#50

01600
SOCL
Water Quality Status Report #50 - Lower

LOWER BOISE RIVER DRAINS — WA
CANYON COUNTY, IDAI

State of Idaho — Department of Health & Welfare — Division of Environment

1983

COVER: Upper left - severely eroded cornfield, Sand Hollow Drain area; Upper middle - wastewater entering Conway Gulch; Upper right - cattle on banks of South Drain; Center - Boise River near mouth; Lower left - Buried pipe runoff system, Conway Gulch area; Lower right - Sediment pond, Conway Gulch area. Photos by author, 1978-1982.

WATER QUALITY STATUS REPORT

LOWER BOISE RIVER DRAINS

CANYON COUNTY, IDAHO

Report By:

William H. Clark

and

Stephen B. Bauer

1983

IDAHO DEPARTMENT OF HEALTH AND WELFARE
Division of Environment
Boise, Idaho

In cooperation with the Lower Boise River 208 Project
Canyon Soil Conservation District
Caldwell, Idaho

Water Quality Series No. 50

TABLE OF CONTENTS

	PAGE
List of Tables	ii
List of Figures	iii
List of Appendices	iv
Summary	v-vi
Introduction	
Objectives	1
Drainage Description	1-4
Past Water Quality Studies	4-5
Materials and Methods	6-7
Results	
Sand Hollow Drain	
Suspended Sediment	8
Bedload Sediment	8-9
Physical Parameters	9-10
Nutrients	10-11
Bacteria	12-13
Pesticides	13-14
Dixie Drain	
Suspended Sediment	15-16
Bedload Sediment	16
Physical Parameters	16-17
Nutrients	17-18
Bacteria	18-19
Pesticides	19
South Boise Drains	
Suspended Sediment	20
Physical Parameters	20-21
Nutrients	21-22
Bacteria	22
Pesticides	23
Discussion	
Pollutant Reduction Goals	25-28
Priorities	28-30
Conclusions and Recommendations	31-33
Acknowledgements	34
Literature Cited	35-36

LIST OF TABLES

		Page
Table 1.	Lower Boise Valley Drain Water Quality Stations - WY 1980	37
Table 2.	Lower Boise Valley Drain Water Quality Stations - WY 1981	38
Table 3.	Summary of Suspended Sediment Data for Sand Hollow Drain and Parma Drain (WY 1980-1981)	39
Table 4.	Bedload Sediment Loadings (tons/day) for Selected Lower Boise River Drains (WY 1980-1981)	40
Table 5.	Flow (cfs) in Sand Hollow and Dixie Drains - WY 1980	41
Table 6.	Dissolved Oxygen Concentration (mg/l) and Percent Saturation for Lower Boise Drains - WY 1980	42
Table 7.	Water Temperature (°C) for Lower Boise River Drains - WY 1980	43
Table 8.	PH Values (in standard units) for Lower Boise River Drains - WY 1980	44
Table 9.	Total Phosphorus Loading for Drains - WY 1980	45
Table 10.	Bacteria Concentrations in Sand Hollow Drain - WY 1980	46
Table 11.	Summary of DDT and Toxaphene Residues in Fish in Lower Boise River Drains - WY 1980, WY 1981	47
Table 12.	Summary of Suspended Sediment Data for Dixie Drain Drainage - WY 1980	48
Table 13.	Bacteria Concentrations in Dixie Drain and Tributaries - WY 1980	49
Table 14.	Summary of Suspended Sediment Data for Drains - WY 1981	50
Table 15.	Flow (cfs) for Lower Boise River Drains - WY 1981	51
Table 16.	Dissolved Oxygen Concentration (mg/l) and Percent Saturation for Lower Boise River Drains - WY 1981	52
Table 17.	Water Temperature (°C) for Lower Boise River Drains - WY 1981	53
Table 18.	PH Values for Lower Boise River Drains - WY 1981	54
Table 19.	Total Phosphorus Loading for Drains - WY 1981	55
Table 20.	Total Nitrate Loading for Drains - WY 1981	56
Table 21.	Bacteria Concentrations in Lower Boise Valley Drains - WY 1981	57
Table 22.	Nutrient of Suspended Sediment Data for the Boise River - WY 1980 - WY 1982	58
Table 23.	Rank of Suspended Sediment Concentrations, Irrigation Season	59
Table 24.	Rank of Suspended Sediment Loading, Irrigation Season	60

LIST OF FIGURES

		Page
Figure 1.	Location of Drain Stations in 208 Project Area, Lower Boise River.	61
Figure 2.	Suspended Sediment Load in Sand Hollow Drain at Mouth - WY 1980.	62
Figure 3.	Bedload Texture in Sand Hollow Drain - WY 1980	63
Figure 4.	Mean Flow (cfs) in Sand Hollow Drain - WY 1980	64
Figure 5.	Phosphorus Load (pounds) in Sand Hollow Drain - WY 1980. . .	65
Figure 6.	Fecal Coliform Bacteria in Sand Hollow Drain - WY 1980 . . .	66
Figure 7.	Fecal Streptoccus Bacteria in Sand Hollow Drain - WY 1980.	67
Figure 8.	Suspended Sediment Load (tons) in Dixie Drain - WY 1980. . .	68
Figure 9.	Mean Flow (cfs) in Dixie Drain - WY 1980	69
Figure 10.	Phosphorus Load (pounds) in Dixie Drain - WY 1980	70
Figure 11.	Fecal Coliform Bacteria in Dixie Drain - WY 1980	71
Figure 12.	Fecal Streptococcus Bacteria in Dixie Drain - WY 1980. . . .	72
Figure 13.	Suspended Sediment Load (tons) in Drains - WY 1981	73
Figure 14.	Mean Flow (cfs) in Drains - WY 1981.	74
Figure 15.	Phosphorus Load (pounds) in Drains - WY 1981	75
Figure 16.	Nitrate Load (pounds) in Drains - WY 1981.	76
Figure 17.	Nitrate Concentration in Ross East End Drain, April, 1981 to April, 1982.	77
Figure 18.	Fecal Coliform Bacteria in Drains - WY 1981.	78
Figure 19.	Fecal Streptococcus Bacteria in Drains - WY 1981	79
Figure 20.	Nitrates in Boise River at Parma, November, 1979 to September, 1982.	80

LIST OF APPENDICES

		Page
APPENDIX A - TEXTURAL ANALYSIS		81
A-1	Textural Analysis (weight in grams) of Bedload Sediment for Sand Hollow Drain - Irrigation Season, WY 1980	82-84
A-2	Textural Analysis of Bedload Sediment for the Drains on the South Side of the Boise River - WY 1980-1981	85
A-3	Textural Analysis of Bedload Sediment for the Drains on the North Side of the Boise River - April 1981	86
APPENDIX B - TRACE ORGANICS IN FISH		87
B-1	Trace Organic (Pesticide) Residues from Fish from Sand Hollow Drain, Mouth (mg/kg, wet weight)	88
B-2	Trace Organic (Pesticide) Residues from Fish from Parma Drain, Mouth (mg/kg, wet weight)	89
B-3	Trace Organic (Pesticide) Residues from Fish from Sand Hollow Drain, Highway 20/26 (mg/kg, wet weight)	90-92
B-4	Trace Organic (Pesticide) Residues from Fish from Dixie Drain, Mouth (mg/kg, wet weight)	93
B-5	Trace Organic (Pesticide) Residues from Fish from Dixie Drain, Guess Gulch (mg/kg, wet weight)	94
B-6	Trace Organic (Pesticide) Residues from Fish from Dixie Drain, Super Lateral Road (mg/kg, wet weight)	95
B-7	Trace Organic (Pesticide) Residues from Fish from West End Drain, Above Renshaw (mg/kg, wet weight)	96-97
B-8	Trace Organic (Pesticide) Residues from Fish from South Boise Drain, Scott Pitt Road (mg/kg, wet weight)	98
B-9	Trace Organic (Pesticide) Residues from Fish from Ross East End Drain, Highway 95 (mg/kg, wet weight)	99
APPENDIX C - LINEAR REGRESSION OF DDT AND TOXAPHENE RESIDUES IN FISH TO WEIGHT OF FISH AND LIPID CONTENT		100 - 101

SUMMARY

1) A water quality monitoring program was established on the irrigation drainage system in the Lower Boise River Valley as part of a 208 project to develop a pollution abatement plan for agricultural lands. The 208 project area encompassed irrigated lands along the Boise River from Caldwell to the Snake River. This included Conway Drain and Sand Hollow Drain on the north side, and Dixie Drain, Ross East End Drain, and South Boise drain on the south side. Conway Drain and Dixie Drain empty into the Boise River within the project area. The other drains empty into the Snake River. Samples for suspended sediment, nutrients, bacteria, and toxics in fish were collected between November 1979 and March 1982.

