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**SEDIMENTATION SURVEY REPORT  
SOUTH UNIT, LAKE ANDES  
CHARLES MIX COUNTY, SOUTH DAKOTA**

**SOUTH DAKOTA CLEAN LAKES PROGRAM  
DIVISION OF WATER RESOURCES MANAGEMENT  
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES  
SOUTH DAKOTA  
ROBERT E. ROBERTS, SECRETARY**

**MAY 1993**

# LAKE ANDES SEDIMENT SURVEY

## INTRODUCTION

The purpose of this report is to present sediment survey information on the south unit of Lake Andes. This information was acquired between the dates of February 1 and 25, 1993. This survey was initiated as part of the Lake Assessment Project in order to assess the current distribution of the sediment, water depth variation, and lake volumetric calculations for sediment and water. This report addresses procedures used to obtain the data, a listing of the data, the analysis of the data, and the potential restoration alternatives for Lake Andes.

## BACKGROUND INFORMATION

Lake Andes is a natural lake which has had a history of going dry on average every 11-14 years. At the present, the lake is in a state of stagnation and will continue in this state, or eventually become dry, unless a considerable amount of rainfall and snowmelt occurs in the next few years. The water supply for the lake comes almost entirely from watershed runoff. Lake Andes has a fairly small watershed relative to its lake size thereby resulting in a shortage of water during drought conditions. In 1934, a high water elevation of 1437.25 feet msl was established for Lake Andes via the construction of an artificial outlet. This structure permanently lowered the high water elevation of 1450 feet msl required to overflow the natural outlet by 12.75 feet. Other structures have been constructed on both the watershed and the lake to allow for effective management of the water. However, these structures do not deter the high evaporation rates of this semiarid region (i.e. - average annual evaporation and transpiration rates are 41.2 inches per year, average annual precipitation rate is 22.4 inches per year).

## SEDIMENTATION SURVEY

The survey was conducted between the dates of February 1 and 25, 1993. The survey crews consisted of two crews of three people each to acquire data at each station along with a two person crew at the base station to survey each station and record the data. The data was collected through the ice by drilling holes at surveyed stations (via-TOPCON GTS-3B) and recording the water and sediment depth. A baseline with cross-sections (600 foot increments) was initially established (figure 1). Holes were then drilled at 300 foot increments along each cross-section to establish a grid with 368 cells (cell size 600 ft. x 300 ft.). At each station, water depth (via. stadia rod) and sediment depth (via. 1/2" rebar)(figures 2a-2j) were recorded. On each cross-section, shore points and high water marks were also recorded in order to determine the current lake capacity and high water aerial extent.

## DATA ANALYSIS

The sediment and water data was initially plotted by hand on engineering grid paper and contoured. The perimeter of the lake (shore points, high water marks) was then digitized in order to determine the area of the lake. The data was then loaded into a spreadsheet program (QUATTRO PRO) and analyzed to determine the following selected statistical parameters:

### LAKE ANDES CHARACTERISTICS (SOUTH FORK)

MEAN WATER DEPTH	=	3.10	FEET
MEAN SEDIMENT DEPTH	=	4.68	FEET
MEDIUM WATER DEPTH	=	3.30	FEET
MEDIUM SEDIMENT DEPTH	=	4.80	FEET
LAKE AREA (SHORE POINT)	=	1598	ACRES
LAKE AREA (HIGH WATER)	=	1710	ACRES
VOLUME OF WATER (SP)	=	4954	ACRE-FEET
VOLUME OF SEDIMENT	=	7479	ACRE-FEET
MAXIMUM WATER DEPTH	=	10.6	FEET
WATER DEPTH STD. DEV.	=	.62	FEET
SEDIMENT DEPTH STD. DEV.	=	1.15	FEET

A graphical depiction of sediment and water depth frequency is displayed in figures 3 thru 6. An analysis was made to determine if there was a correlation between water depth and sediment accumulation (figure 7). It was established by this plot that there is not a correlation between sediment accumulation and water depth.

### RESTORATION ALTERNATIVES

There are several alternatives available for the restoration of Lake Andes. These alternatives listed below were chosen on the basis of effectiveness, cost, and their probability of success :

1. No action
2. Selective dredging
3. Land based removal of sediment
4. Dilution/Flushing

#### No Action

If no action is taken to restore the quality of Lake Andes and its watershed, problems will continue and may become more serious. Sediment buildup will continue and the depth will decrease until the lake is a wetland or marsh which could only be used by waterfowl.

### Selective Dredging

If sediment input from the watershed is found to be minimal or minimized by the implementation of BMP's in the watershed, dredging selected areas on the south unit of the lake may be a good option. It has been demonstrated that sediment removal also helps to retard nutrient releases. Certain areas where dredging takes place may provide significant habitat for fish and other living organisms which may prevent or minimize fishkill events. Selective dredging is less expensive and less time consuming than whole lake dredging. The total amount of sediment and the location of the greatest sediment concentrations would still need to be calculated. The average operational cost of an eight inch dredge for a year is \$200,000 , not including startup costs of approximately \$75,000.

