.	0.
1627	3	2	15	2	0	1.5	4.	942.	0.
1628	3	2	15	2	0	1.5	4.	942.	0.
1629	3	2	15	2	0	1.5	4.	942.	0.
1630	3	2	15	2	0	1.5	4.	942.	0.
1631	3	2	15	2	0	1.5	7.	942.	1.
1632	3	1	14	2	0	4.5	26.	819.	3.
1633	3	1	11	2	0	2.0	13.	516.	3.
1634	3	1	8	2	0	1.0	5.	289.	2.
1635	1	1	8	2	0	1.0	4.	255.	1.
1636	1	1	8	2	0	1.0	4.	255.	1.
1637	1	1	8	2	0	1.0	4.	255.	1.
1638	1	1	8	2	0	1.0	5.	255.	2.
1639	1	1	9	2	0	2.0	10.	318.	3.
1640	1	1	10	2	0	1.5	7.	389.	2.
1641	1	1	11	2	0	1.5	5.	461.	1.
1642	1	1	10	1	0	0.5	2.	389.	0.
1643	3	1	10	1	0	1.0	3.	436.	1.
1644	3	1	12	1	0	1.5	3.	609.	1.
1645	3	1	12	1	0	0.0	0.	609.	0.
1646	3	1	10	1	0	1.0	4.	436.	1.
1647	3	1	10	1	0	3.0	18.	436.	4.
1648	3	1	10	1	0	2.0	11.	436.	3.
1649	3	1	10	1	0	1.0	4.	436.	1.
1650	3	1	10	1	0	1.0	4.	436.	1.
1651	3	1	11	1	0	2.5	11.	516.	2.
1652	3	3	11	1	0	1.5	8.	516.	2.
1653	3	3	10	1	1	2.0	10.	436.	2.
1654	3	3	10	1	1	2.0	10.	436.	2.
1655	3	3	11	1	1	1.0	6.	516.	1.
1656	3	3	12	1	1	3.0	14.	609.	2.
1657	3	3	11	1	1	1.5	8.	516.	2.
1658	3	1	10	1	1	1.5	7.	436.	2.
1659	3	1	10	1	1	2.0	11.	436.	3.
1660	3	1	10	2	0	2.5	13.	436.	3.
1661	3	1	11	2	0	1.0	6.	516.	1.
1662	3	1	12	2	0	3.0	17.	609.	3.
1663	3	1	13	2	0	3.0	22.	709.	3.
1664	3	1	14	2	0	4.0	29.	819.	4.
1665	3	1	14	2	0	4.0	29.	819.	4.
1666	3	1	18	2	0	3.0	19.	1398.	1.
1667	3	1	23	2	0	5.0	22.	2783.	1.
1668	3	1	22	1	0	3.0	12.	2402.	1.
1669	3	1	19	1	0	2.0	8.	1595.	0.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1670	3	1	15	1	0	3.0	13.	942.	1.
1671	3	1	14	1	0	2.0	17.	819.	2.
1672	3	1	14	1	0	6.5	96.	819.	12.
1673	2	1	14	1	0	13.5	265.	2571.	10.
1674	2	1	17	1	0	8.5	107.	3680.	3.
1675	2	1	18	8	0	1.0	9.	4121.	0.
1676	2	1	16	8	1	2.0	7.	3270.	0.
1677	2	1	17	8	1	3.0	12.	3680.	0.
1678	2	1	11	8	1	2.0	12.	1721.	1.
1679	2	1	10	8	1	2.0	11.	1478.	1.
1680	2	1	10	8	1	2.0	11.	1478.	1.
1681	2	1	10	8	0	2.0	11.	1478.	1.
1682	2	1	10	8	0	2.0	11.	1478.	1.
1683	3	1	14	3	0	2.0	8.	819.	1.
1684	3	1	14	3	0	2.0	9.	819.	1.
1685	3	1	10	3	0	3.0	21.	436.	5.
1686	3	1	10	3	0	2.5	19.	436.	4.
1687	3	1	10	3	0	2.5	21.	436.	5.
1688	2	1	14	3	0	4.0	33.	2571.	1.
1689	2	1	14	3	0	6.0	57.	2571.	2.
1690	3	1	12	2	0	4.0	42.	609.	7.
1691	3	1	12	1	0	3.5	41.	609.	7.
1692	3	1	12	1	0	7.0	82.	609.	14.
1693	3	1	12	1	0	4.0	59.	609.	10.
1694	3	1	12	1	0	7.0	99.	609.	16.
1695	3	1	11	1	0	7.0	114.	516.	22.
1696	1	1	10	1	0	5.0	86.	389.	22.
1697	1	1	11	1	0	6.0	88.	461.	19.
1698	1	1	12	1	0	6.0	76.	541.	14.
1699	1	1	12	1	0	4.0	32.	541.	6.
1700	1	1	12	1	0	0.0	4.	541.	1.
1701	3	2	12	2	1	4.0	29.	609.	5.
1702	3	2	12	2	1	5.0	55.	609.	9.
1703	3	2	13	2	1	5.0	58.	709.	8.
1704	3	2	18	2	1	6.0	55.	1398.	4.
1705	3	2	21	2	1	7.0	50.	2084.	2.
1706	3	2	32	2	1	3.0	13.	37855.	0.
1707	2	2	32	2	0	5.0	17.	38365.	0.
1708	2	2	20	2	0	5.0	31.	5185.	1.
1709	2	2	19	2	0	3.5	20.	4629.	0.
1710	2	2	24	2	0	3.0	12.	8401.	0.
1711	2	2	26	2	0	4.0	19.	11047.	0.
1712	2	2	27	2	0	7.0	35.	12903.	0.
1713	2	2	25	2	0	4.0	23.	9588.	0.
1714	1	2	18	2	0	5.0	36.	1245.	3.
1715	2	2	21	2	0	5.0	28.	5821.	0.
1716	3	2	22	2	0	3.0	14.	2402.	1.
1717	2	2	20	2	0	3.5	16.	5185.	0.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1718	2	2	20	2	0	3.5	17.	5185.	0.
1719	2	2	19	2	0	3.5	24.	4629.	1.
1720	2	2	18	2	0	7.0	87.	4121.	2.
1721	2	2	18	1	0	13.5	215.	4121.	5.
1722	2	2	18	9	0	10.0	172.	4121.	4.
1723	2	2	18	9	0	10.0	134.	4121.	3.
1724	2	1	18	4	0	6.0	75.	4121.	2.
1725	2	1	18	1	0	8.0	75.	4121.	2.
1726	2	1	18	1	0	4.0	31.	4121.	1.
1727	2	1	17	1	0	3.0	18.	3680.	0.
1728	2	1	14	3	1	4.0	45.	2571.	2.
1729	2	1	17	3	1	9.5	120.	3680.	3.
1730	2	1	18	2	1	9.5	139.	4121.	3.
1731	2	1	21	2	1	9.5	96.	5821.	2.
1732	2	1	29	2	1	4.0	32.	19054.	0.
1733	2	1	34	2	1	10.0	49.	--	--
1734	2	1	35	2	0	5.0	40.	--	--
1735	2	1	35	2	0	15.0	106.	--	--
1736	2	1	31	2	0	8.0	59.	33094.	0.
1737	3	1	15	2	0	3.5	32.	942.	3.
1738	3	1	11	2	0	3.0	22.	516.	4.
1739	3	1	14	2	0	2.0	14.	819.	2.
1740	3	1	15	2	0	5.0	35.	942.	4.
1741	3	1	14	2	0	4.0	29.	819.	4.
1742	2	1	11	2	0	2.0	16.	1721.	1.
1743	2	1	16	2	0	3.0	21.	3270.	1.
1744	2	1	25	2	0	7.0	55.	9588.	1.
1745	2	1	21	2	0	12.0	153.	5821.	3.
1746	2	1	20	2	0	10.0	103.	5185.	2.
1747	2	1	20	2	0	0.0	10.	5185.	0.
1748	2	1	24	2	0	6.0	26.	8401.	0.
1749	2	1	25	2	0	5.0	20.	9588.	0.
1750	2	1	24	2	0	0.0	5.	8401.	0.
1751	2	1	23	2	0	8.0	45.	7394.	1.
1752	3	1	30	2	0	5.0	33.	21287.	0.
1753	2	1	27	2	0	9.0	58.	12903.	0.
1754	3	1	26	2	0	5.0	29.	4643.	1.
1755	3	1	18	2	0	3.0	21.	1398.	1.
1756	3	1	19	2	0	5.0	29.	1595.	2.
1757	3	1	20	2	0	4.0	30.	1825.	2.
1758	2	1	21	2	0	7.0	83.	5821.	1.
1759	2	1	28	2	0	16.0	207.	15388.	1.
1760	2	1	31	2	0	18.0	222.	33094.	1.
1761	2	1	38	2	0	10.0	68.	--	--
1762	2	1	38	2	0	4.0	14.	--	--
1763	2	1	31	2	0	2.0	5.	33094.	0.
1764	2	1	30	2	0	2.0	3.	28871.	0.
1765	2	1	30	2	0	2.0	3.	28871.	0.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1766	2	1	30	2	0	2.0	3.	28871.	0.
1767	2	1	29	1	0	2.0	6.	19054.	0.
1768	2	1	23	1	0	5.0	22.	7394.	0.
1769	2	1	12	1	0	4.0	41.	1973.	2.
1770	2	1	10	1	0	4.0	45.	1478.	3.
1771	3	1	10	1	1	4.0	42.	436.	10.
1772	2	1	10	1	1	3.0	28.	1478.	2.
1773	2	1	10	1	1	3.0	26.	1478.	2.
1774	3	1	10	1	1	3.0	26.	436.	6.
1775	3	1	11	1	1	3.0	26.	516.	5.
1776	3	1	16	1	1	4.0	26.	1077.	2.
1777	3	1	18	1	1	4.0	25.	1398.	2.
1778	3	1	17	1	1	4.0	24.	1224.	2.
1779	3	1	16	1	1	3.0	19.	1077.	2.
1780	2	1	19	1	1	4.0	20.	4629.	0.
1781	2	1	20	1	1	3.0	18.	5185.	0.
1782	3	1	23	1	1	6.0	29.	2783.	1.
1783	2	1	20	1	1	3.0	17.	5185.	0.
1784	2	1	18	1	1	3.0	17.	4121.	0.
1785	2	1	22	1	1	5.0	31.	6556.	0.
1786	2	1	32	1	1	7.0	30.	38365.	0.
1787	2	1	35	1	1	4.0	14.	--	--
1788	2	1	35	1	1	4.0	11.	--	--
1789	2	1	33	1	1	4.0	13.	45130.	0.
1790	2	1	25	1	1	5.0	20.	9588.	0.
1791	3	1	16	1	1	2.0	11.	1077.	1.
1792	3	1	15	1	1	2.0	7.	942.	1.
1793	3	1	15	1	1	2.0	9.	942.	1.
1794	2	1	19	1	1	3.0	12.	4629.	0.
1795	2	1	20	1	1	3.0	11.	5185.	0.
1796	2	1	18	1	1	2.0	10.	4121.	0.
1797	2	1	15	1	1	4.0	23.	2905.	1.
1798	2	1	24	1	1	3.0	18.	8401.	0.
1799	2	1	33	1	1	8.0	43.	45130.	0.
1800	2	1	35	1	1	10.0	62.	--	--
1801	2	1	34	1	1	8.0	51.	--	--
1802	2	1	30	1	1	8.0	44.	28871.	0.