2) Suspended sediment loading was calculated on an annual and irrigation season basis. Annual suspended sediment loads for the major drains are: Sand Hollow Drain - 11,040 tons; Dixie Drain - 11,900 tons; Ross East Drain - 4,100 tons; and South Boise Drain - 3,260 tons. Tributary drains that are characteristic of erosion areas that carried high loads included Renshaw Canal - 8,370 tons, Mammon Gulch - 2,680, and West End Drain - 7,780 tons.

3) Bedload sediment (sand-size particles on the stream bottom) is an important component of the total sediment load on the north side of the river. At one station on Sand Hollow Drain the bedload sediment was approximately double the suspended sediment load. This impact needs to be considered when settling ponds and other sediment trapping practices are designed in this area.

4) Concentrations of total phosphorus and inorganic nitrogen exceed accepted instream criteria in most drains throughout the year. Calculated total phosphorus loads show that the drains contribute large quantities of phosphorus to the Boise and Snake River. Annual total phosphorus loads for the major drains are: Sand Hollow Drain - 51 tons; Dixie Drain - 85 tons; Ross East End Drain - 11 tons; South Boise Drain - 17 tons; Renshaw Canal - 10 tons; Mammon Gulch - 6 tons; and West End Drain - 25 tons.

   A significant percentage of the total phosphorus is in the ortho-phosphate or dissolved phosphorus phase. Implementation of erosion control practices can only be expected to reduce the phosphorus associated with sediment. In Sand Hollow Drain it was calculated that approximately 58% of the phosphorus is associated with sediment, in Dixie Drain this percentage is approximately 35%.

5) Annual mean concentrations of nitrate ranged from 2.2 to 4.8 mg/l. Nitrates are lowest during the irrigation season and highest during the winter when discharge is made up primarily of groundwater. Although nitrates result from agricultural practices and the associated irrigation system it is not expected that implementation of BMPs will reduce nitrates.

6) Fish were collected and analyzed for pesticide residues. The larger drains had considerable populations of Carp and Suckers. Of the 18 pesticides or other trace organics analyzed, only two - DDT and toxaphene - were consistently above minimum detection limits. Residues measured in fish flesh were generally less than FDA action levels for human consumption of fish,

and are therefore not considered a public health problem. However, a large number of DDT samples and all toxaphene samples exceeded threshold levels identified in the literature at which sublethal impacts on fish are expected. Pesticide residues were significantly correlated to lipid content of the flesh.

7) Fecal coliform and fecal streptococcus numbers were high in drains throughout the 208 project area. This data was compared to primary contact recreation standards since the receiving streams, the Boise River and Snake River, are designated for primary contact recreation. All stations sampled exceeded the geometric mean standard of 50/100 ml. Geometric means were generally in a range from 500 - 3,000/100 ml. Fecal coliform - fecal streptococcus ratios indicate that livestock wastes are the primary source of bacteria. Many of the drains are used as a direct source of livestock water or flow through a concentrated livestock feeding area.

8) Temperatures occasionally reached 22°C in the drains which is the maximum temperature criteria for cold water biota. Dissolved oxygen also was occasionally measured at concentrations less than 6 mg/l. This indicates that at present the drains may be considered marginal with respect to supporting cold water biota (i.e. trout).

INTRODUCTION

OBJECTIVES

The State Agricultural Water Pollution Abatement Plan (Idaho Soil Conservation Commission 1979) identified the Boise River Valley in Canyon County as high priority for decreasing sediment caused by irrigated agriculture. The Boise Valley west of Caldwell in Canyon County was rated as first priority. The Canyon Soil Conservation District (SCD) was awarded a 208 Clean Water Act grant to develop a water pollution abatement plan for irrigated lands in this area, IDHW-DOE undertook a water quality study of drains within the 208 project area to assist the Canyon SCD in identifying pollution sources and to characterize the magniture of the problem.

The specific objectives of the monitoring program were;

1) To determine suspended sediment loads in the major drainage systems on an annual and irrigation season basis.

2) To characterize nutrient, bacteria, and pesticide parameters in the drains.

3) To use this information to develop a water quality basis for setting priorities in sub-drainages for implementation programs.

DRAINAGE DESCRIPTION

The Lower Boise River drains are a network of natural and man-made irrigation drainage ditches that are located in Canyon County along the north and south sides of the Boise River from Caldwell to the rivers' confluence with the Snake River (See Figure 1). The irrigation water for the area north of the river originates from Black Canyon Reservoir (Payette River) and the

Boise River. The area on the south side of the river is irrigated either directly from the Boise River or indirectly from Lake Lowell (Deer Flat Reservoir).

The drains were divided for study into the following groups based loosely on watersheds. Some of the drainage patterns are rather complex and often water can be routed in several different ways.

1) Sand Hollow Drain

Sand Hollow Drain, also known as Sand Run, is the largest drainage in the study area. Sand Hollow is on the north side of the Boise River, flows parallel to the river along the lower 12 miles, then empties into the Snake River in the vicinity of Fort Boise. Parma Drain is a tributary to Sand Hollow.

2) Conway Gulch

Conway Gulch is the major direct inflow on the north side of the river within the project area.

3) Dixie Drain/West End Drain

Dixie Drain, also known as Dixie Slough, is the major inflow to the Boise River from the south side. North Drain and South Drain empty into Dixie Drain. Renshaw Canal which drains Pipe Gulch empties into the West End Drain. West End Drain can either be routed into Dixie Drain or be used for further irrigation by emptying into the Riverside Canal.

4) South Boise Drains

Ross East End Drain parallels the Boise River on the south side. It joins drainage from the South Boise Drain and flows into the Snake River some distance above the confluence of the Boise River (Figure 1).

Mammon Gulch empties into Ross East End Drain. There are control structures available so that Mammon Gulch could be routed into a canal at the lower end; however, during the survey the water emptied directly into Ross East End Drain.

The Canyon SCD inventoried the number of acres in the project area by subwatershed, and categorized the critical erosion areas. Critical acreage is cropland which exceeds an average annual erosion rate of five tons/acre/year. This rate is considered severe by the Soil Conservation Service (SCS) since on the average it exceeds the natural soil replacement rate. Glen Nielson, Canyon SCD, (Personal Communication) supplied the following figures:

Subwatershed Area

Name	Total Acres	Critical Acres
Sand Hollow Drain	17,660	10,680
Conway Gulch	18,220	12,880
Parma Drain	1,140	1,050
Ross East End, South Boise, & Alkali Drains	4,840	3,920
West End, Dixie Drains	11,390	8,170
Mammon Gulch	5,380	5,240
Renshaw Drain	5,260	3,990

Recently, the Canyon SCD has been awarded a grant from the Idaho Water Pollution Control Account to reduce pollution from irrigated cropland in the Conway Gulch Drain, which is located northwest of Caldwell (Figure 1).

Priest et al. (1972) gives an indication of the relatively long history of irrigation in the Boise River Valley and notes that by 1865 much of the

low-lying land near the river was irrigated. The soils of the area north of the river are described in a general manner, as follows: Lower Conway Drain, the Parma Drain and most of the lower part of Sand Hollow Drain lie in the Greenleaf-Nyssaton-Garbutt Association consisting of well drained silt loams on lake terraces and alluvial fans; the upper sections of Conway Gulch and Sand Hollow Drain are in the Elijah-Lankbush-Vickery Association consisting of well drained silt loams to sandy loams on high uplands. The lower areas on the south side of the Boise River (Dixie Drain, North Drain, South Drain, Mammon Gulch, Ross East End Drain, South Boise Drain, and the lower sections of the Dixie, West End and Renshaw Drains) also lie in the Greenleaf-Nyssaton-Garbutt Association. The upper sections of the Dixie and Renshaw Drains are in the Power-Purdam Association. Part of the South Boise-Alkali Drain system is partly in the Turbyfill-Cencove-Feltham Association consisting of well-drained and somewhat excessively drained fine sandy loams and loamy fine sands (Priest et al. 1972).