### Land Based Removal of Sediment

This method may be the most feasible since Lake Andes has a high tendency to go dry approximately once every twenty years. It may be in the best interest of this project to use land-based equipment to remove the sediment if this event takes place in the next few years. The end result of the land based removal would be similar to that of selective dredging. The advantage of land based removal is that it can be accomplished with conventional equipment such as draglines, bulldozers, or scrapers.

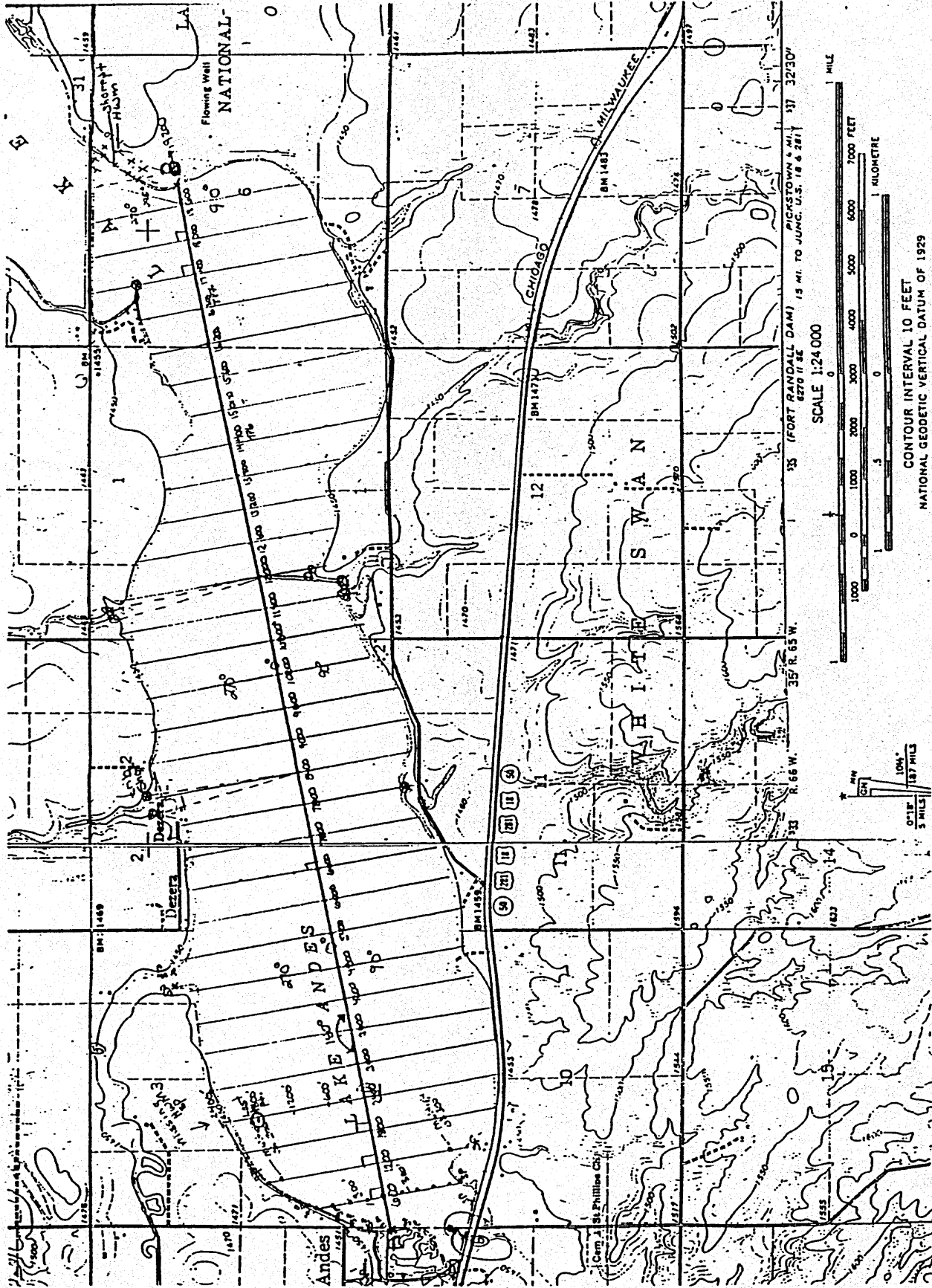
### Dilution/Flushing

In the event that the Lake Andes-Wagner/Marty II irrigation project is completed within the Lake Andes area a dilution/flushing restoration alternative may be created with off-peak pumping into the south unit. If the depth of the south unit is maintained at the high water elevation of 1437.25 feet msl it still may be necessary to dredge selectively to increase the depth in certain areas of the lake.

### CONCLUSIONS

Lake Andes has the characteristics of a typical South Dakota lake. It is concave and shallow and has a tendency to fill with sediment. Because of the negative water balance (precipitation - (evaporation + transpiration)) and low watershed/lake area ratio, this lake will have a tendency to have a highly fluctuating water level. Currently, the mean water depth is 3.10 feet and the mean sediment depth is 4.68 feet. If the recreational uses, wildlife and water quality are to be maintained and improved, an effort should be made to increase the lake water depth and volume through the implementation of a dredging program and water conservation measures.