1803	2	1	30	1	1	3.0	14.	28871.	0.
1804	2	1	30	1	1	4.0	23.	28871.	0.
1805	2	1	31	1	1	12.0	107.	33094.	0.
1806	2	1	38	1	1	16.0	138.	--	--
1807	2	1	36	1	1	12.0	78.	--	--
1808	2	1	23	1	1	0.0	16.	7394.	0.
1809	2	1	20	1	1	10.0	88.	5185.	2.
1810	2	1	28	1	1	8.0	65.	15388.	0.
1811	2	1	30	1	1	8.0	60.	28871.	0.
1812	2	1	30	1	1	10.0	99.	28871.	0.
1813	2	1	30	1	1	16.0	195.	28871.	1.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1814	2	1	30	1	1	16.0	226.	28871.	1.
1815	2	1	30	1	1	17.0	241.	28871.	1.
1816	2	1	30	1	1	16.0	226.	28871.	1.
1817	2	1	30	1	1	16.0	204.	28871.	1.
1818	2	1	34	1	1	12.0	113.	--	--
1819	2	1	35	1	0	10.0	76.	--	--
1820	2	1	35	1	0	10.0	71.	--	--
1821	2	1	32	1	0	10.0	75.	38365.	0.
1822	2	1	20	1	0	8.0	72.	5185.	1.
1823	1	2	10	1	0	1.5	19.	389.	5.
1824	1	2	8	1	0	1.5	8.	255.	3.
1825	1	2	8	1	0	1.5	8.	255.	3.
1826	1	2	8	1	0	1.5	8.	255.	3.
1827	1	2	8	1	0	1.5	8.	255.	3.
1828	1	2	8	1	0	1.5	8.	255.	3.
1829	1	2	8	1	0	1.5	8.	255.	3.
1830	1	2	8	1	0	1.5	8.	255.	3.
1831	1	2	8	1	0	1.5	8.	255.	3.
1832	1	2	8	1	0	1.5	8.	255.	3.
1833	1	2	8	1	0	1.5	8.	255.	3.
1834	1	2	8	1	0	1.5	8.	255.	3.
1835	1	2	8	1	0	1.5	8.	255.	3.
1836	1	2	8	1	0	1.5	8.	255.	3.
1837	1	2	8	1	0	1.5	8.	255.	3.
1838	1	2	8	1	0	1.5	8.	255.	3.
1839	1	2	8	1	0	1.5	8.	255.	3.
1840	1	2	8	1	0	1.5	7.	255.	3.
1841	1	2	8	9	0	1.0	4.	255.	2.
1842	1	2	8	9	0	1.0	4.	255.	1.
1843	1	2	8	9	0	1.0	4.	255.	1.
1844	1	2	8	9	0	1.0	4.	255.	1.
1845	1	2	8	9	0	1.0	4.	255.	1.
1846	1	2	8	9	0	1.0	4.	255.	1.
1847	1	2	8	9	0	1.0	4.	255.	1.
1848	1	2	8	9	0	1.0	4.	255.	1.
1849	1	2	8	9	0	1.0	4.	255.	1.
1850	1	2	8	9	0	1.0	4.	255.	1.
1851	1	2	8	9	0	1.0	4.	255.	1.
1852	1	2	8	9	0	1.0	4.	255.	1.
1853	1	2	8	9	0	1.0	4.	255.	1.
1854	1	2	8	9	0	1.0	4.	255.	1.
1855	1	2	8	9	0	1.0	4.	255.	1.
1856	1	2	8	9	0	1.0	4.	255.	1.
1857	1	2	8	9	0	1.0	4.	255.	1.
1858	1	2	8	9	0	1.0	4.	255.	1.
1859	1	2	8	9	0	1.0	4.	255.	1.
1860	1	2	8	9	0	1.0	4.	255.	1.
1861	1	2	8	9	0	1.0	4.	255.	1.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1862	1	2	8	9	0	1.0	4.	255.	1.
1863	1	2	8	9	0	1.0	4.	255.	1.
1864	1	2	8	9	0	1.0	4.	255.	1.
1865	1	2	8	9	0	1.0	4.	255.	1.
1866	1	2	8	9	0	1.0	4.	255.	1.
1867	1	2	8	9	0	1.0	2.	255.	1.
1868	1	3	8	9	0	0.0	0.	255.	0.
1869	1	3	8	9	0	0.0	0.	255.	0.
1870	1	3	8	9	0	0.0	0.	255.	0.
1871	1	3	8	9	0	0.0	0.	255.	0.
1872	1	3	8	9	0	0.0	0.	255.	0.
1873	1	3	8	9	0	0.0	0.	255.	0.
1874	1	3	8	9	0	0.0	0.	255.	0.
1875	1	3	8	9	0	0.0	0.	255.	0.
1876	1	3	8	9	0	0.0	0.	255.	0.
1877	1	3	8	9	0	0.0	0.	255.	0.
1878	1	3	8	9	0	0.0	0.	255.	0.
1879	1	3	8	9	0	0.0	0.	255.	0.
1880	1	3	8	9	0	0.0	0.	255.	0.
1881	1	3	8	9	0	0.0	0.	255.	0.
1882	1	3	8	9	0	0.0	0.	255.	0.
1883	1	3	8	9	0	0.0	0.	255.	0.
1884	1	3	8	9	0	0.0	0.	255.	0.
1885	1	3	8	9	0	0.0	0.	255.	0.
1886	1	3	9	9	0	0.0	0.	318.	0.
1887	3	1	13	8	0	0.5	0.	709.	0.
1888	3	1	15	8	0	0.5	0.	942.	0.
1889	3	1	15	8	0	0.5	0.	942.	0.
1890	3	1	15	8	0	0.5	0.	942.	0.
1891	3	1	15	8	0	0.5	0.	942.	0.
1892	3	1	15	8	0	0.5	0.	942.	0.
1893	3	1	15	8	0	0.5	0.	942.	0.
1894	3	1	15	8	0	0.5	0.	942.	0.
1895	3	1	15	8	0	0.5	0.	942.	0.
1896	3	1	15	8	0	0.5	0.	942.	0.
1897	3	1	15	8	0	0.5	0.	942.	0.
1898	3	1	15	8	0	0.5	0.	942.	0.
1899	3	1	15	8	0	0.5	0.	942.	0.
1900	3	1	15	8	0	0.5	0.	942.	0.
1901	3	1	15	8	0	0.5	0.	942.	0.
1902	3	1	15	8	0	0.5	0.	942.	0.
1903	3	1	15	8	0	0.5	0.	942.	0.
1904	3	1	15	8	0	0.5	0.	942.	0.
1905	3	1	15	8	0	0.5	0.	942.	0.
1906	3	1	15	8	0	0.5	0.	942.	0.
1907	3	1	15	8	1	0.5	0.	942.	0.
1908	3	1	15	8	1	0.5	0.	942.	0.
1909	3	1	15	8	1	0.5	1.	942.	0.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1910	3	1	16	8	1	1.0	1.	1077.	0.
1911	3	1	17	8	1	1.0	2.	1224.	0.
1912	3	1	17	8	0	1.0	2.	1224.	0.
1913	3	1	17	8	0	1.0	2.	1224.	0.
1914	3	1	17	8	0	1.0	2.	1224.	0.
1915	3	1	17	8	0	1.0	2.	1224.	0.
1916	3	1	17	8	0	1.0	2.	1224.	0.
1917	3	1	17	8	0	1.0	2.	1224.	0.
1918	3	1	17	8	0	1.0	2.	1224.	0.
1919	3	1	17	8	0	1.0	2.	1224.	0.
1920	3	1	17	8	0	1.0	2.	1224.	0.
1921	3	1	17	8	0	1.0	2.	1224.	0.
1922	3	1	17	8	0	1.0	2.	1224.	0.
1923	3	1	17	8	0	1.0	2.	1224.	0.
1924	3	1	17	8	0	1.0	2.	1224.	0.
1925	3	1	17	8	0	1.0	2.	1224.	0.
1926	3	1	17	8	0	1.0	2.	1224.	0.
1927	3	1	17	8	0	1.0	2.	1224.	0.
1928	3	1	17	8	0	1.0	2.	1224.	0.
1929	3	1	17	8	0	1.0	2.	1224.	0.
1930	3	1	17	8	0	1.0	2.	1224.	0.
1931	3	1	17	8	0	1.0	2.	1224.	0.
1932	3	1	17	8	0	1.0	2.	1224.	0.
1933	3	1	17	8	0	1.0	2.	1224.	0.
1934	3	1	17	8	0	1.0	2.	1224.	0.
1935	3	1	17	8	0	1.0	2.	1224.	0.
1936	3	1	17	8	0	1.0	2.	1224.	0.
1937	3	1	17	8	0	1.0	2.	1224.	0.
1938	3	1	17	8	0	1.0	2.	1224.	0.
1939	3	1	17	8	0	1.0	2.	1224.	0.
1940	3	1	17	8	0	1.0	2.	1224.	0.
1941	3	1	17	8	0	1.0	2.	1224.	0.
1942	3	1	17	8	0	1.0	2.	1224.	0.
1943	3	1	17	8	1	1.0	2.	1224.	0.
1944	3	1	17	8	1	1.0	2.	1224.	0.
1945	3	1	17	8	1	1.0	2.	1224.	0.
1946	3	1	17	8	0	1.0	2.	1224.	0.
1947	3	1	17	8	0	1.0	2.	1224.	0.
1948	3	1	17	8	0	1.0	2.	1224.	0.
1949	3	1	17	8	0	1.0	2.	1224.	0.
1950	3	1	17	8	0	1.0	2.	1224.	0.
1951	3	1	17	8	0	1.0	2.	1224.	0.
1952	3	1	17	8	0	1.0	2.	1224.	0.
1953	3	1	17	8	0	1.0	2.	1224.	0.
1954	3	1	17	8	0	1.0	2.	1224.	0.
1955	3	1	17	8	0	1.0	2.	1224.	0.
1956	3	1	17	8	0	1.0	2.	1224.	0.
1957	3	1	17	8	0	1.0	2.	1224.	0.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
1958	3	1	17	8	0	1.0	2.	1224.	0.
1959	3	1	17	8	0	1.0	2.	1224.	0.
1960	3	1	17	8	0	1.0	2.	1224.	0.
1961	3	1	17	8	0	1.0	2.	1224.	0.
1962	3	1	17	8	0	1.0	2.	1224.	0.
1963	3	1	17	8	0	1.0	2.	1224.	0.
1964	3	1	17	8	0	1.0	2.	1224.	0.
1965	3	1	17	8	0	1.0	2.	1224.	0.
1966	3	1	17	8	0	1.0	2.	1224.	0.
1967	3	1	17	8	0	1.0	2.	1224.	0.
1968	3	1	17	8	0	1.0	2.	1224.	0.
1969	3	1	17	8	0	1.0	2.	1224.	0.
1970	3	1	17	8	0	1.0	2.	1224.	0.
1971	3	1	17	8	0	1.0	2.	1224.	0.
1972	3	1	17	8	1	1.0	2.	1224.	0.
1973	3	1	17	8	1	1.0	2.	1224.	0.
1974	3	1	17	8	0	1.0	2.	1224.	0.
1975	3	1	17	8	0	1.0	2.	1224.	0.
1976	3	1	17	8	0	1.0	2.	1224.	0.
1977	3	1	20	8	0	1.0	1.	1825.	0.