PAST WATER QUALITY STUDIES

A variety of water quantity and water quality studies and reports have been done on the Boise River in the last decade. A smaller number of studies have been conducted on drains in the Lower Boise Valley. Dion (1972) gives detailed information on groundwater quality and flow for the area just east (upstream) of the study area. Priest et al. (1972) conducted the soil survey for the Canyon area. Thomas and Dion (1974) present water quality data for groundwater and streams, including Conway Gulch at Notus, South Boise Drain, West End Drain, Dixie Drain, Sand Hollow Drain and Ross East End Drain. Naylor et al. (1976) gave water quality data for several drains including Conway drain, individual field tailwater and canal headwaters. The U.S. Bureau of Reclamation (BOR)(1977) presented water quality data on the area including

Conway Gulch and Dixie Drain. Groundwater quality data as well as drain water quality data was presented for much of the area south of the Boise River by Lewis et al. (1978). Water quality data taken during the 1977 drought are presented in the Bureau of Reclamation (1978) and includes information on Conway Gulch, Sand Hollow Drain, Dixie Drain, and East End Drain. Parliman (1982) provided detailed groundwater quality data for many wells in Canyon County including several located within the study area.

MATERIALS AND METHODS

Two sets of stations were selected in the project area. Sand Hollow Drain and Dixie Drain watersheds were sampled in Water Year 1980 (Table 1). Renshaw Canal and Mammon Gulch were sampled at this time at the request of the Canyon SCD. In 1981 Conway Gulch, West End Drain, Ross East End Drain, and South Boise Drain were sampled (See Table 2). A station on Parma Drain and Sand Hollow Drain were repeated. The results of the water quality survey on Conway Gulch has been reported on separately in Clark and Bauer (1982). As part of this study, the U. S. BOR sampled the mouths of the selected drains and three locations on the Boise River monthly.

Field parameters were determined with the use of portable meters. Dissolved oxygen and temperature were measured with a Yellow Springs Instrument Company Model 54A meter. The pH was determined with a Photvolt 126A pH meter. The meters were calibrated at the beginning of each survey and checked for accuracy at the end of the survey.

All chemical samples were collected with DH-48 and DH-59 suspended sediment samplers. Composite samples were collected into a churn splitter. Sub-samples were then dispensed into new one liter cubitainers. One liter was preserved with two ml. of concentrated H_2SO_4 for nutrient analysis; and when trace metals were examined, a liter cubitainer was preserved with 10 ml. of 1:1 distilled HNO_3. For sampling and laboratory quality control, we took duplicate split samples on each sample date at Conway Gulch Station #1 for both chemical samples and bacteriological samples.

Bacterial grab samples were collected into sterile 250 ml. Nalgene bottles. All samples were placed on ice and cooled to 4° C. Chemical and bacteriological

analyses were conducted by the State of Idaho, Bureau of Laboratories following Standard Methods (American Public Health Association 1980). Color photographs were taken of a representative stream section and a one liter Imhoff cone sample on most sample dates. These photographs are used to illustrate relative changes in turbidity and suspended sediment concentration.

Flow (discharge in cubic feet per second) was measured with a Marsh-McBirney portable water current meter. Staff gauges were installed at each station to aid in flow measurements.

Bedload sediment samples were collected with a Helley-Smith bedload sampler. Samples were first air dried, then oven dried, and weighed in the laboratory. Texture analysis was made with a standard sieve set.

Fish collections for organic (pesticide) analysis were collected with electro-fishing equipment and help from the Idaho Department of Fish and Game and from Gene Ralston. Samples were wrapped in aluminum foil and frozen.

To define the effects of irrigated agriculture on the water quality of the Lower Boise River Drains, the period of our study was divided into two nearly equal time periods. April 1 through October 15 was considered to be the "Irrigation season" although this may vary somewhat between years. The period from October 16 to April 30 was considered the "non-irrigation season"; water flow present during this period is considered the base flow or groundwater runoff (Novotny and Chester 1981).

RESULTS

SAND HOLLOW DRAIN

Suspended Sediment

Data for suspended sediment in Sand Hollow Drain and Parma Drain is summarized in Table 3. Suspended sediment load increased from 311 tons/year at the top of Sand Hollow to 11,034 tons/year near the mouth (Figure 2). This was due to an increase in discharge of approximately 10 fold, and an increase in suspended sediment concentration by approximately four times to an average of 108 mg/l.

There is considerable variation from year to year in sediment loading as shown by the difference at Sand Hollow at Hiway 20/26 and the station at Parma Drain from 1980 to 1981. Sediment loading decreased at Sand Hollow-Hiway 20/26 from 1980 to 1981 but increased in Parma Drain during the same period.

The percentage of the annual load attributed to the irrigation season is shown in Table 3. Flows in Parma Drain are substantially lower during the non-irrigation season. This accounts for the high loading percentage of 94-99% for the irrigation season.

Bedload Sediment

As its name implies, there is a considerable amount of sand moving along the bottom of the channel in Sand Hollow Drain. The bedload material is made up primarily of very coarse sand (sieve #20), coarse sand (sieve #35), and medium sand (sieve #60). Particle size distribution varies throughout the irrigation season as shown in Figure 3. Texture analysis for the rest of the stations is shown in Appendix A, Tables A-1 to A-3.

Bedload sediment data are shown in Table 4. For 1981 it is estimated that 6,257 tons of bedload sediment was transported at the Hiway 20/26 site. This is in addition to the 3,738 tons of suspended sediment, which yields a total sediment load of 9,995 tons/year. This demonstrates that in areas with a sandy soil suspended sediment sampling alone does not adequately measure the impact of agricultural runoff.

In Parma Drain, annual bedload sediment was estimated at 2,140 tons/year. This is approximately equal to the amount of suspended sediment transported, which yields a total sediment load of 4,589 tons.

Physical Parameters

The discharge record for the sample period is shown in Table 5. Flows remain high during the non-irrigation season, 70-79 cfs near the mouth, due to drainage of the perched water table. Discharge was highest throughout the irrigation season in Sand Hollow Drain near Parma (See Figure 4).

Dissolved oxygen concentrations and percent saturation values are shown in Table 6. Dissolved oxygen concentrations generally exceed state standards (IDHW-DOE 1980). Dissolved oxygen did drop below state standards (6 mg/l) on two occasions. 4.8 mg/l was recorded on May 19, 1980 near the mouth, and 5.7 mg/l was recorded on August 25, 1980 at Hiway 20/26.

Temperature measurements taken when chemical samples were collected are shown in Table 7. Water Quality Standards specify that the temperature should not exceed a maximum of 22°C or a daily average of 19°C for cold water biota. Temperatures recorded at the end of July were 22°C at three stations. This indicates that Sand Hollow Drain may not be suitable for development of a trout fishery. These warm temperatures are due to heating of irrigation water in the fields, and lack of riparian vegetation for shading.

pH values in Sand Hollow Drainage werein the range of 7.6 to 8.5 (Table 8). This meets State standards which specify that pH be within a range of 6.5 to 9.0.

Nutrients

Phosphorus

A summary of phosphorus loading is shown in Table 9 and Figure 5. Total phosphorus load for a one-year period at the mouth was estimated at 102,344 pounds (51 tons). The mean concentration for total phosphorus increased from an average of 0.35 mg/l at Hiway 30 to 0.49 mg/l near the mouth.

The percentage of phosphorus transported during the irrigation season - April 15 to October 1st - compared to annual load ranged from 59% to 87% (See Table 9). An increase during this period may be due to either an increase in phosphorus concentration during the irrigation season or increased flows or both. A comparison of total phosphorus concentrations during the irrigation season to the non-irrigation season shows that there is a slight increase in total phosphorus concentration during the irrigation season. For example, at Sand Hollow near the mouth the average irrigation season concentration was 0.52 mg/l; the average non-irrigation season concentration was 0.39 mg/l. Therefore, the increase in phosphorus load shown for the irrigation season is due primarily to increased discharge during this period.