FIGURE 1



## LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
600	0.00	0.90	4.50
600	-299.85	1.10	2.90
600	300.42	1.30	4.20
600	-600.57	1.30	4.10
600	599.49	1.40	2.80
600	-900.11	1.50	2.90
600	900.28	1.50	2.50
1200	0.00	1.50	5.70
1200	300.67	1.50	5.70
1200	-300.04	1.50	4.40
1200	599.89	1.50	5.80
1200	-600.89	1.60	4.80
1200	899.94	1.60	5.40
1200	1200.12	1.60	4.90
1200	1499.56	1.80	4.10
1200	1800.04	1.90	5.00
1800	0.00	1.90	5.20
1800	300.52	1.90	5.30
1800	-300.34	1.90	5.20
1800	600.45	2.00	4.90
1800	-599.89	2.00	6.40
1800	900.42	2.00	4.80
1800	-900.17	2.00	5.10
1800	1200.00	2.00	5.40
1800	1500.57	2.00	4.80
1800	-1200.21	2.00	5.40
1800	1800.69	2.10	5.10
1800	2100.30	2.10	3.20
1800	-1499.69	2.10	3.70
1800	-1800.34	2.10	2.30
2400	0.00	2.10	6.30
2400	300.14	2.10	4.20
2400	-299.62	2.20	5.10
2400	600.02	2.30	5.80
2400	-599.82	2.30	4.40
2400	899.94	2.30	4.80
2400	-900.21	2.30	5.60
2400	1200.22	2.30	4.30
2400	-1200.49	2.30	4.90

LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
2400	1500.11	2.30	4.30
2400	-1500.63	2.30	4.20
2400	1800.04	2.30	4.90
2400	-1800.59	2.40	5.20
3000	0.00	2.40	5.00
3000	299.50	2.40	4.90
3000	-300.50	2.40	4.30
3000	600.01	2.40	4.20
3000	-600.25	2.40	4.20
3000	899.88	2.40	4.00
3000	-900.22	2.40	4.70
3000	1200.20	2.40	4.70
3000	-1199.74	2.40	4.90
3000	1500.04	2.40	4.50
3000	-1500.19	2.40	4.30
3000	1800.14	2.40	4.30
3000	-1800.34	2.40	4.20
3000	2099.76	2.50	4.90
3600	0.00	2.50	4.30
3600	300.21	2.50	4.00
3600	-300.31	2.50	5.00
3600	600.29	2.50	4.30
3600	-599.80	2.50	4.70
3600	899.97	2.50	5.70
3600	-900.10	2.50	5.70
3600	1199.63	2.50	4.70
3600	-1200.10	2.50	5.70
3600	1500.09	2.50	4.30
3600	-1500.35	2.50	5.00
3600	1800.34	2.50	4.70
3600	-1799.81	2.55	5.70
3600	2100.28	2.60	5.80
3600	2399.95	2.60	5.50
4200	0.00	2.60	4.10
4200	299.98	2.60	5.40
4200	-300.30	2.60	4.00
4200	600.52	2.60	5.30
4200	-600.19	2.60	4.50
4200	900.32	2.60	4.50



## LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
4200	-900.10	2.60	3.40
4200	1200.42	2.60	7.60
4200	-1200.37	2.60	5.60
4200	-1500.08	2.60	3.20
4200	1500.12	2.60	6.50
4200	1799.68	2.65	5.40
4200	2100.19	2.70	6.30
4800	0.00	2.70	7.60
4800	300.17	2.70	4.80
4800	-299.99	2.70	7.60
4800	600.37	2.70	4.40
4800	-600.28	2.70	5.90
4800	899.61	2.70	6.10
4800	-900.12	2.70	5.20
4800	1199.62	2.70	5.20
4800	-1200.12	2.75	5.20
4800	1500.17	2.80	5.00
4800	-1500.47	2.80	5.30
4800	1800.24	2.80	3.40
4800	-1800.31	2.80	5.60
5400	0.00	2.80	5.00
5400	300.24	2.80	5.70
5400	-300.32	2.80	4.90
5400	599.59	2.80	5.60
5400	-599.64	2.80	5.00
5400	900.41	2.80	4.50
5400	-900.19	2.80	4.90
5400	1200.10	2.80	2.20
5400	1499.91	2.90	2.20
5400	1799.65	2.90	2.20
5400	-1200.35	2.90	4.50
5400	-1499.99	2.90	5.50
5400	-1799.85	2.90	5.50
5400	-2100.33	2.90	4.20
6000	0.00	2.90	5.00
6000	300.54	2.90	5.00
6000	-299.95	2.90	5.00
6000	600.39	2.90	4.30
6000	-600.18	2.90	4.70



LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
6000	900.04	2.90	5.40
6000	-900.32	2.90	4.10
6000	1199.99	2.90	6.00
6000	-1200.04	2.90	4.60
6000	1499.62	3.00	4.30
6000	-1500.08	3.00	4.80
6000	1799.89	3.00	2.40
6000	-1800.38	3.00	6.00
6000	2099.62	3.00	1.80
6000	-2099.75	3.00	4.00
6600	0.00	3.00	5.00
6600	-300.50	3.00	5.30
6600	-599.95	3.00	4.90
6600	-900.44	3.00	5.50
6600	-1199.85	3.00	4.80
6600	-1500.12	3.00	4.50
6600	-1799.96	3.00	5.10
6600	300.55	3.00	5.50
6600	600.09	3.00	4.70
6600	899.74	3.00	5.30
6600	1199.55	3.00	5.30
6600	1500.17	3.00	5.20
6600	1799.80	3.00	4.60
6600	2100.43	3.05	4.60
7200	0.00	3.05	4.10
7200	300.24	3.10	4.40
7200	-300.41	3.10	4.10
7200	599.67	3.10	5.50
7200	899.79	3.10	4.90
7200	-600.18	3.10	4.80
7200	1200.22	3.10	5.40
7200	1499.58	3.10	5.50
7200	-899.99	3.10	4.60
7200	1800.03	3.10	5.60
7200	-1199.89	3.10	4.00
7200	-1499.78	3.10	2.20
7800	0.00	3.10	4.50
7800	-300.47	3.10	4.80
7800	-600.14	3.10	4.50

LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
7800	-900.37	3.10	3.90
7800	-1200.05	3.10	2.10
7800	299.61	3.10	5.00
7800	600.43	3.10	3.50
7800	900.09	3.10	4.00
7800	1199.64	3.10	3.30
7800	1499.99	3.20	5.20
7800	1800.39	3.20	5.00
8400	0.00	3.20	4.50
8400	300.37	3.20	4.30
8400	-300.45	3.20	4.40
8400	600.23	3.20	4.20
8400	-599.56	3.20	4.20
8400	900.33	3.20	4.80
8400	-900.16	3.20	4.00
8400	1199.96	3.20	4.20
8400	-1199.83	3.20	4.50
8400	1500.31	3.20	4.80
8400	-1499.68	3.20	2.80
8400	1799.83	3.20	2.00
9000	0.00	3.20	4.80
9000	299.99	3.20	4.50
9000	-300.18	3.20	3.80
9000	599.57	3.20	4.30
9000	-600.25	3.30	4.10
9000	900.36	3.30	4.00
9000	-900.05	3.30	3.90
9000	1200.03	3.30	4.10
9000	-1199.66	3.30	3.60
9000	1500.17	3.30	4.30
9000	-1499.97	3.30	3.10
9000	1799.85	3.30	4.00
9000	-1800.27	3.30	2.00
9600	0.00	3.30	4.40
9600	300.30	3.30	5.10
9600	-300.23	3.30	4.80
9600	599.54	3.30	4.30
9600	-599.92	3.30	5.40
9600	900.39	3.30	4.20

## LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
9600	-900.05	3.30	5.00
9600	1200.38	3.30	4.80
9600	-1200.21	3.30	5.30
9600	1500.04	3.30	4.80
9600	-1500.32	3.30	4.00
9600	1800.35	3.30	4.50
9600	2099.53	3.30	2.70
10200	0.00	3.30	5.00
10200	300.49	3.30	4.30
10200	-300.37	3.30	5.50
10200	600.02	3.30	4.30
10200	-600.19	3.30	5.20
10200	900.09	3.30	4.80
10200	-900.10	3.30	4.60
10200	1200.05	3.30	3.40
10200	-1199.91	3.30	5.00
10200	1500.23	3.40	5.10
10200	1800.23	3.40	4.70
10200	2099.73	3.40	2.00
10800	0.00	3.40	5.50
10800	299.93	3.40	4.30
10800	-299.53	3.40	4.90
10800	600.38	3.40	4.40
10800	-600.35	3.40	5.90
10800	900.34	3.40	4.60
10800	-900.20	3.40	3.90
10800	1199.56	3.40	4.40
10800	1500.32	3.40	4.30
10800	1800.54	3.40	4.30
10800	2100.19	3.40	2.90
11400	0.00	3.40	3.70
11400	300.32	3.40	4.20
11400	-300.19	3.40	5.30
11400	599.83	3.40	4.00
11400	900.05	3.40	3.80
11400	1200.24	3.40	4.90
11400	1500.08	3.40	3.70
11400	1800.06	3.40	3.60
11400	2100.12	3.40	4.20

LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
12000	0.00	3.40	4.60
12000	300.11	3.40	4.20
12000	-300.14	3.40	4.80
12000	599.58	3.40	3.90
12000	-599.85	3.40	5.40
12000	899.78	3.40	3.60
12000	-899.84	3.40	4.40
12000	1199.86	3.40	2.50
12000	1500.34	3.40	3.60
12600	0.00	3.40	4.90
12600	299.72	3.40	4.30
12600	-299.57	3.50	5.90
12600	599.93	3.50	5.00
12600	-599.71	3.50	5.80
12600	900.17	3.50	5.40
12600	-899.97	3.50	6.30
12600	1200.02	3.50	4.40
12600	-1199.83	3.50	3.40
12600	1500.04	3.50	2.90
13200	0.00	3.50	4.90
13200	300.41	3.50	4.80
13200	-299.72	3.50	4.60
13200	600.19	3.50	3.60
13200	-599.56	3.50	4.40
13200	899.97	3.50	3.40
13200	-899.81	3.50	5.00
13200	1200.17	3.50	2.90
13200	-1199.82	3.50	3.50
13800	0.00	3.50	4.30
13800	299.53	3.50	5.80
13800	-300.07	3.50	4.00
13800	599.94	3.50	3.40
13800	-600.19	3.50	4.90
13800	900.10	3.50	3.00
13800	-900.25	3.50	4.50
13800	-1199.65	3.50	3.30
14400	0.00	3.50	5.40
14400	300.41	3.50	3.80
14400	-300.36	3.50	5.10

LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
14400	-599.77	3.50	5.10
14400	-900.07	3.50	4.10
14400	-1199.70	3.50	4.90
14400	-1499.69	3.50	5.50
14400	-1800.01	3.55	5.90
14400	-2100.20	3.55	10.60
14400	-2400.16	3.60	2.20
15000	0.00	3.60	4.90
15000	300.24	3.60	6.10
15000	-300.00	3.60	6.20
15000	-600.06	3.60	6.80
15000	-900.26	3.60	6.50
15000	-1200.26	3.60	5.50
15000	-1499.87	3.60	6.20
15000	-1800.42	3.60	5.10
15000	-2100.06	3.60	5.50
15000	-2400.17	3.60	5.70
15000	-2700.19	3.60	2.10
15600	0.00	3.60	3.90
15600	299.89	3.60	6.30
15600	-299.54	3.60	5.20
15600	-600.35	3.60	5.50
15600	-900.44	3.60	4.10
15600	600.09	3.60	3.00
15600	-1200.16	3.60	5.80
15600	-1500.08	3.60	6.10
15600	-1800.32	3.60	4.80
15600	-2099.68	3.60	5.80
15600	-2399.98	3.60	5.80
15600	-2700.34	3.60	3.80
16200	0.00	3.60	5.30
16200	300.39	3.60	3.70
16200	-300.15	3.60	5.20
16200	600.01	3.60	3.30
16200	-599.92	3.60	5.60
16200	899.54	3.60	3.00
16200	-900.00	3.60	5.80
16200	-1200.07	3.70	6.30
16200	-1499.66	3.70	5.20

LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
16200	-1800.16	3.70	5.80
16200	-2099.56	3.70	5.30
16200	-2400.46	3.70	3.90
16200	-2700.17	3.70	1.80
16800	0.00	3.70	6.10
16800	299.92	3.70	5.50
16800	-300.09	3.70	5.70
16800	600.23	3.70	3.80
16800	-600.06	3.70	6.00
16800	900.06	3.70	2.20
16800	-900.25	3.70	6.00
16800	-1199.98	3.70	5.00
16800	-1500.02	3.70	4.90
16800	-1799.88	3.75	6.20
16800	-2099.84	3.80	5.10
16800	-2399.79	3.80	3.30
17400	0.00	3.80	6.10
17400	300.08	3.80	7.00
17400	599.88	3.80	6.90
17400	899.79	3.80	2.90
17400	-300.15	3.80	6.40
17400	-599.81	3.80	6.50
17400	-899.97	3.80	6.50
17400	-1200.21	3.80	6.70
17400	-1500.29	3.80	6.10
17400	-1800.50	3.80	5.40
17400	-2099.85	3.80	2.40
18000	0.00	3.80	6.40
18000	300.20	3.90	4.80
18000	-299.64	3.90	4.80
18000	599.98	3.90	4.90
18000	-600.03	3.90	5.30
18000	900.30	3.90	3.70
18000	-899.94	3.90	6.80
18000	1200.39	3.90	1.00
18000	-1200.36	3.90	5.50
18000	1499.72	4.00	6.10
18000	-1499.68	4.00	3.30
18000	-1799.86	4.00	5.40

LAKE ANDES SEDIMENT SURVEY

LOCATION	STATION (+N,-S)	WATER DEPTH	SEDIMENT DEPTH
18000	-2099.98	4.00	4.70
18600	0.00	4.00	4.40
18600	300.50	4.00	3.20
18600	-300.20	4.00	3.20
18600	-600.34	4.00	4.20
18600	600.06	4.00	4.70
18600	-900.36	4.00	2.90
18600	899.68	4.00	4.70
18600	-1199.90	4.00	2.10
18600	1200.21	4.10	6.60
18600	-1499.80	4.10	3.00
18600	1500.31	4.10	7.50
18600295	299.87	4.10	2.30
18600295	600.21	4.10	6.40
18600295	900.07	4.20	5.70
18600295	1200.30	4.20	6.90
18600295	1500.41	4.20	6.70

MEAN WATER DEPTH	=	3.10 FEET
MEAN SEDIMENT DEPTH	=	4.68 FEET
MEDIUM WATER DEPTH	=	3.30 FEET
MEDIUM SEDIMENT DEPTH	=	4.80 FEET
LAKE AREA (SHORE POINTS)	=	1598 ACRES
LAKE AREA (HIGH WATER)	=	1710 ACRES
VOLUME OF WATER (SHORE POINT)	=	4954 ACRE-FEET
VOLUME OF SEDIMENT	=	7479 ACRE-FEET
MAXIMUM WATER DEPTH	=	4.2 FEET
MAXIMUM SEDIMENT DEPTH	=	10.6 FEET
WATER DEPTH STD. DEV.	=	0.621 FEET
SEDIMENT DEPTH STD. DEV.	=	1.15 FEET