1978	1	1	36	9	0	0.5	0.	--	--
1979	1	1	40	9	0	0.5	0.	--	--
1980	1	1	40	9	0	0.5	0.	--	--
1981	1	1	40	9	0	0.5	0.	--	--
1982	1	1	40	9	0	0.5	0.	--	--
1983	1	1	40	9	0	0.5	0.	--	--
1984	1	1	34	9	0	0.5	0.	--	--
1985	1	1	10	9	0	0.5	1.	389.	0.
1986	1	1	4	8	0	0.5	2.	47.	4.
1987	1	1	4	8	0	0.5	2.	47.	4.
1988	1	1	4	8	0	0.5	2.	47.	4.
1989	1	1	4	8	0	0.5	2.	47.	4.
1990	1	1	4	8	0	0.5	2.	47.	4.
1991	1	1	4	8	0	0.5	2.	47.	4.
1992	1	1	4	8	0	0.5	2.	47.	4.
1993	1	1	4	8	0	0.5	2.	47.	4.
1994	1	1	4	8	0	0.5	2.	47.	4.
1995	1	1	4	8	0	0.5	2.	47.	4.
1996	1	1	4	8	0	0.5	2.	47.	4.
1997	1	1	4	8	0	0.5	2.	47.	4.
1998	1	1	4	8	0	0.5	2.	47.	4.
1999	1	1	4	8	0	0.5	2.	47.	4.
2000	1	1	4	8	0	0.5	2.	47.	4.
2001	1	1	4	8	0	0.5	2.	47.	4.
2002	1	1	4	8	0	0.5	2.	47.	4.
2003	1	1	4	8	0	0.5	2.	47.	4.
2004	1	1	4	8	0	0.5	2.	47.	4.
2005	1	1	4	8	0	0.5	2.	47.	4.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
2006	1	1	4	8	0	0.5	2.	47.	4.
2007	1	1	4	8	0	0.5	2.	47.	4.
2008	1	1	4	8	0	0.5	2.	47.	4.
2009	1	1	4	8	0	0.5	2.	47.	4.
2010	1	1	5	8	0	0.5	5.	97.	5.
2011	3	1	13	8	0	3.0	14.	709.	2.
2012	3	1	15	8	0	3.0	17.	942.	2.
2013	3	1	15	8	0	3.0	17.	942.	2.
2014	3	1	15	8	0	3.0	17.	942.	2.
2015	3	1	15	8	0	3.0	17.	942.	2.
2016	3	1	15	8	0	3.0	17.	942.	2.
2017	3	1	15	8	0	3.0	17.	942.	2.
2018	3	1	15	8	0	3.0	17.	942.	2.
2019	3	1	15	8	0	3.0	17.	942.	2.
2020	3	1	15	8	0	3.0	17.	942.	2.
2021	3	1	15	8	0	3.0	17.	942.	2.
2022	3	1	15	8	0	3.0	17.	942.	2.
2023	3	1	15	8	0	3.0	17.	942.	2.
2024	3	1	15	8	0	3.0	17.	942.	2.
2025	3	1	15	9	0	3.0	17.	942.	2.
2026	3	1	15	9	0	3.0	17.	942.	2.
2027	3	1	15	9	0	3.0	17.	942.	2.
2028	3	1	15	9	0	3.0	17.	942.	2.
2029	3	1	15	9	0	3.0	17.	942.	2.
2030	3	1	15	9	0	3.0	17.	942.	2.
2031	3	1	15	9	0	3.0	17.	942.	2.
2032	3	1	15	9	0	3.0	17.	942.	2.
2033	3	1	15	9	0	3.0	17.	942.	2.
2034	3	1	15	9	0	3.0	17.	942.	2.
2035	3	1	15	9	0	3.0	17.	942.	2.
2036	3	1	15	9	0	3.0	17.	942.	2.
2037	3	1	15	9	0	3.0	17.	942.	2.
2038	3	1	15	9	0	3.0	17.	942.	2.
2039	3	1	15	9	0	3.0	17.	942.	2.
2040	3	1	15	9	0	3.0	17.	942.	2.
2041	3	1	15	9	0	3.0	17.	942.	2.
2042	3	1	15	9	0	3.0	17.	942.	2.
2043	3	1	15	9	0	3.0	17.	942.	2.
2044	3	1	15	9	0	3.0	17.	942.	2.
2045	3	1	15	9	0	3.0	17.	942.	2.
2046	3	1	15	9	0	3.0	14.	942.	1.
2047	3	1	15	9	0	1.5	6.	942.	1.
2048	3	1	15	9	0	1.5	4.	942.	0.
2049	3	1	15	9	0	1.5	4.	942.	0.
2050	3	1	15	9	0	1.5	4.	942.	0.
2051	3	1	15	9	0	1.5	4.	942.	0.
2052	3	1	15	9	0	1.5	4.	942.	0.
2053	3	1	15	9	0	1.5	4.	942.	0.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
2054	3	1	15	9	0	1.5	4.	942.	0.
2055	3	1	15	9	0	1.5	4.	942.	0.
2056	3	1	15	9	0	1.5	4.	942.	0.
2057	3	1	15	9	0	1.5	4.	942.	0.
2058	3	1	15	9	0	1.5	4.	942.	0.
2059	3	1	15	9	0	1.5	4.	942.	0.
2060	3	1	15	9	0	1.5	4.	942.	0.
2061	3	1	15	9	0	1.5	4.	942.	0.
2062	3	1	15	9	0	1.5	4.	942.	0.
2063	3	1	15	9	0	1.5	4.	942.	0.
2064	3	1	15	9	0	1.5	4.	942.	0.
2065	3	1	15	9	0	1.5	4.	942.	0.
2066	3	1	15	1	0	1.5	4.	942.	0.
2067	3	1	15	1	0	1.5	4.	942.	0.
2068	3	1	15	1	0	1.5	4.	942.	0.
2069	3	1	15	1	0	1.5	4.	942.	0.
2070	3	1	15	1	0	1.5	4.	942.	0.
2071	3	1	15	1	0	1.5	4.	942.	0.
2072	3	1	15	1	0	1.5	4.	942.	0.
2073	3	1	15	1	0	1.5	4.	942.	0.
2074	3	1	15	1	0	1.5	4.	942.	0.
2075	3	1	15	1	0	1.5	4.	942.	0.
2076	3	1	15	1	0	1.5	4.	942.	0.
2077	3	1	15	1	0	1.5	4.	942.	0.
2078	3	1	15	1	0	1.5	4.	942.	0.
2079	3	1	15	1	0	1.5	4.	942.	0.
2080	3	1	15	1	0	1.5	4.	942.	0.
2081	3	1	15	1	0	1.5	4.	942.	0.
2082	3	1	15	1	0	1.5	4.	942.	0.
2083	3	1	15	1	0	1.5	4.	942.	0.
2084	3	1	15	1	0	1.5	4.	942.	0.
2085	3	1	15	1	0	1.5	4.	942.	0.
2086	3	1	15	1	0	1.5	4.	942.	0.
2087	3	1	15	1	0	1.5	4.	942.	0.
2088	3	1	15	1	0	1.5	4.	942.	0.
2089	3	1	15	1	0	1.5	4.	942.	0.
3000	3	1	15	4	0	1.0	2.	942.	0.
3001	3	1	15	4	0	1.0	2.	942.	0.
3002	3	1	15	4	0	1.0	2.	942.	0.
3003	3	1	15	4	0	1.0	2.	942.	0.
3004	3	1	15	4	0	1.0	2.	942.	0.
3005	3	1	15	4	0	1.0	2.	942.	0.
3006	3	1	15	4	0	1.0	2.	942.	0.
3007	3	1	15	4	0	1.0	2.	942.	0.
3008	3	1	15	4	0	1.0	2.	942.	0.
3009	3	1	15	4	0	1.0	2.	942.	0.
3010	3	1	15	4	0	1.0	2.	942.	0.
3011	3	1	15	4	0	1.0	2.	942.	0.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3012	3	1	15	4	0	1.0	2.	942.	0.
3013	3	1	15	4	0	1.0	2.	942.	0.
3014	3	1	15	4	0	1.0	2.	942.	0.
3015	3	1	15	4	0	1.0	2.	942.	0.
3016	3	1	15	4	0	1.0	2.	942.	0.
3017	3	1	15	4	0	1.0	2.	942.	0.
3018	3	1	15	4	0	1.0	2.	942.	0.
3019	3	1	15	4	0	1.0	2.	942.	0.
3020	3	1	15	4	0	1.0	2.	942.	0.
3021	3	1	15	4	0	1.0	2.	942.	0.
3022	3	1	15	4	0	1.0	2.	942.	0.
3023	3	1	15	4	0	1.0	2.	942.	0.
3024	3	1	15	4	0	1.0	2.	942.	0.
3025	3	1	15	4	0	1.0	2.	942.	0.
3026	3	1	15	4	0	1.0	2.	942.	0.
3027	3	1	15	4	0	1.0	2.	942.	0.
3028	3	1	15	4	0	1.0	2.	942.	0.
3029	3	1	15	4	0	1.0	2.	942.	0.
3030	3	1	15	4	0	1.0	2.	942.	0.
3031	3	1	15	4	0	1.0	2.	942.	0.
3032	3	1	15	4	0	1.0	2.	942.	0.
3033	3	1	15	4	0	1.0	2.	942.	0.
3034	3	1	15	4	0	1.0	2.	942.	0.
3035	3	1	15	4	0	1.0	2.	942.	0.
3036	3	1	15	4	0	1.0	2.	942.	0.
3037	3	1	15	4	0	1.0	2.	942.	0.
3038	3	1	15	4	0	1.0	2.	942.	0.
3039	3	1	15	4	0	1.0	2.	942.	0.
3040	3	1	15	4	0	1.0	2.	942.	0.
3041	3	1	15	4	0	1.0	2.	942.	0.
3042	3	1	15	4	0	1.0	2.	942.	0.
3043	3	1	15	4	0	1.0	2.	942.	0.
3044	3	1	15	4	0	1.0	2.	942.	0.
3045	3	1	15	4	0	1.0	2.	942.	0.
3046	3	1	15	4	0	1.0	2.	942.	0.
3047	3	1	15	4	0	1.0	2.	942.	0.
3048	3	1	15	4	0	1.0	2.	942.	0.
3049	3	1	15	4	0	1.0	2.	942.	0.
3050	3	1	15	4	0	1.0	2.	942.	0.
3051	3	1	15	4	0	1.0	2.	942.	0.
3052	3	1	15	4	0	1.0	2.	942.	0.
3053	3	1	15	4	0	1.0	2.	942.	0.
3054	3	1	15	4	0	1.0	2.	942.	0.
3055	3	1	15	4	0	1.0	2.	942.	0.
3056	3	1	15	4	0	1.0	2.	942.	0.
3057	3	1	15	4	0	1.0	2.	942.	0.
3058	3	1	15	4	0	1.0	2.	942.	0.
3059	3	1	15	4	0	1.0	2.	942.	0.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3060	3	1	15	4	0	1.0	2.	942.	0.
3061	3	1	15	4	0	1.0	2.	942.	0.
3062	3	1	15	4	0	1.0	2.	942.	0.
3063	3	1	15	4	0	1.0	2.	942.	0.
3064	3	1	15	4	0	1.0	2.	942.	0.
3065	3	1	15	4	0	1.0	2.	942.	0.
3066	3	1	15	4	0	1.0	2.	942.	0.