Another consideration in examining phosphorus data is the amount of phosphorus associated with suspended sediment in comparison to dissolved phosphorus. Implementation of erosion control BMP's can be expected to reduce total phosphorus associated with sediment, but will have little effect on dissolved phosphorus. A comparison of total versus dissolved phosphorus at the mouth of Sand Hollow Drain shows that, on the average, 58% of the

phosphorus during the irrigation season is associated with sediment. This is the maximum percentage of the phosphorus load that could be controlled by implementation of BMP's in the watershed.

Instream criteria for phosphorus are based on controlling excessive plant and algal growth. For flowing water, a maximum of 0.1 mg/l total phosphorus is an accepted criteria (Mackenthun 1973). The concentrations of total phosphorus exceed this criteria throughout the year in the Sand Hollow Drainage.

In addition to agricultural runoff, one point source contributes to phosphorus loading in the Drain. The Parma STP effluent had an average concentration of 4.81 mg/l. This is an annual phosphorus load of 12,556 pounds, which accounts for 12% of the total phosphorus measured near the mouth of Sand Hollow Drain.

Bacteria

Fecal coliform and fecal streptococcus bacteria are found in the intestinal tract of warm-blooded animal and are, therefore, used as indicators of contamination and the possible presence of other disease-causing organisms. Sand Hollow Drain is not specifically included in the Water Quality Standards (IDHW-DOE 1980), but is a tributary to the Snake River (SWB-30) which is protected for primary contact recreation. For consistency, the standards for primary contact recreation will be used for instream criteria for all the drains in this report although these standards may not apply in a legal sense. Standards for primary contact recreation specify that the geometric mean for fecal coliforms shall not exceed 50/100 mls or 500/100 mls at any time.

The results of facterial sampling are shown in Table 10 and Figures 6 and 7. The geometric mean standard of 50/100 mls is exceeded throughout Sand Hollow Drain. Geometric means range from 309/100 mls at Sand Hollow at Hwy. 20/26 to 1,204/100 mls at Sand Hollow near the mouth. The percent of the time that the 500/100 mls standard is exceeded is shown in Table 10.

Comparing the ratio of fecal coliform bacteria to fecal streptococcus bacteria provides an indication of the source of bacteria. A fecal coliform/fecal streptococcus ratio less than 0.7 is indicative of animal wastes, a ratio which exceeds 4 is an indicator of contamination from human wastes (Clausen et al. 1977).

Ratios shown in Table 10 indicate that there is considerable contamination from human wastes. Generally in water contaminated by livestock wastes, fecal streptococcus numbers are clearly greater than fecal coliform numbers. For example, this data can be compared to the bacteria counts for Conway Gulch

in Table 2. However, the ratios for four of the Sand Hollow stations are comparable or higher than the ratio shown for the Parma STP. This data indicates a strong possibility that individual septic systems are not functioning properly or are connected directly to Sand Hollow Drain.

Pesticides

Fish were collected and analyzed for pesticide residues. Fish are used as an indicator of pesticide contamination because they accumulate and concentrate these substances in their tissues over a period of time.

Suckers, Carp, Brown Bullhead, and Rainbow Trout were collected in Sand Hollow Drain. Suckers, Redside Shiners, Carp and Chiselmouth were collected in Parma Drain. Individual analytical results are shown in Tables B-1 through B-5 in Appendix B. Of the eighteen pesticides or other trace organics analyzed, only two--DDT and toxaphene--were consistently above minimum detection limits. Data for DDT and toxaphene are summarized in Table 11.

The U. S. FDA (1979) action level for toxaphene and DDT (including its analogs) is 5.0 ppm. The action level is the concentration at which FDA would take legal action to have a contaminated product removed from the market. The average DDT concentration for 21 samples in the Sand Hollow drainage was 0.42 mg/kg (See Table 11). No samples for DDT exceeded the 5.0 ppm criteria. One rough fish, a Chiselmouth Chub, from Parma Drain had the highest DDT and toxaphene concentration measured during the survey. The toxaphene concentration of 16.97 mg/kg exceeds FDA criteria.

Although most of the DDT and toxaphene concentrations found are below levels harmful to humans, these residues may impact the survival or reproduction of sensitive fish species. Sixty-one percent of the samples for total DDT exceeded the 0.2 mg/kg criteria suggested by Miller et al. (1979) in the American Fisheries Society Review of the EPA Redbook. All of the

toxaphene residues which were above detection limits exceeded 0.4 mg/kg, which was the threshold identified by Mayer and Mehrle (1977) above which psysiological damage or reproductive failure is expected.

There is no identifiable relationship between concentration of DDT or toxaphene and species of fish. The major factor which correlates positively with the magnitude of pesticide residue in fish is lipid content of the flesh. Linear regression analysis showed a positive significant correlation between the DDT concentration and percent lipid (See Appendix C). For Sand Hollow Drain, the correlation coefficient was significant at the 95% level; for all the samples from the drains, the correlation coefficient was significant at the 99% level. For toxaphene, the correlation coeffecient was low which showed no relationship between lipid content and toxaphene concentration. Also, a linear regression between weight of fish and pesticide concentration was calculated. No correlation between weight of fish and pesticide residue was found.

DIXIE DRAIN

Suspended Sediment

The data for suspended sediment in Dixie Drain, Renshaw Canal, and West End Drain are summarized in Table 12. Dixie Drain carried 11,906 tons of suspended sediment into the Boise River in WY 1980. Sixty-nine percent of this sediment was delivered during the irrigation season which is due primarily to increased discharge.

The North and South Drains were fairly clear throughout the year and did not contribute substantially to the sediment load in Dixie Drain. The North Drain carried 15% and the South Drain 12% of the sediment load discharged by Dixie Drain to the Boise River (See Figure 8).

Examination of sediment loading figures in the three Dixie Drain stations shows that most of the sediment was already in the channel at the Super Lateral site (See Figure 1, Table 12). Sediment load at this site was 97% of the load measured at the mouth of Dixie Drain. Sediment load at the uppermost station on Dixie Drain (at Guess Gulch) was 5,984 tons which is 50% of the load at the mouth. In between these two stations Dixie Drain picks up 4,265 tons of sediment which is not accounted for by tributaries which were sampled. This sediment likely comes from water released periodically from the Riverside Canal, when that water is not being used for irrigation.

The Renshaw Canal empties into West End Drain which joins the Riverside Canal. The Riverside may empty into Dixie Drain or be used for irrigation depending on irrigation demand. For its size, the Renshaw Canal carried a high sediment load, 8,369 tons annually, and had the highest sediment concentration, 362 mg/l average during the irrigation season, in the Dixie drainage. The West End Drain also carried a high sediment load. Although

these drains carry considerable sediment loads, it is difficult to determine their impact on surface streams since this water may either be used for irrigation or may end up in the Snake River or Boise River.

Bedload Sediment

A few bedload sediment samples were taken during the summer which are shown in Table 4. These samples showed that bedload material was fairly low in comparison to suspended sediment. For example, in Renshaw Drain the bedload sediment was 12% of suspended sediment in June and 4% in July.

The soils on the south side of the river are different than those on the north side and contain relatively little sand in comparison. Textural analysis of bedload for drains on the south side is shown in Table A-4 and A-5 in Appendix A. The bedload material primarily consists of medium sand (sieve #60) in contract to the high percentage of very coarse and coarse sand in drains on the north side.

Physical Parameters

The discharge record for Dixie Drain and tributary stations is shown in Table 5. Dixie Drain is the largest drain which empties into the Boise River in the project area. Base flow during the non-irrigation season at the mouth averages 80 cfs, the flow during the irrigation season averages 265 cfs. The peak flow of 467 cfs was measured in September. This high flow is due to irrigation water in the canals which is not being diverted for irrigation. The relationship of measured tributaries to discharge in Dixie Drain is shown in Figure 9.