FIGURE 3

FREQUENCY PLOT OF WATER DEPTH

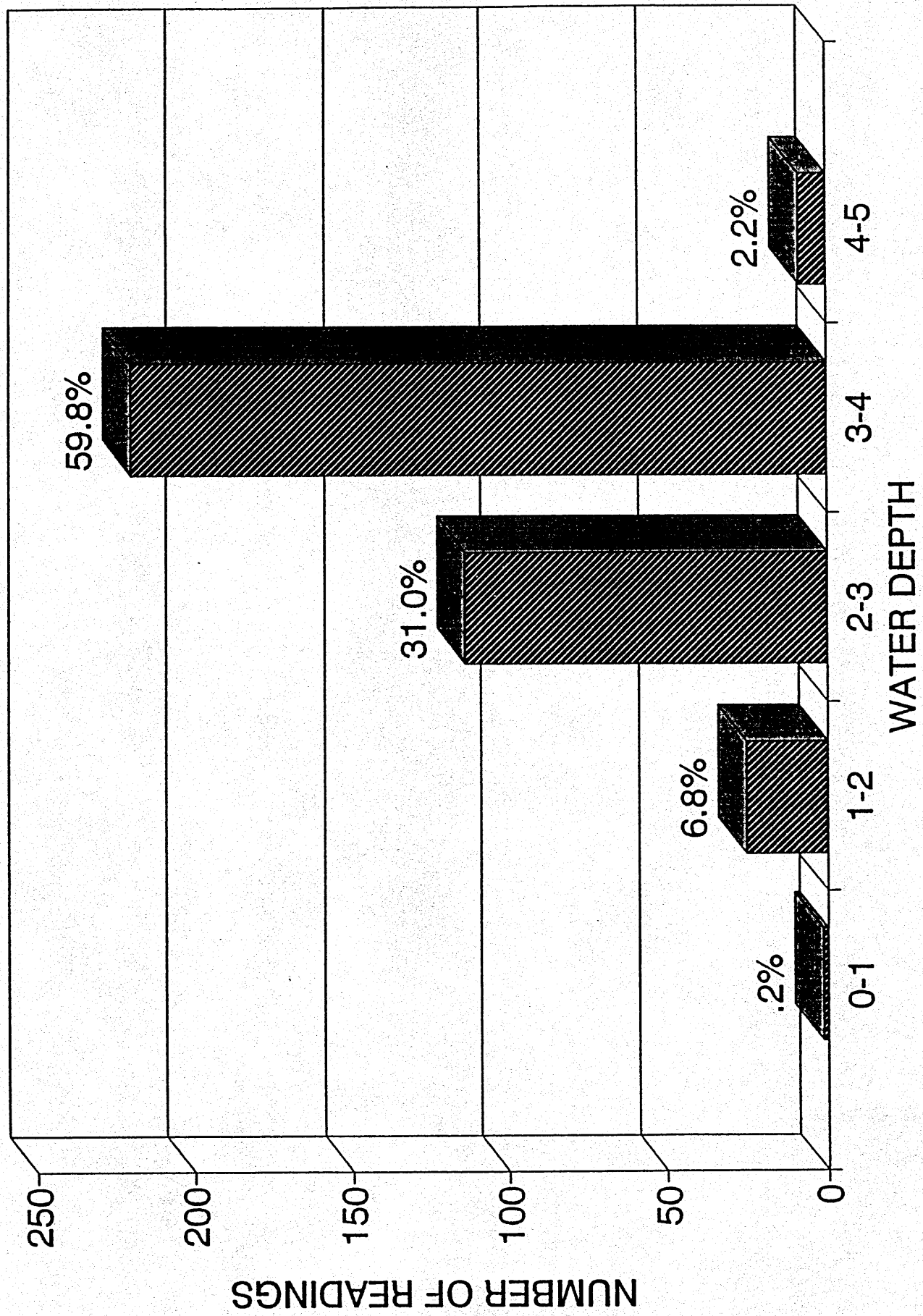


FIGURE 4

FREQUENCY PLOT OF SEDIMENT DEPTH