3067	3	1	15	4	0	1.0	2.	942.	0.
3068	3	1	15	4	0	1.0	2.	942.	0.
3069	3	1	15	3	0	1.0	2.	942.	0.
3070	3	1	15	3	0	1.0	2.	942.	0.
3071	3	1	15	3	0	1.0	2.	942.	0.
3072	3	1	15	3	0	1.0	2.	942.	0.
3073	3	1	15	3	0	1.0	2.	942.	0.
3074	3	1	15	3	0	1.0	2.	942.	0.
3075	3	1	15	3	0	1.0	2.	942.	0.
3076	3	1	15	3	0	1.0	2.	942.	0.
3077	3	1	15	3	0	1.0	2.	942.	0.
3078	3	1	15	3	0	1.0	2.	942.	0.
3079	3	1	15	3	0	1.0	2.	942.	0.
3080	3	1	15	3	0	1.0	2.	942.	0.
3081	3	1	15	3	0	1.0	2.	942.	0.
3082	3	1	15	3	0	1.0	2.	942.	0.
3083	3	1	15	3	0	1.0	2.	942.	0.
3084	3	1	15	3	0	1.0	2.	942.	0.
3085	3	1	15	3	0	1.0	2.	942.	0.
3086	3	1	15	3	0	1.0	2.	942.	0.
3087	3	1	15	3	0	1.0	2.	942.	0.
3088	3	1	13	3	0	1.0	2.	709.	0.
3089	1	1	9	4	0	0.0	0.	318.	0.
3090	1	1	8	4	0	0.0	0.	255.	0.
3091	1	1	8	4	0	0.0	0.	255.	0.
3092	1	1	8	4	0	0.0	0.	255.	0.
3093	1	1	8	4	0	0.0	0.	255.	0.
3094	1	1	8	4	0	0.0	0.	255.	0.
3095	1	1	8	4	0	0.0	0.	255.	0.
3096	1	1	8	4	0	0.0	0.	255.	0.
3097	1	1	8	4	0	0.0	0.	255.	0.
3098	1	1	8	4	0	0.0	0.	255.	0.
3099	1	1	8	4	0	0.0	0.	255.	0.
3100	1	1	8	1	0	0.0	0.	255.	0.
3101	1	1	8	1	0	0.0	0.	255.	0.
3102	1	1	8	1	0	0.0	0.	255.	0.
3103	1	1	8	1	0	0.0	0.	255.	0.
3104	1	1	8	1	0	0.0	0.	255.	0.
3105	1	1	9	1	0	0.0	1.	318.	0.
3106	3	1	13	3	0	3.0	14.	709.	2.
3107	3	1	15	3	0	3.0	17.	942.	2.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3108	3	1	15	3	0	3.0	17.	942.	2.
3109	3	1	15	3	0	3.0	17.	942.	2.
3110	3	1	15	3	0	3.0	17.	942.	2.
3111	3	1	15	3	0	3.0	17.	942.	2.
3112	3	1	15	3	0	3.0	17.	942.	2.
3113	3	1	15	3	0	3.0	17.	942.	2.
3114	3	1	15	3	0	3.0	17.	942.	2.
3115	3	1	15	3	0	3.0	17.	942.	2.
3116	3	1	15	3	0	3.0	17.	942.	2.
3117	3	1	15	3	0	3.0	17.	942.	2.
3118	3	1	15	3	0	3.0	17.	942.	2.
3119	3	1	15	3	0	3.0	17.	942.	2.
3120	3	1	15	3	0	3.0	17.	942.	2.
3121	3	1	15	3	0	3.0	17.	942.	2.
3122	3	1	15	3	0	3.0	17.	942.	2.
3123	3	1	15	3	0	3.0	17.	942.	2.
3124	3	1	15	3	0	3.0	17.	942.	2.
3125	3	1	15	3	0	3.0	17.	942.	2.
3126	3	1	15	3	0	3.0	17.	942.	2.
3127	3	1	15	3	0	3.0	17.	942.	2.
3128	3	1	13	3	0	3.0	15.	709.	2.
3129	1	3	9	5	0	1.0	6.	318.	2.
3130	1	3	8	5	0	1.0	4.	255.	1.
3131	1	3	8	5	0	1.0	4.	255.	1.
3132	1	3	8	5	0	1.0	4.	255.	1.
3133	1	3	8	5	0	1.0	4.	255.	1.
3134	1	3	8	5	0	1.0	4.	255.	1.
3135	1	3	8	4	0	1.0	4.	255.	1.
3136	1	3	8	4	0	1.0	4.	255.	1.
3137	1	3	8	4	0	1.0	4.	255.	1.
3138	1	3	8	4	0	1.0	4.	255.	1.
3139	1	3	8	4	0	1.0	4.	255.	1.
3140	1	3	8	4	0	1.0	4.	255.	1.
3141	1	3	8	3	0	1.0	4.	255.	1.
3142	1	3	8	3	0	1.0	4.	255.	1.
3143	1	3	8	3	0	1.0	4.	255.	1.
3144	1	3	8	3	0	1.0	4.	255.	1.
3145	1	3	8	3	0	1.0	4.	255.	1.
3146	1	3	9	3	0	1.0	4.	318.	1.
3147	3	1	13	4	0	2.0	7.	709.	1.
3148	3	1	15	4	0	2.0	7.	942.	1.
3149	3	1	15	4	0	2.0	7.	942.	1.
3150	3	1	15	4	0	2.0	7.	942.	1.
3151	3	1	15	4	0	2.0	7.	942.	1.
3152	3	1	15	4	0	2.0	7.	942.	1.
3153	3	1	15	4	0	2.0	7.	942.	1.
3154	3	1	15	4	0	2.0	7.	942.	1.
3155	3	1	15	4	0	2.0	7.	942.	1.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3156	3	1	15	4	0	2.0	7.	942.	1.
3157	3	1	15	4	0	2.0	7.	942.	1.
3158	3	1	15	4	0	2.0	7.	942.	1.
3159	3	1	15	4	1	2.0	7.	942.	1.
3160	3	1	15	4	1	2.0	7.	942.	1.
3161	3	1	15	4	1	2.0	7.	942.	1.
3162	3	1	15	4	1	2.0	7.	942.	1.
3163	3	1	15	4	1	2.0	7.	942.	1.
3164	3	1	15	4	1	2.0	7.	942.	1.
3165	3	1	15	4	0	2.0	7.	942.	1.
3166	3	1	15	4	0	2.0	7.	942.	1.
3167	3	1	15	4	0	2.0	7.	942.	1.
3168	3	1	15	4	0	2.0	7.	942.	1.
3169	3	1	15	4	0	2.0	7.	942.	1.
3170	3	1	13	4	0	2.0	9.	709.	1.
3171	1	1	9	6	0	2.0	13.	318.	4.
3172	1	1	8	6	0	2.0	14.	255.	6.
3173	1	1	8	6	0	2.0	14.	255.	6.
3174	1	1	8	6	0	2.0	14.	255.	6.
3175	1	1	8	6	0	2.0	14.	255.	6.
3176	1	1	8	6	0	2.0	14.	255.	6.
3177	1	1	8	4	0	2.0	14.	255.	6.
3178	1	1	8	4	0	2.0	14.	255.	6.
3179	1	1	8	4	0	2.0	14.	255.	6.
3180	1	1	8	4	0	2.0	14.	255.	6.
3181	1	1	8	4	0	2.0	14.	255.	6.
3182	1	1	8	4	0	2.0	14.	255.	6.
3183	1	1	8	4	0	2.0	14.	255.	6.
3184	1	1	8	4	0	2.0	14.	255.	6.
3185	1	1	8	4	0	2.0	14.	255.	6.
3186	1	1	8	4	0	2.0	14.	255.	6.
3187	1	1	8	4	0	2.0	14.	255.	6.
3188	1	1	8	5	0	2.0	14.	255.	6.
3189	1	1	8	5	0	2.0	14.	255.	6.
3190	1	1	8	5	0	2.0	14.	255.	6.
3191	1	1	8	5	0	2.0	14.	255.	6.
3192	1	1	8	5	0	2.0	14.	255.	6.
3193	1	1	8	5	0	2.0	14.	255.	6.
3194	1	1	8	4	0	2.0	14.	255.	6.
3195	1	1	8	4	0	2.0	14.	255.	6.
3196	1	1	8	4	0	2.0	14.	255.	6.
3197	1	1	8	4	0	2.0	14.	255.	6.
3198	1	1	8	4	0	2.0	14.	255.	6.
3199	1	1	8	4	0	2.0	14.	255.	6.
3200	1	1	8	4	0	2.0	14.	255.	6.
3201	1	1	8	4	0	2.0	14.	255.	6.
3202	1	1	8	4	0	2.0	14.	255.	6.
3203	1	1	8	4	0	2.0	14.	255.	6.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3204	1	1	9	4	0	2.0	20.	318.	6.
3205	3	1	13	5	0	5.0	44.	709.	6.
3206	3	1	15	5	0	5.0	47.	942.	5.
3207	3	1	15	5	0	5.0	47.	942.	5.
3208	3	1	15	5	0	5.0	47.	942.	5.
3209	3	1	15	5	0	5.0	47.	942.	5.
3210	3	1	15	5	0	5.0	47.	942.	5.
3211	3	1	15	5	0	5.0	47.	942.	5.
3213	3	1	14	5	0	5.0	50.	819.	6.
3214	3	1	14	5	0	5.0	50.	819.	6.
3215	3	1	14	5	0	5.0	50.	819.	6.
3216	3	1	15	5	0	5.0	47.	942.	5.
3217	3	1	15	5	0	5.0	47.	942.	5.
3218	3	1	15	5	0	5.0	47.	942.	5.
3219	3	1	15	5	0	5.0	47.	942.	5.
3220	3	1	15	5	0	5.0	47.	942.	5.
3221	3	1	15	5	0	5.0	47.	942.	5.
3222	3	1	15	5	0	5.0	47.	942.	5.
3223	3	1	15	5	0	5.0	47.	942.	5.
3224	3	1	15	5	0	5.0	47.	942.	5.
3225	3	1	15	5	0	5.0	47.	942.	5.
3226	3	1	15	5	0	5.0	47.	942.	5.
3227	3	1	15	5	0	5.0	47.	942.	5.
3228	3	1	15	5	0	5.0	47.	942.	5.
3229	3	1	15	5	0	5.0	47.	942.	5.
3230	3	1	15	5	0	5.0	47.	942.	5.
3231	3	1	15	5	0	5.0	47.	942.	5.
3232	3	1	15	5	0	5.0	47.	942.	5.
3233	3	1	15	5	0	5.0	47.	942.	5.
3234	3	1	15	5	0	5.0	47.	942.	5.
3235	3	1	14	5	0	5.0	41.	819.	5.
3236	3	1	11	5	0	2.0	18.	516.	4.
3237	3	1	15	5	0	3.0	15.	942.	2.
3238	3	1	17	5	0	3.0	16.	1224.	1.
3239	1	1	15	5	0	4.0	19.	839.	2.
3240	1	1	15	5	0	0.0	1.	839.	0.
3241	1	1	15	5	0	0.0	0.	839.	0.
3242	1	1	15	5	0	0.0	0.	839.	0.
3243	3	1	15	5	0	2.0	7.	942.	1.
3244	3	1	15	5	0	3.5	23.	942.	2.
3245	3	1	14	5	0	5.0	45.	819.	6.
3246	3	1	14	5	0	5.0	44.	819.	5.