Dissolved oxygen concentrations and percent saturation is shown in Table 6. Dissolved oxygen dropped below state standards of 6.0 mg/l at most

stations on May 19, 1981. The upper end of South Drain was below state standards throughout most of the year. This is attributed to organic enrichment from cattle wastes combined with the low flows at this station. Otherwise, dissolved oxygen exceeded state standards in Dixie Drain throughout the year.

Instantaneous temperature measurements recorded when chemistry samples were collected are shown in Table 7. Temperatures in several of the tributary drains exceeded state standards for cold water biota from June through August. This is due to heating of irrigation water in the fields and lack of riparian vegetation for shading in the canals and ditches. The temperature in Dixie Drain rose above state standards for cold water biota in June and July. This indicates that the drain may not be suitable for development of a trout fishery.

Values for pH for Dixie Drain and tributaries were within state standards. pH in Dixie Drain varied from 7.0 to 8.6 (See Table 8).

Nutrients

Phosphorus

A summary of total phosphorus concentration and loadings is shown in Table 9 and Figure 10 for Dixie Drain and tributaries. Total phosphorus loading from this drain was 170,000 pounds (85 5ons). The mean concentration for the year at the mouth was 0.44 mg/l.

The percentage of the phosphorus transported during the irrigation season compared to the annual load ranged from 64% to 86% (See Table 9) at all the sites. The increase in loading in this period is primarily due to increased discharge. Mammon Gulch and Renshaw Canal have a very low base flow during the non-irrigation season. The total phosphorus concentration

increases during the irrigation season. At Dixie Drain at the mouth, the average irrigation season concentration was 0.51 mg/l; the total average non-irrigation season concentration was 0.29 mg/l.

Implementation of erosion control BMP's can be expected to reduce total phosphorus associated with sediment but will have little effect on the dissolved phosphorus concentration. A comparison of total versus dissolved phosphorus for Dixie Drain at the mouth shows that on the average 33% of the phosphorus during the irrigation season is associated with sediment. This is an estimate of the maximum reduction of phosphorus that could be expected by implementation of BMP's in the watershed.

Instream criteria for phosphorus are based on controlling excessive plant and algal growth. For flowing water, a maximum concentration of 0.1 mg/l total phosphorus is an accepted criteria (Mackenthun 1973). The concentration of total phosphorus exceeds this criteria in Dixie Drain and tributaries.

Bacteria

The results of bacterial sampling for Dixie Drain are shown in Table 13 and Figures 11 and 12. Fecal coliform bacteria numbers are high; the geometric mean standard of 50/100 mls is exceeded at every station. The fecal coliform counts exceed the 500/100 mls standard 70-80% of the time in Dixie Drain; percentages for the other stations are shown in Table 13.

The fecal coliform/fecal streptococcus ratios indicate that the source of bacteria at most stations are livestock wastes. The only obvious exception is North Drain at Dixie Road at which fecal coliform numbers indicate contamination from human sewage.

Data from South Drain at Dixie Road show that interpretation of fecal coliform/fecal streptococcus ratios is a useful indicator of the source of

bacteria. The South Drain is a small drainage ditch. The sample site was located within and below a concentrated livestock operation. Cattle were observed grazing on the banks of the drain and using the drain for a source of water. Fecal contamination was obvious. Fecal streptococcus counts were consistently higher than fecal coliform counts. The average fecal coliform/ fecal streptococcus ratio for ten samples was 0.4. This compares favorably to the ratio of less than 0.7 reported by Clausen et al. (1977) as a guideline for indicating contamination by livestock wastes.

Pesticides

A variety of fish species were collected in Dixie Drain and tributaries and analyzed for pesticide residues. Species collected include Small Mouth Bass, Brown Bullhead, Largescale Sucker, Bridgelip Sucker, Carp, Chiselmouth, Yellow Perch, Redside Shiner, and Tui Chub. The most abundant species were Carp and Suckers. Individual analytical results are shown in Tables B-6 to B-10 in Appendix B. Of the eighteen trace organic compounds analyzed, only two--DDT and toxaphene--were consistently above minimum detection limits.

Data for DDT and toxaphene are summarized in Table 11. The average concentration in fish for DDT was 0.224 mg/kg and 0.745 mg/kg for toxaphene. No fish samples exceeded the FDA action level of 5 ppm for DDT or toxaphene.

The DDT concentration was highly correlated to the lipid content in the fish sample. This was discussed in the Sand Hollow Results section and is summarized in Appendix C.

South Boise Drains

Three stations were sampled which depict water quality in drains in the Southwest corner of the 208 project area. Mammon Gulch was sampled in WY 1980. This drain empties into Ross East End Drain or a canal depending on irrigation demand. Ross East End Drain and South Boise Drain were sampled in WY 1981; they empty into the Snake River upstream from the Boise River.

Other drains were sampled in 1981 and these data are placed together in the following tables. Conway Gulch was discussed in a separate report (See Clark & Bauer 1983). Parma Drain and Sand Hollow--at Hiway 20/26--was included in the Sand Hollow Results section. West End Drain was included in the Dixie Drain Results section.

Suspended Sediment

Suspended sediment loading is summarized in Table 14 for Ross East End Drain, South Boise Drain, and Mammon Gulch. Sediment loading for stations sampled in 1981 are shown in Figure 13. The majority of sediment is transported in South Boise and Mammon Gulch during the irrigation season (92%).

Physical Parameters

The discharge records for South Boise Drain and Ross East End Drain are shown in Table 15 and Figure 14, Mammon Gulch in Table 5. Average annual flow is estimated at 24 cfs for Ross East End, 12.2 cfs for Mammon Gulch and 49.5 for South Boise Drain. The discharge in Mammon Gulch and South Boise Drain is primarily from surface returns during the irrigation season; the discharge in Ross East End Drain is more even throughout the year due to groundwater input in the non-irrigation season.

Dissolved oxygen concentrations are shown in Table 16. Dissolved oxygen concentrations were above 6 mg/l except in South Boise Drain in August when the dissolved oxygen was 4.8 mg/l.

Temperature measurements are shown in Table 17. Several measurements rise above 19°C, which indicates that these waters may not be suitable for cold water biota.

pH values are listed in Table 18. All pH measurements were within state standards of 6.5 - 9.0 mg/l.

Nutrients

Phosphorus

The data for phosphorus are summarized in Table 19 and Figure 15 for South Boise Drain and Ross East End Drain, and in Table 9 for Mammon Gulch. Most of the phosphorus in South Boise Drain and Mammon Gulch was transported during the irrigation season (81%).

Average annual concentration of total phosphorus was 0.43 mg/l for Ross East End, 0.37 mg/l for South Boise Drain, and 0.48 mg/l for Mammon Gulch. The concentration of total phosphorus exceeds the recommended maximum criteria of 0.1 mg/l throughout the year.

Nitrogen

The major component of inorganic nitrogen in the drains is nitrate (NO_3). The recommended maximum criteria for nitrate based on preventing excess algal and plant growth is 0.3 mg/l (IDHW-DOE 1980).

Nitrate loading data are summarized in Table 20 and Figure 16 for drains sampled in WY 1981. The nitrate concentrations exceed the instream criteria of 0.3 mg/l throughout the year. Annual average nitrate concentration ranged from 2.2 mg/l to 4.8 mg/l.

Nitrates are derived from agricultural fertilizers, organic wastes such as livestock wastes, and nitrogen-fixing crops like legumes. Nitrates percolate readily through the soil and are discharged from the shallow groundwater into the drains.

Nitrate concentrations fluctuate throughout the year in the drains depending on the ratio of groundwater, which contains nitrates, to surface irrigation water, which is initially low in nitrates. This is shown in Figure 17 for Ross East End Drain. Nitrate concentrations drop in May after irrigation water enters the drain, stays relatively low during the irrigation season, then rises throughout the fall and winter. Although nitrates are derived from agricultural sources, BMP implementation programs will have little affect on this cycle. The only BMP which may decrease nitrate percolation into the groundwater is irrigation water management which reduces the total amount of applied water.

Bacteria

The results of bacterial sampling in WY 1981 are shown in Table 21 and Figures 18 and 19. Fecal coliform counts exceed the 50/100 ml geometric mean standard in Ross East End Drain (mean = 656/100 ml) and South Boise Drain (mean = 476/100 ml). The single sample standard of 500/100 ml is exceeded 60% of the time in Ross East End Drain and 44% of the time in South Boise Drain. Data for Mammon Gulch are shown in Table 13.