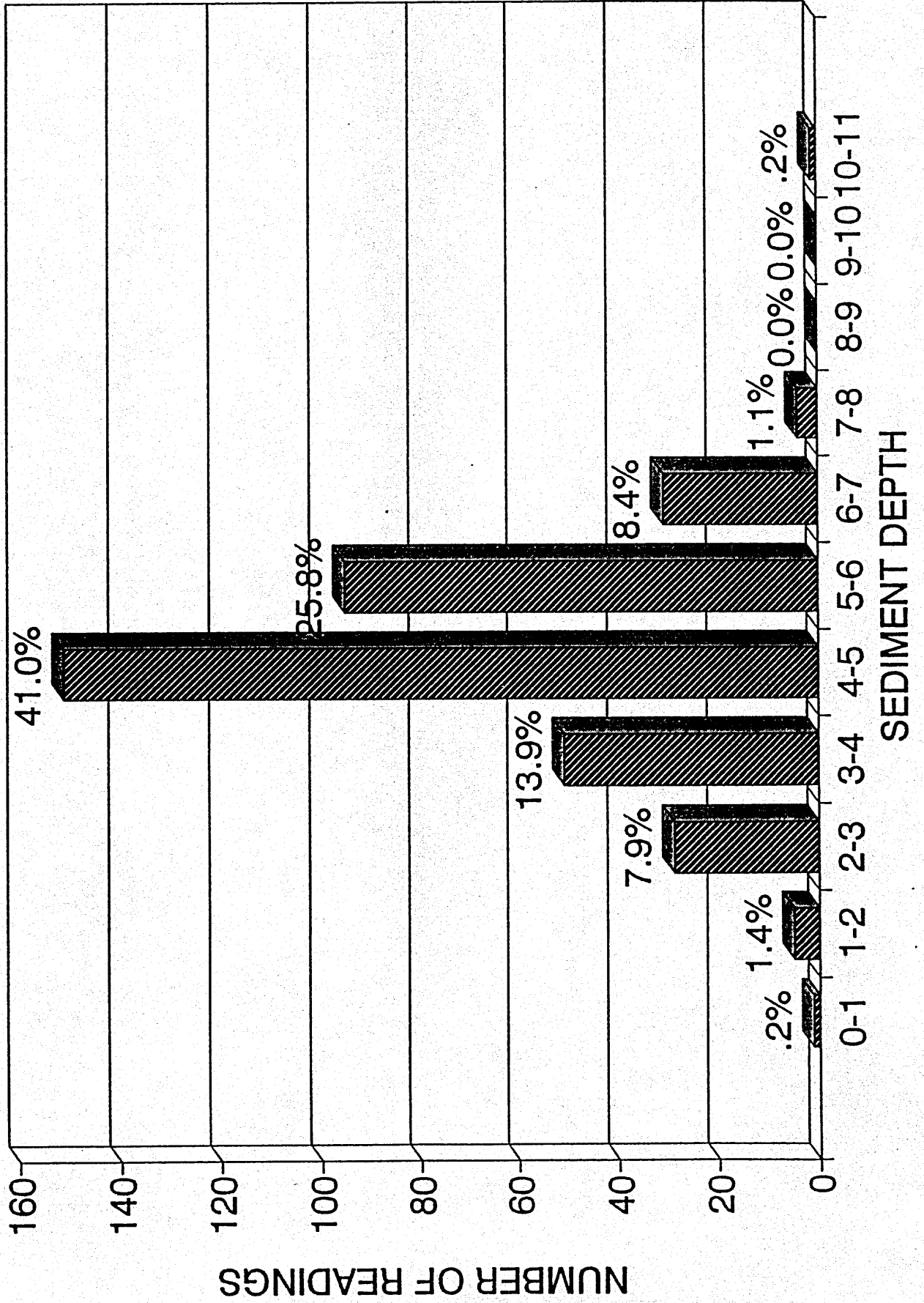


FIGURE 5

WATER DEPTH DISTRIBUTION

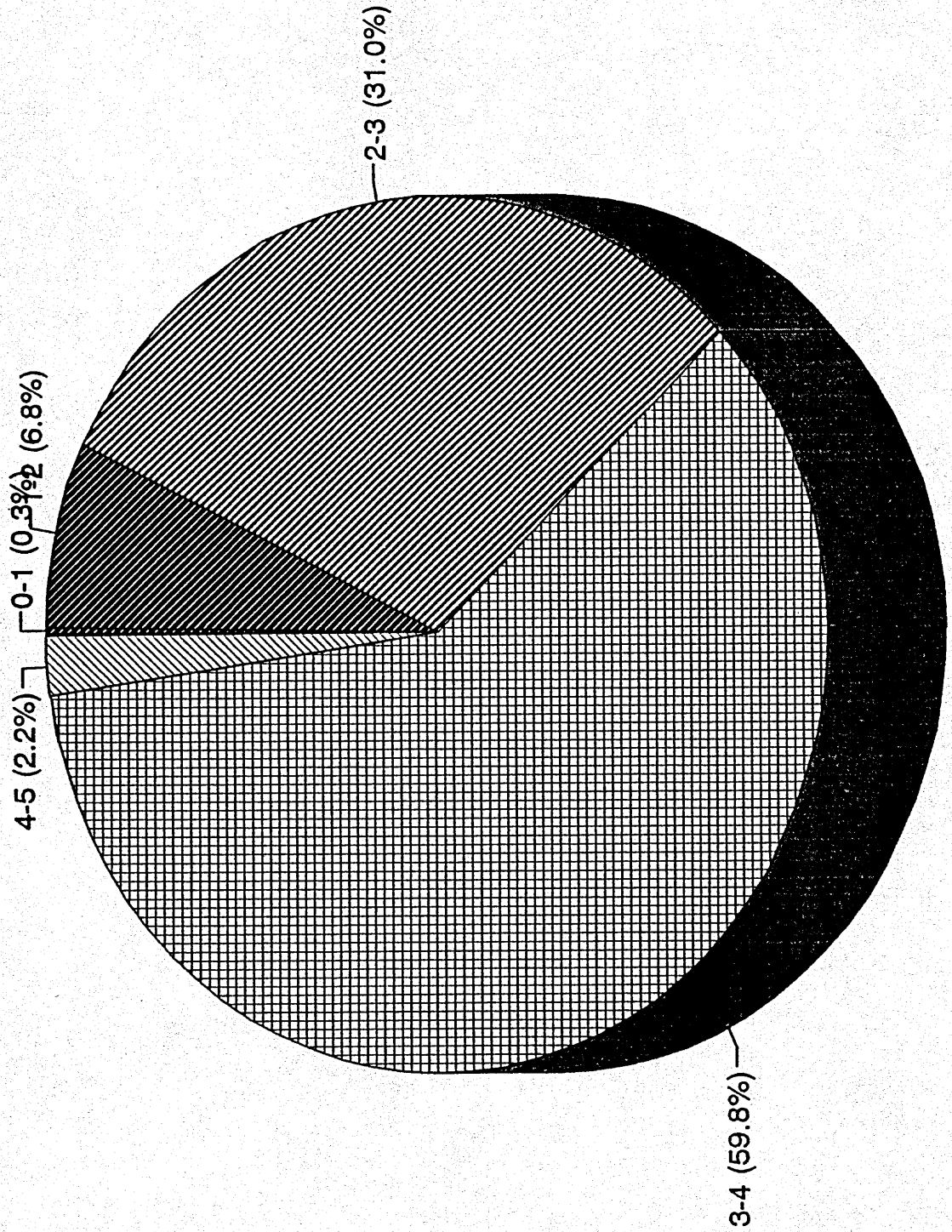