3247	3	1	13	5	0	3.0	29.	709.	4.
3248	3	1	14	5	0	5.0	38.	819.	5.
3249	1	1	13	5	0	3.0	27.	627.	4.
3250	3	1	15	5	0	4.0	39.	942.	4.
3251	3	1	15	5	0	8.5	75.	942.	8.
3252	3	1	15	5	0	0.0	12.	942.	1.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3253	2	1	16	5	0	7.0	53.	3270.	2.
3254	3	1	15	5	0	5.0	47.	942.	5.
3255	3	1	15	5	0	3.0	21.	942.	2.
3256	1	1	15	5	0	3.0	13.	839.	2.
3257	3	1	17	5	0	1.0	5.	1224.	0.
3258	3	1	16	5	0	3.0	12.	1077.	1.
3259	1	1	11	5	0	3.0	26.	461.	6.
3260	3	1	13	5	0	4.0	35.	709.	5.
3261	3	1	16	5	0	5.0	33.	1077.	3.
3262	3	1	14	5	0	2.0	11.	819.	1.
3263	3	1	10	5	0	1.0	4.	436.	1.
3264	3	1	10	5	0	1.0	5.	436.	1.
3265	3	1	10	5	0	3.0	20.	436.	5.
3266	3	1	10	5	0	3.0	18.	436.	4.
3267	1	1	10	5	0	0.0	1.	389.	0.
3268	1	1	10	5	0	0.0	0.	389.	0.
3269	3	1	10	5	0	2.0	8.	436.	2.
3270	3	1	10	5	0	2.0	11.	436.	3.
3271	3	1	12	5	0	2.0	7.	609.	1.
3272	1	1	13	5	0	0.0	0.	627.	0.
3273	1	1	13	5	0	0.0	1.	627.	0.
3274	3	1	14	5	0	3.0	14.	819.	2.
3275	3	1	14	5	0	4.0	29.	819.	4.
3276	3	1	15	5	0	4.0	30.	942.	3.
3277	3	1	14	5	0	4.0	32.	819.	4.
3278	3	1	14	5	0	4.0	32.	819.	4.
3279	3	1	14	5	0	4.0	35.	819.	4.
3280	3	1	14	5	1	5.0	47.	819.	6.
3281	3	1	15	5	0	5.0	41.	942.	4.
3282	3	1	15	5	0	3.0	23.	942.	2.
3283	3	1	16	5	0	4.0	26.	1077.	2.
3284	1	1	12	5	0	4.0	38.	541.	7.
3285	3	1	14	5	0	4.0	35.	819.	4.
3286	3	3	15	5	0	5.0	38.	942.	4.
3287	3	3	16	5	0	3.0	19.	1077.	2.
3288	1	3	12	5	0	3.0	21.	541.	4.
3289	3	3	14	5	0	3.0	18.	819.	2.
3290	3	3	15	5	0	3.0	17.	942.	2.
3291	3	3	15	5	0	3.0	17.	942.	2.
3292	3	3	15	5	0	3.0	17.	942.	2.
3293	3	3	15	5	0	3.0	17.	942.	2.
3294	3	3	14	5	0	3.0	20.	819.	2.
3295	1	3	10	5	0	4.0	42.	389.	11.
3296	1	3	10	5	0	4.0	32.	389.	8.
3297	1	3	10	6	0	0.0	1.	389.	0.
3298	1	3	10	7	0	0.0	0.	389.	0.
3299	1	3	10	5	0	0.0	0.	389.	0.
3300	1	3	10	5	0	0.0	0.	389.	0.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3301	1	3	10	5	0	0.0	1.	389.	0.
3302	3	3	13	5	0	3.0	17.	709.	2.
3303	3	3	11	6	0	5.0	48.	516.	9.
3304	3	3	14	6	0	3.0	22.	819.	3.
3305	3	3	15	6	0	3.0	18.	942.	2.
3306	3	3	15	6	0	3.5	22.	942.	2.
3307	3	3	15	6	0	3.5	22.	942.	2.
3308	3	2	15	6	0	3.0	18.	942.	2.
3309	3	2	15	6	0	3.0	17.	942.	2.
3310	3	2	14	6	0	3.0	22.	819.	3.
3311	3	2	11	6	0	5.0	64.	516.	12.
3312	3	3	13	6	0	7.0	82.	709.	12.
3313	3	3	13	6	0	4.0	47.	709.	7.
3314	3	3	14	6	0	5.0	44.	819.	5.
3315	3	3	13	6	0	4.0	38.	709.	5.
3316	3	3	13	6	0	4.0	35.	709.	5.
3317	3	3	13	6	0	4.0	32.	709.	4.
3318	1	3	15	6	0	3.0	25.	839.	3.
3319	3	3	17	6	0	6.0	49.	1224.	4.
3320	3	3	17	6	0	6.0	62.	1224.	5.
3321	3	3	16	6	0	7.0	78.	1077.	7.
3322	3	3	15	6	1	6.0	71.	942.	8.
3323	3	3	15	6	1	6.0	56.	942.	6.
3324	3	2	15	6	1	3.0	21.	942.	2.
3325	3	2	15	6	1	2.0	13.	942.	1.
3326	3	2	15	6	1	5.0	38.	942.	4.
3327	3	2	15	6	1	5.0	44.	942.	5.
3328	3	2	14	6	1	4.0	38.	819.	5.
3329	3	2	12	6	1	5.0	59.	609.	10.
3330	3	2	10	6	0	6.0	83.	436.	19.
3331	3	2	12	6	0	3.5	26.	609.	4.
3332	3	2	13	6	0	0.0	3.	709.	0.
3333	3	2	12	6	0	4.0	21.	609.	3.
3334	3	2	12	6	0	2.0	26.	609.	4.
3335	3	3	12	6	0	8.0	80.	609.	13.
3336	3	3	10	6	0	1.0	13.	436.	3.
3337	3	3	10	6	0	1.0	5.	436.	1.
3338	3	3	10	6	0	3.0	20.	436.	5.
3339	3	3	10	6	0	3.0	26.	436.	6.
3340	3	3	10	6	0	3.0	23.	436.	5.
3341	3	3	11	6	0	2.0	12.	516.	2.
3342	3	3	12	6	0	2.0	11.	609.	2.
3343	3	3	12	6	0	3.0	21.	609.	3.
3344	3	3	13	6	0	4.0	32.	709.	4.
3345	3	1	11	6	0	4.0	41.	516.	8.
3346	3	1	14	6	0	4.0	35.	819.	4.
3347	3	1	15	6	0	5.0	44.	942.	5.
3348	3	1	15	6	0	5.0	44.	942.	5.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3349	3	1	15	6	0	4.0	32.	942.	3.
3350	3	1	15	6	0	4.0	30.	942.	3.
3351	3	1	15	6	0	4.0	30.	942.	3.
3352	3	1	14	6	0	4.0	29.	819.	4.
3353	3	1	11	6	0	3.0	21.	516.	4.
3354	3	1	13	6	0	1.0	6.	709.	1.
3355	3	1	10	6	0	3.0	20.	436.	5.
3356	3	1	10	6	0	3.0	32.	436.	7.
3357	3	1	13	6	0	5.0	44.	709.	6.
3358	3	1	13	6	0	4.0	38.	709.	5.
3359	3	1	13	6	0	4.0	32.	709.	4.
3360	3	1	11	6	0	3.0	26.	516.	5.
3361	3	1	12	6	0	3.0	21.	609.	3.
3362	3	1	14	6	0	3.0	22.	819.	3.
3363	3	1	14	6	0	5.0	41.	819.	5.
3364	3	1	13	6	0	4.0	38.	709.	5.
3365	3	1	12	6	0	4.0	38.	609.	6.
3366	3	1	12	6	0	4.0	26.	609.	4.
3367	1	1	12	6	0	0.0	4.	541.	1.
3368	3	1	13	6	0	4.0	24.	709.	3.
3369	3	1	14	6	0	4.0	33.	819.	4.
3370	3	1	14	6	0	4.5	38.	819.	5.
3371	3	1	13	6	0	4.0	36.	709.	5.
3372	3	1	12	6	0	4.0	35.	609.	6.
3373	3	1	14	6	0	3.0	22.	819.	3.
3374	3	1	15	5	0	4.0	30.	942.	3.
3375	2	1	15	5	0	5.0	38.	2905.	1.
3376	3	1	15	4	0	3.0	23.	942.	2.
3377	3	1	14	4	0	4.0	25.	819.	3.
3378	3	1	13	4	0	2.0	12.	709.	2.
3379	3	1	15	8	0	2.0	9.	942.	1.
3380	3	1	17	8	0	3.0	16.	1224.	1.
3381	3	1	15	8	0	5.0	41.	942.	4.
3382	3	1	12	7	0	5.0	49.	609.	8.
3383	3	1	10	7	0	2.5	18.	436.	4.
3384	1	1	10	7	0	0.0	9.	389.	2.
3385	2	1	14	6	0	8.0	80.	2571.	3.
3386	2	1	15	6	0	6.0	67.	2905.	2.
3387	3	1	17	6	0	4.0	28.	1224.	2.
3388	3	1	18	6	0	3.0	25.	1398.	2.
3389	2	1	18	6	0	8.0	52.	4121.	1.
3390	2	1	17	6	0	0.0	7.	3680.	0.
3391	2	1	15	6	0	4.0	21.	2905.	1.
3392	3	1	15	6	0	4.0	25.	942.	3.
3393	2	1	16	6	0	2.0	12.	3270.	0.
3394	2	1	13	6	0	4.0	29.	2259.	1.
3395	1	1	10	6	0	4.0	42.	389.	11.
3396	1	1	8	6	0	3.0	36.	255.	14.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3397	1	1	8	6	0	3.0	32.	255.	13.
3398	1	1	8	6	0	3.0	29.	255.	11.
3399	1	1	8	6	0	2.0	19.	255.	8.
3400	1	1	8	6	0	3.0	29.	255.	11.
3401	3	1	8	6	0	3.0	32.	289.	11.
3402	3	1	8	6	0	3.0	32.	289.	11.
3403	3	1	8	6	0	3.0	32.	289.	11.
3404	3	1	9	6	0	3.0	28.	358.	8.
3405	3	1	10	6	0	3.0	23.	436.	5.
3406	3	1	10	6	0	2.0	13.	436.	3.
3407	3	1	10	6	0	2.0	13.	436.	3.
3408	3	1	10	6	0	3.0	26.	436.	6.
3409	3	1	10	6	1	4.0	42.	436.	10.
3410	3	1	10	6	1	4.0	38.	436.	9.
3411	3	1	10	6	1	2.0	13.	436.	3.
3412	3	1	10	6	1	1.0	5.	436.	1.
3413	1	1	10	7	1	2.0	10.	389.	2.
3414	1	1	10	7	1	2.0	15.	389.	4.
3415	1	1	10	6	1	4.0	26.	389.	7.
3416	1	1	10	6	1	0.0	1.	389.	0.
3417	1	1	10	6	0	0.0	0.	389.	0.
3418	1	1	10	6	0	0.0	0.	389.	0.
3419	3	2	10	5	0	2.0	8.	436.	2.
3420	3	2	10	5	0	2.0	11.	436.	3.
3421	3	2	10	5	0	2.0	11.	436.	3.
3422	3	2	10	5	0	2.0	11.	436.	3.
3423	3	2	10	5	0	2.0	11.	436.	3.