Fecal streptococcus counts generally exceed fecal coliform counts. Fecal coliform/fecal streptococcus ratios indicate the source of bacteria in these drains is from livestock.

Pesticides

Carp were obtained from South Boise Drain for pesticide residue analysis, and Redside Shiners and Chub from Ross East End Drain. Analytical results are shown in Table B-11 and B-12 in Appendix B, and summarized in Table 11. The average DDT concentration was comparable to that found in Dixie Drain. The mean for seven samples was 0.151 mg/l. No toxaphene residues were found in fish from Ross East End Drain or South Boise Drain. No samples were obtained from Mammon Gulch.

DISCUSSION

The water quality data was collected to provide information on the sources of sediment and associated pollutants to the Boise River and Snake River as part of the 208 Planning For Implementation Project. The emphasis of the project is on implementation of Best Management Practices following the planning stage. Within an area as large as the Lower Boise River 208 Project (81,590 acres), it is necessary to phase implementation projects over time because of the large public and private investment required. The Canyon Soil Conservation District estimated the total cost of the project at 5.6 million dollars (Canyon SCD 1983). This makes it imperative that priorities used to determine sub-watershed project implementation funding consider instream water quality data that has been collected. The areas which have the greatest impact on receiving streams should receive implementation funds first. Taking care of the worst areas first may in fact meet the water quality goal, which makes further funding of projects unnecessary. Also, it is unlikely that all the sub-watersheds will ever be funded, making it imperative to use public funds where they are expected to do the most good.

In addition to determining priorities, the water quality data can be used to refine stated goals of an implementation grant application. What is an achievable reduction rate in pollutant loading? Grant applications have been based on research data developed in a different irrigation tract or developed under "ideal conditions" of funding and technical expertise. Some of these estimates can be revised based on empirical information collected during the survey. Revising these figures to realistic estimates will give the funding agencies more accurate information in assessing benefits in water quality improvements in comparison to costs.

Pollutant Reduction Goals

In irrigation implementation projects, Best Management Practices (BMP's) fall into two basic categories: 1) sediment trapping practices such as ponds, mini-basins, and filter strips, and 2) erosion reduction practices such as buried pipe runoff control systems and improvements in the irrigation delivery system (gated pipe, concrete ditches, pipelines, etc.). These Best Management Practices are all primarily aimed at reducing sediment loads. Reduction of other pollutants occurs if they are associated with sediment.

The Canyon Soil Conservation District estimated pollutant reductions in the Conway Gulch State Water Quality Project application (Canyon Soil Conservation District 1982) as follows:

75% reduction of sediment

70% reduction of phosphorus

40% reduction of nitrogen

70% reduction of bacteria

65% reduction of toxics

Reduction rates were estimated by correlation with the Rock Creek Rural Clean Water Project application. The Rock Creek Project estimates were in turn based on the 208 irrigation return flow study in LQ Drain (Brockway, et al. 1980).

Sediment

Estimates of reduction rates for sediment are based on Best Management Practices efficiencies which have been evaluated by Agricultural Research scientists at the SEA-ARS station in Kimberly, Idaho. These rates can be multiplied by the suspended sediment loads measured for a particular site

and the reduction in tons of sediment to the receiving water can be calculated. It should be noted, however, that these efficiencies are based on suspended sediment. The effect on bedload sediment (sand-sized material) which makes up to fifty percent of the total load in some of the drains on the North side of the Boise River, is not known. The effect of this sand needs to be accounted for when SCS conservationists are designing settling ponds and basins.

Phosphorus

In regard to reduction rates for nutrients, the estimates for phosphorus and nitrogen appear to be overly optimistic. Reductions in phosphorus are based on the assumption that most of the phosphorus is associated with sediment particles. This is not the case for phosphorus in the Lower Boise River Drains. In examining the partition of phosphorus types, it can be noted that dissolved phosphorus makes up a fairly high proportion of the total phosphorus. The dissolved phosphorus cannot be expected to be affected by Best Management Practices used on irrigated lands. It was estimated for Sand Hollow Drain at the mouth that 58 percent of the total phosphorus is associated with sediment during the irrigation season. For Dixie Drain this figure is 35 percent. Based on a seventy-five percent reduction rate for sediment, the maximum estimated reduction rates for total phosphorus in Sand Hollow Drain is 43 percent (75% X 58%); for Dixie Drain the reduction rate is estimated as 28 percent (75% X 38%). Although these figures may change with improved precision for phosphorus data, it appears that these figures are more accurate estimates of percent reductions than are presently available. This same procedure could be used for each side at which the total and ortho-phosphate data are available.

Nitrogen

As discussed in the results section, the major form of nitrogen in the drains is nitrate which is associated with groundwater. This is illustrated in Figure 17 for Ross East End Drain; nitrates are lowest during the irrigation season when surface water from irrigation dilutes the groundwater component. This is reflected in the nitrate concentrations which occur in the Boise River at Parma (Figure 20, Table 22).

Erosion control BMP's are not expected to affect the nitrate loading from drains. Nitrates in groundwater are a result of the agricultural system in the irrigation tract, but irrigation BMP's are not designed to reduce nitrates. BMP's related to irrigation water management which reduce the total amount of applied water may have the side benefit of reducing nitrate by decreasing subsurface infiltration. If an estimate of reductions in application of irrigation water were available from an implementation project, then the reductions in nitrate loading could be estimated. However, there is no indication that the amount of total irrigation water diverted to the tract will be reduced. Therefore, there is no basis on which to compute a reduction in nitrates. The estimate of 40% reduction in nitrates is not supported and appears to be overly optimistic.

Bacteria

The major source of bacteria in most of the drains is from livestock wastes. (However, as pointed out in the results section, a few drains may be impacted by individual subsurface sewage systems.) Generally, high numbers of bacteria are associated with waters that have a high load of suspended material. When this suspended material is reduced, then bacteria numbers can be expected to decrease.

This effect was observed in the Rock Creek Rural Clean Water Program. A large pond (1,3 acre/ft) was installed on an irrigation return flow drain (I-Coulee) and water quality samples were taken above and below the pond. The log mean for fecal bacteria for the 1981 irrigation season changed from 738 bacteria/100 ml to 232 bacteria/100 ml; a reduction of approximately 70% (Martin and Bauer 1982).

The effect of a large settling basin in reducing bacteria in conjunction with livestock waste management systems should reduce fecal bacterial loads. The results from the Rock Creek project indicate that a 70% reduction in bacteria is reasonable.

Toxics

Toxics refer to agribultural pesticides and "demossing" agents. The water quality data do not provide any information on potential reduction rates for toxic chamicals from a BMP implementation program. It is assumed that most organic pesticides and herbicides will be adsorbed by sediments and, therefore, trapped with sediment by erosion control practices. No effect on reducing demossing agents such as zylene can be anticipated through BMP implementation. Sampling pesticide residues in fish tissues showed some high toxaphene residues in the drains. These residues may be expected to be controlled only through a concerted I&E campaign aimed at careful application of these materials and safe disposal of containers.

Setting Priority for Implementation Programs

Water quality data can be used to help set priorities on subwatersheds or drains for implementation funding. Suspended sediment data are used as an indicator since the implementation programs are primarily aimed at reducing sediment loads. Suspended sediment concentration indicates the

ambient quality in the drain, while suspended sediment loading indicates the relative impact of drains on receiving waters. Suspended sediment data is ranked for the irrigation season in Table 23 for concentration and in Table 24 for loading.

Use of this ranked data for setting priorities depends on the goals of the implementation program or the water pollution abatement plan for the area. If the goal of the plan is to reduce pollutant loadings to the Boise River, then the ranking reduces only to those drains which empty directly into the river. In the project area this includes only Dixie Drain and Conway Drain. Several other drains which are upstream of the 208 project area would also have to be considered. For loading to the Snake River only South Boise Drain, Ross East End, and Sand Hollow Drain need to be considered.