FIGURE 6

SEDIMENT DEPTH DISTRIBUTION

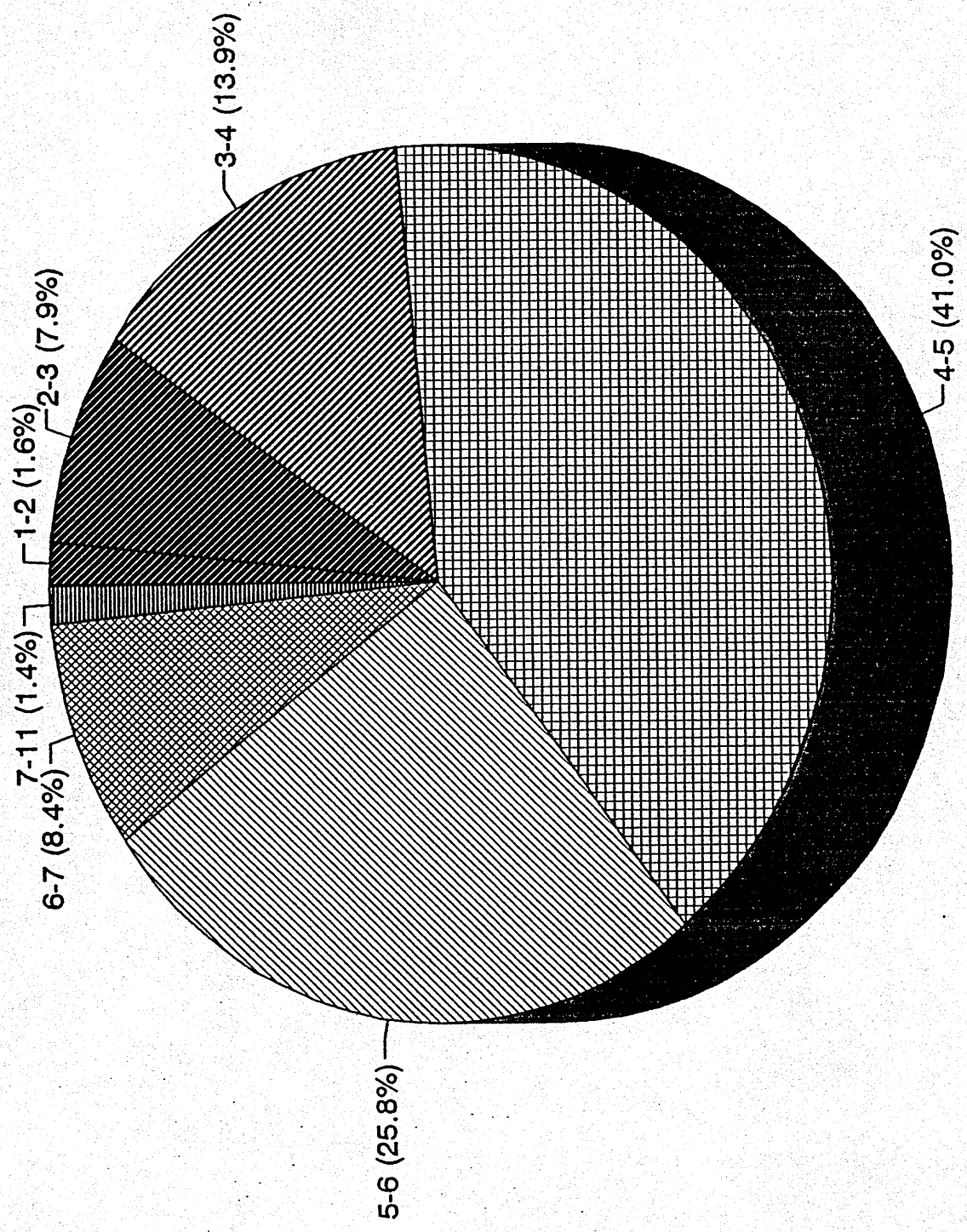


FIGURE 7

WATER/SEDIMENT CORRELATION