3424	3	2	10	5	0	2.0	11.	436.	3.
3425	3	2	10	5	0	2.0	11.	436.	3.
3426	3	2	10	5	0	2.0	11.	436.	3.
3427	3	2	10	5	0	2.0	11.	436.	3.
3428	3	2	10	5	0	2.0	11.	436.	3.
3429	3	1	13	8	0	2.0	9.	709.	1.
3430	3	1	14	8	0	2.0	8.	819.	1.
3431	3	1	14	8	0	2.0	8.	819.	1.
3432	3	1	14	8	0	2.0	8.	819.	1.
3433	3	1	14	8	0	2.0	8.	819.	1.
3434	3	1	14	8	0	2.0	9.	819.	1.
3435	3	1	14	7	0	3.0	16.	819.	2.
3436	3	1	15	7	0	3.0	17.	942.	2.
3437	3	1	15	7	0	3.0	17.	942.	2.
3438	3	1	15	7	0	3.0	17.	942.	2.
3439	3	1	15	7	0	3.0	17.	942.	2.
3440	3	1	15	7	0	3.0	17.	942.	2.
3441	3	1	15	7	0	3.0	17.	942.	2.
3442	3	1	15	7	0	3.0	17.	942.	2.
3443	3	1	15	7	0	3.0	17.	942.	2.
3444	3	1	15	7	0	3.0	17.	942.	2.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3445	3	1	15	7	0	3.0	17.	942.	2.
3446	3	1	15	6	0	3.0	17.	942.	2.
3447	3	1	15	6	0	3.0	17.	942.	2.
3448	3	1	15	6	0	3.0	17.	942.	2.
3449	3	1	15	6	0	3.0	17.	942.	2.
3450	3	1	15	6	0	3.0	17.	942.	2.
3451	3	1	15	6	0	3.0	17.	942.	2.
3452	3	1	15	6	0	3.0	17.	942.	2.
3453	3	1	15	6	0	3.0	17.	942.	2.
3454	3	1	15	6	0	3.0	17.	942.	2.
3455	3	1	15	6	0	3.0	17.	942.	2.
3456	3	1	15	6	0	3.0	17.	942.	2.
3457	3	1	15	6	0	3.0	17.	942.	2.
3458	3	1	15	6	0	3.0	17.	942.	2.
3459	3	1	15	6	0	3.0	17.	942.	2.
3460	3	2	15	6	0	3.0	17.	942.	2.
3461	3	2	15	6	0	3.0	17.	942.	2.
3462	3	2	15	6	0	3.0	17.	942.	2.
3463	3	2	15	6	0	3.0	17.	942.	2.
3464	3	2	15	6	0	3.0	17.	942.	2.
3465	3	2	15	6	0	3.0	17.	942.	2.
3466	3	2	15	6	0	3.0	17.	942.	2.
3467	3	2	15	6	0	3.0	17.	942.	2.
3468	3	2	15	6	0	3.0	17.	942.	2.
3469	3	2	15	6	0	3.0	17.	942.	2.
3470	3	2	15	6	0	3.0	17.	942.	2.
3471	3	2	15	6	0	3.0	14.	942.	1.
3472	3	2	15	6	0	1.5	6.	942.	1.
3473	3	2	15	6	0	1.5	4.	942.	0.
3474	3	2	15	6	0	1.5	4.	942.	0.
3475	3	2	15	6	0	1.5	4.	942.	0.
3476	3	2	15	6	0	1.5	4.	942.	0.
3477	3	2	15	6	0	1.5	4.	942.	0.
3478	3	2	15	6	0	1.5	4.	942.	0.
3479	3	2	15	6	0	1.5	4.	942.	0.
3480	3	2	15	6	0	1.5	4.	942.	0.
3481	3	2	15	6	0	1.5	4.	942.	0.
3482	3	2	15	6	0	1.5	4.	942.	0.
3483	3	2	15	6	0	1.5	4.	942.	0.
3484	3	2	15	6	0	1.5	4.	942.	0.
3485	3	2	15	6	0	1.5	4.	942.	0.
3486	3	2	15	6	0	1.5	3.	942.	0.
3487	3	1	14	6	0	0.0	0.	819.	0.
3488	3	1	10	6	0	1.0	5.	436.	1.
3489	3	1	10	6	0	4.0	28.	436.	7.
3490	3	1	11	6	0	2.0	10.	516.	2.
3491	3	1	11	6	0	0.0	2.	516.	0.
3492	3	1	10	6	0	3.0	15.	436.	4.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3493	3	1	11	6	0	2.0	16.	516.	3.
3494	3	1	12	6	0	4.0	29.	609.	5.
3495	3	1	13	6	0	3.0	24.	709.	3.
3496	3	1	12	6	0	4.0	29.	609.	5.
3497	3	1	16	6	0	2.0	11.	1077.	1.
3498	3	1	15	6	0	3.0	21.	942.	2.
3499	3	1	14	6	0	6.0	50.	819.	6.
3500	3	1	13	6	0	3.0	44.	709.	6.
3501	3	1	12	6	0	9.0	110.	609.	18.
3502	3	1	13	6	0	2.0	38.	709.	5.
3503	1	1	10	6	1	8.0	91.	389.	23.
3504	2	1	10	6	1	0.0	6.	1478.	0.
3505	3	1	10	6	1	1.0	4.	436.	1.
3506	3	1	10	6	1	3.0	23.	436.	5.
3507	3	1	11	6	1	4.0	45.	516.	9.
3508	1	1	10	6	1	6.0	62.	389.	16.
3509	1	1	10	6	1	0.0	3.	389.	1.
3510	1	1	10	6	1	0.0	1.	389.	0.
3511	3	1	10	6	1	3.0	15.	436.	4.
3512	3	1	10	6	1	2.0	11.	436.	3.
3513	3	1	10	6	0	1.0	8.	436.	2.
3514	3	1	12	6	0	4.0	24.	609.	4.
3515	2	1	8	6	0	2.0	40.	1041.	4.
3516	2	1	13	6	0	8.0	70.	2259.	3.
3517	2	1	14	6	0	0.0	9.	2571.	0.
3518	2	1	13	6	0	5.0	62.	2259.	3.
3519	2	1	13	6	0	12.0	195.	2259.	9.
3520	2	1	10	6	0	4.0	71.	1478.	5.
3521	1	1	10	6	0	2.0	11.	389.	3.
3522	1	1	10	6	0	0.0	2.	389.	1.
3523	2	1	10	6	0	3.0	15.	1478.	1.
3524	2	1	13	6	0	2.0	12.	2259.	1.
3525	2	1	14	6	0	3.0	14.	2571.	1.
3526	2	1	11	6	0	2.0	16.	1721.	1.
3527	3	1	13	6	0	4.0	29.	709.	4.
3528	2	1	15	6	0	4.0	41.	2905.	1.
3529	2	1	18	6	0	8.0	75.	4121.	2.
3530	2	1	23	6	0	6.0	50.	7394.	1.
3531	2	1	21	6	0	7.0	77.	5821.	1.
3532	2	1	25	6	0	12.0	186.	9588.	2.
3533	2	1	33	6	0	24.0	373.	45130.	1.
3534	2	1	35	6	0	24.0	389.	--	--
3535	2	1	39	6	0	20.0	251.	--	--
3536	2	1	40	6	0	17.0	176.	--	--
3537	2	1	37	6	0	15.0	121.	--	--
3538	2	1	27	6	0	4.0	33.	12903.	0.
3539	2	1	25	6	0	4.0	20.	9588.	0.
3540	2	1	25	6	0	6.0	30.	9588.	0.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3541	2	1	25	6	0	4.0	34.	9588.	0.
3542	2	1	28	6	0	12.0	88.	15388.	1.
3543	2	1	25	6	0	6.0	50.	9588.	1.
3544	2	1	22	6	0	5.0	27.	6556.	0.
3545	2	1	26	6	0	2.0	6.	11047.	0.
3546	1	1	24	6	0	2.0	11.	2932.	0.
3547	2	1	31	7	0	9.0	63.	33094.	0.
3548	2	1	28	7	0	14.0	117.	15388.	1.
3549	3	1	17	6	0	2.0	28.	1224.	2.
3550	1	1	14	6	0	3.0	14.	730.	2.
3551	1	1	11	6	0	2.0	14.	461.	3.
3552	2	1	13	6	0	3.0	22.	2259.	1.
3553	2	1	13	6	0	5.0	44.	2259.	2.
3554	3	1	14	6	0	4.0	27.	819.	3.
3555	3	1	15	6	0	1.0	4.	942.	0.
3556	3	1	14	6	0	1.0	3.	819.	0.
3557	3	1	11	6	0	2.0	9.	516.	2.
3558	3	1	12	6	0	2.0	8.	609.	1.
3559	3	1	17	6	0	1.0	5.	1224.	0.
3560	2	1	25	5	1	4.0	13.	9588.	0.
3561	2	1	17	5	1	4.0	20.	3680.	1.
3562	2	1	15	5	1	1.0	3.	2905.	0.
3563	1	1	14	5	1	0.0	1.	730.	0.
3564	3	1	12	6	1	2.5	8.	609.	1.
3565	3	1	11	6	1	1.0	11.	516.	2.
3566	2	1	14	6	1	6.0	68.	2571.	3.
3567	2	1	15	5	1	10.0	163.	2905.	6.
3568	2	1	17	5	1	10.0	142.	3680.	4.
3569	2	1	15	6	0	6.0	100.	2905.	3.
3570	2	1	14	6	0	10.0	175.	2571.	7.
3571	2	1	11	6	0	10.0	201.	1721.	12.
3572	3	1	11	6	0	3.0	43.	516.	8.
3573	3	1	10	5	0	2.5	20.	436.	5.
3574	3	1	11	5	0	3.0	24.	516.	5.
3575	2	1	8	4	0	4.0	44.	1041.	4.
3576	2	1	8	3	0	2.0	22.	1041.	2.
3577	2	1	9	3	0	3.0	21.	1247.	2.
3578	2	1	8	2	0	1.5	10.	1041.	1.
3579	2	1	9	2	0	1.0	3.	1247.	0.
3580	2	1	10	2	0	0.0	2.	1478.	0.
3581	2	1	10	6	0	4.0	35.	1478.	2.
3582	2	1	12	6	0	5.0	48.	1973.	2.
3583	2	1	11	6	0	3.0	23.	1721.	1.
3584	2	1	9	6	0	1.0	7.	1247.	1.
3585	2	1	9	6	0	2.0	13.	1247.	1.
3586	2	1	10	6	0	3.0	23.	1478.	2.
3587	2	1	12	6	0	3.0	17.	1973.	1.
3588	2	1	15	6	0	1.0	4.	2905.	0.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3589	2	1	10	6	0	2.0	11.	1478.	1.
3590	2	1	12	6	0	3.0	26.	1973.	1.
3591	2	1	17	6	0	6.0	44.	3680.	1.
3592	2	1	18	6	0	4.0	29.	4121.	1.
3593	2	1	16	6	0	4.0	23.	3270.	1.
3594	2	1	12	6	0	2.0	19.	1973.	1.
3595	2	1	14	6	0	5.0	38.	2571.	1.
3596	3	1	15	6	0	4.0	32.	942.	3.
3597	3	1	13	6	0	4.0	27.	709.	4.
3598	3	1	9	6	0	1.0	7.	358.	2.
3599	3	1	9	5	0	1.0	7.	358.	2.
3600	2	1	13	5	0	4.0	35.	2259.	2.