In regard to soil conservation programs in which the primary goal is to reduce erosion and sediment runoff, the list ranked by concentration (Table 23) may be more useful. This shows that Renshaw Canal, Conway Drain, and Parma Drain carry the most turbid water. The two tributaries to Dixie Drain, North and South Drain, are relatively clear which indicates no need to pursue BMP implementation for erosion control in this area.

Another factor in considering priorities for the drains is the potential for recreational and fisheries uses in the drains themselves. Based on flow characteristics and habitat quality, two drains--Sand Hollow and Dixie Drain--show good fisheries potential. These carry considerable flows year round and have some riparian habitat. At present, they both support a limited fisheries. In addition to decreasing waste loads to the Boise River or Snake River, cleaning up these drains will provide additional instream benefits.

To provide some relative comparison, this data can be compared to pollutant concentrations in the Boise River. Phosphorus, nitrates, and sediment data are summarized in Table 22 for the Boise River at Parma. Sediment loads are based on one sample per month which provides only a rough estimate. Based on an annual load, the Conway Drain accounts for approximately 8% and Dixie Drain for 22% of the sediment in the Boise River measured in 1980 and 1981.

Conclusions and Recommendations

Agricultural drains within the 208 project area carry high pollutant loads due to surface return flows of sediment-laden water and subsurface returns enriched with nutrients. The pesticides DDT and toxaphene occur in elevated concentrations in fish tissues which may limit development of a fishery in these waters. Bacterial indicators of fecal contamination were found in high concentrations. This bacterial load prevents the use of these waters for contact recreation, and contributes to the degradation of the Boise River and Snake River in regard to recreational uses.

The water quality data provide some information applicable to revising goals of an implementation program. Water quality project applications have stated pollutant reduction goals for suspended sediment, phosphorus, nitrogen, bacteria, and toxics. BMPs in implementation programs are primarily aimed at reducing sediment loads. The percent reduction for the other pollutants are based on their estimated association with sediment. Analysis of water quality data indicates the following revisions to the percent reduction goals for drains in the Lower Boise River irrigation tract. The basis for these revisions are outlined in the Discussion section.

Pollutant Reduction Goals

Pollutant Category	Present Reduction	Revised Reduction
Suspended Sediment	75%	Unchanged
Phosphorus	70%	30-40%
Nitrogen	40%	0%
Bacteria	70%	Unchanged
Toxics	65%	??

Due to the complex irrigation and drainage system which has evolved within the Lower Boise River area it is difficult to associate pollutant loads at many of the stations with the resulting impact on the receiving stream. The water from a sub-drainage may be rerouted into several drains or canals before actual discharge into the River. For this reason it is imperative to define the goals of a specific implementation program before prioritizing projects for funding. Utilizing public funds within a particular sub-drainage may have negligable or unknown affects on water quality in the river since a significant portion of the discharge may never reach the river.

The ranked suspended sediment data can be used to set priorities once the goal of a specific implementation program is defined. If the goal is to clean up the Boise River then only Conway Gulch and Dixie Drain within the project area need to be considered. If reducing pollutant loading to the Snake River is the primary goal then Sand Hollow Drain, Ross East End Drain, and South Boise Drain should be considered.

The public benefits which can be derived within the drains need to be considered as well as considering the drains as pollutant sources to the river. Both Dixie Drain and Sand Hollow Drain have the physical capability of supporting increased recreational use if water quality and habitat improvements were made. At present poor water quality is the primary constraint which precludes protected uses in these waters. The other drains are much smaller or are otherwise unsuitable such that the potential for public benefits are minimal.

The following specific recommendations are made:

1) The present State cost share program in Conway Gulch be expanded into other areas. Selection of these areas should be based on specific water quality management goals for the Boise River and Snake River. Revised pollutant reduction rates should be considered in the project selection process so that expected program benefits can be weighed against costs.

2) Implementation programs in the Lower Boise River area should include a pesticide management element. Current implementation programs designed at reducing sediment loads do not specifically address reductions in pesticide contamination. Reduction in pesticide contamination can be expected only through a preventative program aimed at keeping toxic materials out of the waterway. This can be accomplished through inclusion in the Information and Education program and/or by inclusion specifically in the individual Water Quality Farm Plans.

3) Livestock operations contribute large concentrations of bacteria to surface drainage in the Lower Boise River area. Identifications of specific livestock waste sources and recommendations for improvements in waste management system should be included in implementation program applications.

4) The impact of bedload sediment on drains on the north side of the river should be considered in water quality programs in this area. The quantity of bedload sediment should be included as a factor in designing settling basins and other sediment trapping practices. Bedload sediment at present loading rates may prevent development of a fisheries in Sand Hollow Drain by inhibiting macroinvertebrate production and fish spawning even if the other "conventional" pollutants were controlled.

5) A buffer strip of streamside vegetation should be allowed to develop on the banks of the larger drains. This will help reduce sediment from mass wasting, help stabilize the banks, and provide fish habitat. This will have the additional benefit of providing wildlife habitat.

A C K N O W L E D G E M E N T S

We thank the following individuals for assistance in the field:

Don Anderson, Tom Aucutt, Daniel Baer, Gwen Burr, Eldon Edmundson (and his BSU Environmental Health Class), Don Gusman, Susan Lowman, Don Martin, Lura Morgan, Glen Nielson, Gene Ralston, Will Reid, Dorothy Reynolds, Sherie Robison, David Sanders, Craig Shepard, George Varin and Jon Wroten. Kyle Knight assisted with data anylisis.

The following organizations aided with various aspects of this study:

Idaho Department of Health and Welfare, Bureau of Laboratories, Bureau of Water Quality and Boise Field Office;

Idaho Department of Fish and Game;

United States Department of Interior, Bureau of Reclamation;

and the United States Department of Agriculture, Soil Conservation Service, and the Canyon Soil Conservation District.

Literature Cited

American Public Health Association. 1980. Standard methods for the examination of water and wastewater. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D.C. 15th Edition. 1,134 pp.

Brockway, C.D., G.S. Johnson, C.W. Robinson, and D.L. Carter. 1980. Irrigation Return Flow Study, Final Report, 1976-1979. University of Idaho, and SEA-ARS, 131 pp.

Canyon SCD. 1982. Conway Gulch State Water Quality Project Application, submitted to IDHW-Div. of Environment, Boise, ID. 17 pp.

Canyon SCD. 1983. Lower Boise River 208 Project Report, Final Report to IDHW-Div. of Environment, Boise, ID, Canyon SCD, Caldwell, ID, 35 pp.

Clark, W.H., and S.B. Bauer. 1982. Water quality status report, Conway Gulch, Canyon County, Idaho. IDHW-Div. of Environment. Water Quality Series 50.

Clausen, E.M., B.L. Green, and W. Litsky. 1977. Fecal streptococci: indicators of pollution IN: A. W. Hoadley and B.J. Dutka, Eds. Bacterial indicators/health hazards associated with water. American society Testing Materials No. 635: 247-264.

Dion, N.P. 1972. Some effects of land-use changes on the shallow groundwater system in the Boise-Nampa area, Idah. Idaho Department of Water Administration, Water Information Bulletin 26. 47 pp.

Idaho Department of Health and Welfare. 1980. Idaho Water Quality Standards and Wastewater Treatment Requirements. IDHW-Div. of Environment, Boise, Idaho. 62 pp.

Idaho Department of Health and Welfare. 1983. Idaho Water Quality Status Report, 1982. IDHW-Div. of Environment, Boise, Idaho. 93 pp. DRAFT.

Idaho Soil Conservation Commission. 1979. Idaho Agricultural Pollution Abatement Plan, Idaho SCC, Boise, Idaho. 79 pp.

Lewis, G.C., D.V. Naylor, J.R. Busch, and D.W. Fitzsimmons. 1978. Groundwater Quality study in the Boise Valley. University of Idaho Agricultural Experiment Station. Bulletin No. 105. 30 pp.

Mackenthun, K.M. 1973. Toward a cleaner environment. U.S. Environmental Protection Agency, Washington, D.C.

Martin, D., and S. Bauer. 1982. Water Quality Monitoring Assessment of the Rural Clean Water Program: First year baseline report, Rock Creek, Water Year 1981. IDHW-Div. of Environment, Boise, Idaho. 68 pp.