3601	2	1	13	5	0	7.0	106.	2259.	5.
3602	2	1	13	5	0	10.0	156.	2259.	7.
3603	2	1	10	5	0	4.0	53.	1478.	4.
3604	2	1	11	5	0	0.0	4.	1721.	0.
3605	3	1	15	5	0	3.0	9.	942.	1.
3606	3	1	12	5	0	1.0	5.	609.	1.
3607	3	1	16	5	1	2.0	5.	1077.	0.
3608	3	1	15	5	1	1.0	4.	942.	0.
3609	3	1	15	5	1	3.0	9.	942.	1.
3610	3	1	15	5	1	0.0	4.	942.	0.
3611	2	1	15	5	1	6.0	35.	2905.	1.
3612	3	1	16	5	1	2.0	14.	1077.	1.
3613	3	1	21	5	1	3.0	9.	2084.	0.
3614	3	1	20	5	0	2.0	5.	1825.	0.
3615	3	1	19	5	0	0.0	1.	1595.	0.
3616	2	1	15	5	0	4.0	21.	2905.	1.
3617	3	1	17	5	0	4.0	18.	1224.	1.
3618	3	1	17	5	0	0.0	3.	1224.	0.
3619	3	1	15	5	0	4.0	15.	942.	2.
3620	3	1	12	5	0	1.0	7.	609.	1.
3621	3	1	14	5	0	2.5	11.	819.	1.
3622	3	1	16	5	0	3.0	15.	1077.	1.
3623	3	1	15	5	0	3.0	17.	942.	2.
3624	3	1	13	5	0	3.0	15.	709.	2.
3625	3	1	14	5	0	1.0	6.	819.	1.
3626	3	1	15	5	0	3.0	10.	942.	1.
3627	3	1	17	5	0	1.0	4.	1224.	0.
3628	3	1	15	4	0	2.0	7.	942.	1.
3629	3	1	15	4	0	3.0	13.	942.	1.
3630	3	1	14	4	0	2.0	9.	819.	1.
3631	3	1	12	4	0	2.0	7.	609.	1.
3632	3	1	12	4	0	0.0	4.	609.	1.
3633	3	1	13	4	0	6.0	38.	709.	5.
3634	3	1	11	4	0	1.0	12.	516.	2.
3635	3	1	14	4	0	3.0	13.	819.	2.
3636	3	1	14	4	0	2.0	13.	819.	2.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3637	3	1	14	4	0	4.0	18.	819.	2.
3638	3	1	15	4	0	0.0	3.	942.	0.
3639	2	1	15	4	0	3.0	12.	2905.	0.
3640	3	1	15	4	0	3.0	16.	942.	2.
3641	3	1	15	4	0	2.5	13.	942.	1.
3642	3	1	15	4	0	3.0	18.	942.	2.
3643	3	1	14	4	0	4.0	27.	819.	3.
3644	3	1	13	4	0	3.0	24.	709.	3.
3645	3	1	16	4	0	4.0	23.	1077.	2.
3646	3	1	14	4	0	3.0	20.	819.	2.
3647	3	1	15	4	0	3.0	25.	942.	3.
3648	2	1	17	4	0	7.0	44.	3680.	1.
3649	1	1	16	4	0	0.0	4.	960.	0.
3650	3	1	11	4	0	2.0	6.	516.	1.
3651	3	1	8	4	0	1.0	10.	289.	3.
3652	3	1	10	4	0	4.0	28.	436.	7.
3653	3	2	12	4	0	2.0	13.	609.	2.
3654	3	2	14	4	0	2.0	8.	819.	1.
3655	3	2	11	4	0	2.0	9.	516.	2.
3656	3	2	7	4	0	1.0	11.	222.	5.
3657	3	2	8	4	0	4.0	36.	289.	12.
3658	3	2	7	4	0	2.0	29.	222.	13.
3659	3	2	9	4	0	4.0	44.	358.	12.
3660	3	2	8	4	0	4.5	57.	289.	20.
3661	1	2	6	4	0	2.0	28.	144.	19.
3662	1	2	7	4	0	2.0	25.	202.	13.
3663	1	2	8	4	0	5.0	67.	255.	26.
3664	1	2	8	4	0	4.0	52.	255.	20.
3665	1	2	6	4	0	2.0	26.	144.	18.
3666	1	2	7	4	0	2.0	19.	202.	9.
3667	1	3	9	4	0	3.0	25.	318.	8.
3668	1	3	10	4	0	3.0	18.	389.	5.
3669	1	3	10	4	0	0.0	1.	389.	0.
3670	1	3	10	4	0	0.0	0.	389.	0.
3671	1	3	10	4	0	0.0	0.	389.	0.
3672	1	3	10	4	0	0.0	0.	389.	0.
3673	1	3	10	4	0	0.0	0.	389.	0.
3674	1	3	9	4	0	0.0	0.	318.	0.
3675	1	3	5	4	0	1.0	4.	97.	4.
3676	1	3	5	4	0	1.0	8.	97.	8.
3677	1	3	5	4	0	2.0	19.	97.	20.
3678	1	3	5	4	0	2.0	23.	97.	24.
3679	1	3	5	4	0	2.0	23.	97.	24.
3680	1	3	5	4	0	2.0	23.	97.	24.
3681	1	3	5	4	0	2.0	23.	97.	24.
3682	1	3	6	4	0	2.0	22.	144.	15.
3683	3	2	13	5	0	3.0	17.	709.	2.
3684	3	2	15	5	0	3.0	17.	942.	2.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3685	3	2	15	5	0	3.0	17.	942.	2.
3686	3	2	15	5	0	3.0	17.	942.	2.
3687	3	2	15	5	0	3.0	17.	942.	2.
3688	3	2	15	5	0	3.0	17.	942.	2.
3689	3	2	15	5	0	3.0	17.	942.	2.
3690	3	2	15	5	0	3.0	17.	942.	2.
3691	3	2	15	5	0	3.0	17.	942.	2.
3692	3	2	15	5	0	3.0	17.	942.	2.
3693	3	2	15	5	0	3.0	17.	942.	2.
3694	3	2	15	5	0	3.0	17.	942.	2.
3695	3	2	15	5	0	3.0	17.	942.	2.
3696	3	2	15	6	0	3.0	17.	942.	2.
3697	3	2	15	6	0	3.0	17.	942.	2.
3698	3	2	15	6	0	3.0	17.	942.	2.
3699	3	2	15	6	0	3.0	17.	942.	2.
3700	3	2	15	6	0	3.0	17.	942.	2.
3701	3	2	15	6	0	3.0	17.	942.	2.
3702	3	2	15	6	0	3.0	17.	942.	2.
3703	3	2	15	6	0	3.0	17.	942.	2.
3704	3	2	15	6	0	3.0	17.	942.	2.
3705	3	2	14	5	0	3.0	29.	819.	4.
3706	3	2	14	5	0	8.0	94.	819.	11.
3707	3	2	13	5	0	6.0	96.	709.	14.
3708	3	2	12	5	0	8.0	115.	609.	19.
3709	3	2	14	5	0	4.0	41.	819.	5.
3710	3	2	15	5	0	3.0	21.	942.	2.
3711	3	2	14	5	0	4.0	25.	819.	3.
3712	3	1	10	5	0	2.0	18.	436.	4.
3713	3	1	9	5	0	3.0	28.	358.	8.
3714	3	1	13	5	0	4.0	32.	709.	4.
3715	3	2	14	5	0	4.0	22.	819.	3.
3716	1	1	14	5	0	0.0	3.	730.	0.
3717	3	1	14	5	0	3.0	14.	819.	2.
3718	3	2	15	5	0	4.0	32.	942.	3.
3719	3	1	16	5	0	6.0	41.	1077.	4.
3720	2	1	11	5	1	1.0	10.	1721.	1.
3721	2	1	11	5	1	2.0	16.	1721.	1.
3722	3	1	12	5	1	6.0	67.	609.	11.
3723	2	1	14	5	1	6.0	50.	2571.	2.
3724	1	1	14	5	1	0.0	4.	730.	0.
3725	3	1	14	6	1	2.0	9.	819.	1.
3726	2	1	13	6	1	5.0	41.	2259.	2.
3727	2	1	13	6	1	4.0	38.	2259.	2.
3728	3	1	13	6	1	4.0	38.	709.	5.
3729	3	1	13	6	1	5.0	44.	709.	6.
3730	3	1	10	6	1	3.0	28.	436.	7.
3731	2	1	10	6	1	2.0	15.	1478.	1.
3732	3	2	11	6	1	3.0	23.	516.	4.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3733	3	2	12	6	1	4.0	35.	609.	6.
3734	3	2	12	6	1	4.0	29.	609.	5.
3735	3	2	11	6	1	1.0	6.	516.	1.
3736	3	2	10	6	0	1.0	4.	436.	1.
3737	3	2	9	6	0	2.0	17.	358.	5.
3738	3	2	9	6	0	5.0	55.	358.	15.
3739	3	2	10	6	0	3.0	42.	436.	10.
3740	3	2	14	6	0	6.0	50.	819.	6.
3741	3	2	14	6	0	3.0	27.	819.	3.
3742	3	2	11	6	0	4.0	35.	516.	7.
3743	3	1	9	6	0	3.0	32.	358.	9.
3744	3	1	8	6	0	3.0	44.	289.	15.
3745	3	1	9	6	0	6.0	96.	358.	27.
3746	3	1	10	6	0	6.0	108.	436.	25.
3747	3	1	10	6	0	7.0	120.	436.	27.
3748	3	1	10	6	0	5.0	66.	436.	15.
3749	3	1	10	6	0	2.0	18.	436.	4.
3750	3	1	10	6	0	2.0	11.	436.	3.
3751	3	1	9	6	0	2.0	11.	358.	3.
3752	3	1	7	6	0	1.0	4.	222.	2.
3753	3	1	6	6	0	0.0	0.	165.	0.
3754	3	1	5	7	0	0.0	1.	104.	1.
3755	3	1	5	7	0	3.0	27.	104.	26.
3756	3	1	5	7	0	1.0	13.	104.	12.
3757	3	1	5	7	0	2.0	23.	104.	22.
3758	3	1	5	5	0	3.0	41.	104.	39.
3759	3	1	5	5	0	2.0	23.	104.	22.
3760	1	1	5	5	0	1.0	8.	97.	8.
3761	3	1	6	7	0	1.0	8.	165.	5.
3762	3	1	6	7	0	3.0	38.	165.	23.
3763	3	1	5	7	0	4.0	84.	104.	81.
3764	3	1	5	7	0	4.0	77.	104.	74.
3765	3	1	5	6	0	2.0	31.	104.	30.
3766	3	1	7	6	0	2.0	11.	222.	5.
3767	3	1	8	6	0	0.0	5.	289.	2.
3768	3	1	8	6	0	5.0	62.	289.	21.
3769	3	1	8	6	0	5.0	72.	289.	25.
3770	3	1	8	6	0	2.0	32.	289.	11.
3771	3	1	8	6	0	5.0	67.	289.	23.
3772	3	1	10	6	0	4.0	81.	436.	18.
3773	3	1	13	6	0	11.0	156.	709.	22.
3774	3	1	10	5	0	3.0	45.	436.	10.
3775	3	1	10	5	0	1.0	8.	436.	2.
3776	3	1	10	7	0	3.0	20.	436.	5.
3777	3	1	10	6	0	3.0	20.	436.	5.
3778	3	1	10	5	0	1.0	5.	436.	1.
3779	3	1	10	6	0	1.0	3.	436.	1.
3780	3	1	10	6	0	1.0	3.	436.	1.

TABLE 10--CONTINUED

STA-TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN-TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3781	3	1	9	6	0	1.0	6.	358.	2.
3782	3	1	8	6	0	3.0	19.	289.	7.
3783	3	1	8	6	1	1.0	10.	289.	3.
3784	3	1	8	6	1	3.0	32.	289.	11.
3785	3	1	11	6	1	5.0	56.	516.	11.
3786	3	1	12	6	1	5.0	48.	609.	8.
3787	3	1	11	6	1	2.0	23.	516.	4.
3788	3	1	8	6	1	5.0	77.	289.	27.
3789	3	1	8	5	1	6.0	83.	289.	29.
3790	3	1	8	5	1	0.0	14.	289.	5.
3791	3	1	9	6	1	6.0	69.	358.	19.
3792	3	1	10	6	1	4.0	57.	436.	13.
3793	3	1	10	6	1	5.0	62.	436.	14.
3794	3	1	10	6	1	4.0	42.	436.	10.
3795	3	1	10	6	1	2.0	20.	436.	5.
3796	3	1	10	6	1	4.0	28.	436.	7.
3797	3	1	10	6	1	1.0	11.	436.	3.
3798	3	1	10	6	1	4.0	32.	436.	7.
3799	3	1	10	6	1	3.0	32.	436.	7.
3800	3	1	10	6	1	4.0	35.	436.	8.
3801	3	1	10	6	1	2.0	15.	436.	4.
3802	3	1	10	6	1	2.0	13.	436.	3.
3803	3	1	10	6	1	3.0	23.	436.	5.
3804	3	1	9	6	1	3.0	32.	358.	9.
3805	3	1	8	6	0	4.0	44.	289.	15.
3806	3	1	9	6	0	2.0	17.	358.	5.
3807	3	1	10	6	0	2.0	15.	436.	4.
3808	3	1	10	6	0	4.0	35.	436.	8.
3809	3	1	9	6	0	3.0	35.	358.	10.
3810	3	1	9	6	0	4.0	42.	358.	12.
3811	3	1	9	6	0	3.0	35.	358.	10.
3812	3	1	9	6	0	4.0	46.	358.	13.
3813	3	1	9	6	0	4.0	35.	358.	10.
3814	3	1	9	6	0	0.0	3.	358.	1.
3815	3	1	9	6	0	2.0	13.	358.	4.
3816	3	1	9	6	0	4.0	42.	358.	12.
3817	3	1	10	6	0	4.0	42.	436.	10.
3818	3	1	10	6	0	3.0	35.	436.	8.
3819	3	1	10	6	0	5.0	53.	436.	12.
3820	3	1	10	6	0	3.0	32.	436.	7.
3821	3	1	10	6	0	3.0	23.	436.	5.
3822	3	1	10	6	0	2.0	11.	436.	3.
3823	3	1	10	6	0	1.0	5.	436.	1.
3824	3	1	10	6	0	2.0	15.	436.	4.
3825	3	1	10	6	0	5.0	53.	436.	12.
3826	3	1	10	6	0	4.0	49.	436.	11.
3827	3	1	10	6	0	4.0	42.	436.	10.
3828	3	1	10	6	0	3.0	32.	436.	7.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3829	3	1	10	6	0	4.0	42.	436.	10.
3830	3	2	10	6	0	4.0	42.	436.	10.
3831	3	2	10	6	0	3.0	35.	436.	8.
3832	3	2	10	6	0	5.0	53.	436.	12.
3833	3	2	10	6	0	3.0	33.	436.	8.
3834	3	2	10	6	0	3.5	33.	436.	8.
3835	3	2	10	6	0	3.5	35.	436.	8.
3836	3	2	10	6	0	3.5	35.	436.	8.
3837	3	2	10	6	0	3.5	35.	436.	8.
3838	3	2	10	6	0	3.5	35.	436.	8.
3839	3	2	10	6	0	3.5	35.	436.	8.
3840	3	2	10	6	0	3.5	35.	436.	8.
3841	3	2	10	6	0	3.5	35.	436.	8.
3842	3	2	10	5	0	3.5	35.	436.	8.
3843	3	2	10	5	0	3.5	35.	436.	8.
3844	3	2	10	5	0	3.5	35.	436.	8.
3845	3	2	10	7	0	3.5	35.	436.	8.
3846	3	2	10	7	0	3.5	35.	436.	8.
3847	3	2	10	7	0	3.5	44.	436.	10.
3848	3	1	13	7	0	6.0	68.	709.	10.
3849	3	1	14	7	0	6.0	57.	819.	7.
3850	3	1	16	6	0	2.0	17.	1077.	2.
3851	3	1	15	6	0	5.0	30.	942.	3.
3852	3	1	14	6	0	2.0	18.	819.	2.
3853	3	1	12	6	0	5.0	41.	609.	7.
3854	3	1	12	6	0	3.0	26.	609.	4.
3855	3	1	12	6	0	3.0	21.	609.	3.
3856	3	1	11	6	0	3.0	21.	516.	4.
3857	3	1	10	6	0	2.0	15.	436.	4.
3858	3	1	11	6	0	3.0	18.	516.	4.
3859	3	1	9	6	0	2.0	17.	358.	5.
3860	3	1	10	6	0	3.0	23.	436.	5.
3861	3	1	11	6	0	3.0	18.	516.	4.
3862	3	1	7	6	0	1.0	11.	222.	5.
3863	3	1	9	6	0	3.0	22.	358.	6.
3864	3	1	11	6	0	3.0	23.	516.	4.
3865	3	1	12	6	0	3.0	26.	609.	4.
3866	3	1	12	6	0	5.0	48.	609.	8.
3867	3	1	12	6	0	4.0	32.	609.	5.
3868	3	1	14	6	0	1.0	4.	819.	0.
3869	3	1	15	6	0	0.0	0.	942.	0.
3870	3	1	15	6	0	0.0	0.	942.	0.
3871	3	1	14	6	0	3.0	13.	819.	2.
3872	3	1	13	6	0	3.0	19.	709.	3.
3873	3	1	12	6	0	3.0	20.	609.	3.
3874	3	1	12	6	0	2.5	17.	609.	3.
3875	3	1	13	6	0	3.0	18.	709.	3.
3876	3	1	13	6	0	3.0	18.	709.	3.

TABLE 10--CONTINUED

STATION	BANK MATR	LAND USE	BANK SLOPE	ORIENTATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3877	3	1	12	6	0	2.5	16.	609.	3.
3878	3	1	13	6	0	2.5	14.	709.	2.
3879	3	1	13	6	0	3.0	16.	709.	2.
3880	3	1	11	6	0	2.0	11.	516.	2.
3881	3	1	11	6	0	1.5	9.	516.	2.
3882	3	1	11	5	0	3.0	17.	516.	3.
3883	3	1	10	5	0	2.0	15.	436.	4.
3884	3	1	11	5	0	3.0	19.	516.	4.
3885	3	1	12	5	0	2.5	16.	609.	3.
3886	3	1	12	8	0	2.5	17.	609.	3.
3887	2	1	14	8	0	3.5	39.	2571.	2.
3888	2	1	14	7	0	10.0	120.	2571.	5.
3889	3	1	13	6	0	3.0	35.	709.	5.
3890	3	1	12	6	0	2.0	12.	609.	2.
3891	3	1	11	6	0	2.5	13.	516.	3.
3892	3	1	10	6	0	1.5	10.	436.	2.
3893	3	1	12	6	0	2.5	15.	609.	2.
3894	3	1	13	5	0	3.5	21.	709.	3.
3895	3	1	12	5	0	2.0	15.	609.	2.
3896	1	1	12	5	0	3.5	20.	541.	4.
3897	3	1	12	5	0	1.5	9.	609.	1.
3898	3	1	12	5	0	2.0	9.	609.	2.
3899	3	1	12	5	0	2.5	14.	609.	2.
3900	3	1	12	5	0	2.5	14.	609.	2.
3901	3	1	12	5	0	2.0	9.	609.	2.
3902	3	1	11	5	0	1.5	6.	516.	1.
3903	3	1	10	5	0	1.5	7.	436.	2.
3904	3	1	9	5	0	2.0	11.	358.	3.
3905	3	1	9	5	0	1.5	12.	358.	3.
3906	3	1	12	5	0	3.5	20.	609.	3.
3907	3	1	12	5	0	2.0	15.	609.	2.
3908	3	1	13	5	0	3.5	22.	709.	3.
3909	3	1	13	5	0	3.0	19.	709.	3.
3910	3	1	12	5	0	2.5	18.	609.	3.
3911	3	1	10	5	0	3.5	28.	436.	7.
3912	3	1	11	5	0	2.5	35.	516.	7.
3913	1	1	15	5	0	8.5	83.	839.	10.
3914	1	1	11	5	0	3.5	39.	461.	9.
3915	3	1	9	5	0	1.0	6.	358.	2.
3916	3	1	11	5	0	1.0	2.	516.	0.
3917	3	1	12	6	0	0.0	1.	609.	0.
3918	3	1	12	6	0	2.0	8.	609.	1.
3919	3	1	12	6	0	3.0	18.	609.	3.
3920	3	1	13	6	0	2.5	17.	709.	2.
3921	3	1	13	6	0	4.0	25.	709.	4.
3922	3	1	13	6	0	2.0	9.	709.	1.
3923	3	1	13	6	0	0.0	1.	709.	0.
3924	3	1	10	6	0	2.0	12.	436.	3.

TABLE 10--CONTINUED

STA- TION	BANK MATR	LAND USE	BANK SLOPE	ORIEN- TATION	GRD WTR	BANK HT	BANK EROSION	STABLE EROSION	PERCENT COL 8/9
3925	3	1	16	6	0	4.5	28.	1077.	3.
3926	3	1	18	6	0	4.0	24.	1398.	2.
3927	3	1	19	6	0	3.0	19.	1595.	1.
3928	3	1	17	6	0	5.5	41.	1224.	3.
3929	3	1	15	6	0	5.0	44.	942.	5.
3930	3	1	15	6	0	3.5	25.	942.	3.
3931	3	2	18	6	0	3.0	22.	1398.	2.
3932	3	2	15	6	0	7.0	60.	942.	6.
3933	3	2	11	6	0	3.0	38.	516.	7.
3934	3	2	13	6	0	4.0	32.	709.	4.
3935	3	2	14	6	0	4.0	32.	819.	4.
3936	3	2	14	6	0	4.0	29.	819.	4.
3937	3	2	13	6	0	3.0	23.	709.	3.
3938	3	2	12	6	0	3.5	26.	609.	4.
3939	3	2	12	6	0	3.0	22.	609.	4.
3940	3	2	12	6	0	3.0	19.	609.	3.
3941	3	2	12	6	0	2.0	13.	609.	2.
3942	3	2	13	6	0	3.0	12.	709.	2.
3943	3	2	13	4	0	0.0	2.	709.	0.
3944	3	2	13	7	0	3.0	14.	709.	2.
3945	3	2	13	7	0	3.0	19.	709.	3.
3946	3	2	13	7	0	3.0	19.	709.	3.
3947	3	2	13	7	0	3.0	19.	709.	3.
3948	3	2	13	6	0	3.0	19.	709.	3.
3949	3	2	13	6	0	3.0	19.	709.	3.

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