Mayer, F.L., and P.M. Mehrle. 1977. Toxicological Aspects of N.A. Wildlife and Natural Resources Conf. #42, Atlanta, Georgia. March 5-9, 1977. 365-373.

Miller, D.S., T.C. Carver, Jr., and M.G. Zeeman. 1979. DDT. Pages 182-189 In: A review of the EPA Red Bood: Quality criteria for water. R.B. Thurston, R.C. Russon, C.M. Fetterold, Jr., T.A. Edsall, and Y.M. Barter, Jr. (Eds.) Water Quality Section, American Fisheries Society, Bethesda, Maryland.

Naylor, D.V., G.C. Lewis, Jr., R. Busch, and D.W. Fitzsimmons. 1976. Quality of irrigation and drainage waters in the Boise Valley. University of Idaho Agricultural Experiment Station. Bulletin No. 97. 22 pp.

Novotny, V., and G. Chester. 1981. Handbook of nonpoint pollution sources and management. Van Nostrand Reinhold Company, New York. 550 pp.

Parliman, D.J. 1982. Compilation of Ground-Water Quality for Selected Wells in Elmore, Owyhee, Ada, and Canyon Counties, Idaho, 1945 through 1982. U.S. Geological Survey, Open File Report, 83-39. 152 pp.

Priest, T.W., C.W. Case, J.E. Witty, R.K. Preece, Jr., G.A. Monroe, H.W. Biggerstaff, G.H. Logan, L.M. Rasmussen, and D.H. Webb. 1972. Soil survey of Canyon Area, Idaho. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C. 118 pp. + maps.

Thomas, C.A., and N.P. Dion. 1974. Characteristics of streamflow and groundwater conditions in Boise River Valley, Idaho. U.S. Geological Survey, WRI-38-74. 56 pp.

U.S. Bureau of Reclamation, 1977. Water quality study, Boise Valley. Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho. Two volumes.

U.S. Bureau of Reclamation. 1978. 1977 drought effect on water quality, Boise Valley. U.S. Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho.

U.S. Environmental Protection Agency. 1977. Quality criteria for water. Office of Water and Hazardous Materials, U.S. Environmental Protection Agency, Washington, D.C. 256 pp.

U.S. Food and Drug Administration. 1979. Action levels for poisonous or deleterious substances in human food and animal feed. Food and Drug Administration, Washington, D.C. 13 pp.

TABLE 1. LOWER BOISE VALLEY DRAIN WATER QUALITY STATIONS
WY 1980

Station #	Description	Latitude/Longitude	River Mile	Elevation	STORET #
Sand Hollow Drain					
1	Sand Hollow Dr. at Hwy. 30	43°48'20" 116°44'45"	391.3/22	735 m (2410')	2040246
2	Sand Hollow Dr. at Sebree Canal Wasteway	43°45'50" 116°48'40"	391.3/16.5/0.1	713 m (2340')	2040251
3	Sand Hollow Dr. at Hwy. 20/26	43°44'40" 116°51'00"	391.3/13.0	692 m (2270')	2040247
4	Parma Drain at Mouth	43°46'55" 116°57'00"	391.3/5.8/0.1	675 m (2215')	2040252
5	Sand Hollow Dr. below Parma Dr.	43°46'55" 116°57'05"	391.3/5.8	675 m (2215')	2040248
6	Parma STP Effluent	43°47'15" 116°57'25"	391.3/5.2/0.1	674 m (2210')	2040253
7	Sand Hollow Dr. nr. Mouth (at U.S.G.S. Gaging Station)	43°48'00" 116°58'30"	391.3/3.5	671 m (2200')	2040249
Dixie Drain (Dixie Slough)					
Drain Stations					
8	Dixie Drain at Guess Gulch	43°41'45" 116°50'40"	391.3/10.5/4.0	695 m (2280')	2040256
9	Dixie Drain at Super Lateral Rd.	43°42'25" 116°51'55"	391.3/10.5/2.4	692 m (2270')	2040257
10	Dixie Drain Mouth (WPRS station 120)	43°43'50" 116°53'20"	391.3/10.5/0.2	687 m (2255')	2040258
Tributary Stations					
11	South Drain at Dixie Rd.	43°41'05" 116°45'45"	391.3/10.5/3.7/5.2	707 m (2320')	2040259
12	South Drain at Mouth	43°41'55" 116°50'30"	391.3/10.5/3.7/0.2	695 m (2280')	2040260
13	North Drain at Dixie Rd.	43°42'20" 116°48'25"	391.3/10.5/1.4/3.8	700 m (2295')	2040261
14	North Drain at Mouth	43°42'35" 116°52'15"	391.3/10.5/1.4/0.4	690 m (2265')	2040262
15	Mammon Gulch at Hwy. 95 Junction with Rudd/Matthews Rd.	43°43'50" 116°54'55"	---	695 m (2280')	2040263
16	Drain near Dixie Dr. Mouth	43°43'30" 116°52'35"	391.3/10.5/0.5/0.4	689 m (2260')	2040264
17	Renshaw Canal at Mouth	43°40'35" 116°48'20"	---	704 m (2310')	2040265

TABLE 2. LOWER BOISE VALLEY DRAIN WATER QUALITY STATIONS
WY 1981

STATION #		LATITUDE/LONGITUDE	RIVER MILE	ELEVATION	STORET #
18	Conway Gulch, Mouth at Highway 20/26, Notus	43°43'35"/116°48'15"	324.3/391.3/14.5/1.0	703m(2308')	2040326
19	Conway Gulch, at Stafford Rd.	43°45'05"/116°45'10"	324.3/391.3/14.5/4.4	725m(2380')	2040327
20	Conway Gulch, at Highway 30	43°46'10"/116°42'25"	324.3/391.3/14.5/7.4	743m(2437')	2040328
21	Parma Drain, at Highway 20/26, Parma	43°46'55"/116°56'05"	324.3/391.3/6.3/3.6	678m(2225')	2040329
22	West End Drain, above Renshaw	43°40'35"/116°48'05"	No River Mile	704m(2310')	2040330
23	West End Drain, at Farmway Road, Caldwell	43°39'25"/116°42'40"	No River Mile	716m(2350')	2040331
24	Ross East End Drain, at Bluff Lane, Allendale Road	43°44'45"/116°54'50"	324.3/391.3/10.71.7	686m(2250')	2040332
25	South Boise Drain, at Scott Pitt and Brumbach Road	43°46'50"/117°00'40"	324.3/393.2/2.2	668m(2190')	2040333
26	Sand Hollow Drain at Highway 20/26 Crossing	43°44'40"/116°51'00"	324.3/391.3/13.0	692m(2270')	2040247

TABLE 3. SUMMARY OF SUSPENDED SEDIMENT DATA FOR SAND HOLLOW DRAIN AND ITS TRIBUTARY, PARMA DRAIN (WY 1980-1981)*

	ANNUAL			AGRICULTURAL SEASON			
SAMPLE STATION	MEAN FLOW (cfs)	MEAN CONC. (mg/l)	LOAD (tons)	MEAN FLOW (cfs)	MEAN CONC. (mg/l)	LOAD (tons)	PERCENT OF TOTAL LOAD
Sand Hollow Drain							
Highway 30	11.9	25.7	311	15	38.5	244	78
Sebree Canal	42.8	67.7	3,080	53	98	2,659	86
Highway 20/26							
WY 1980	71.3	87	6,426	95.3	134	5,090	79
WY 1981	66.6	58	3,738	78	80	3,232	86
Below Parma Drain	132.6	116	13,993	164	163	10,802	77
Near Mouth	112	108	11,034	134	155	9,059	82
Parma Drain							
WY 1980	10.7	122	1,391	14.2	196	1,312	94
WY 1981	10.2	143	2,449	15	227	2,437	99.5

* WY 1980 unless otherwise noted.

TABLE 4. BEDLOAD SEDIMENT LOADINS (TONS/DAY) FOR SELECTED LOWER BOISE RIVER DRAINS (WY 1980-1981)

SAMPLE STATIONS	1980 June	July	Aug.	1981 Apr.	May*	June	July	Aug.	Oct.	Nov.	1982 Feb.	March
Sand Hollow Drain												
Sand Hollow Dr. at Hwy. 30 -	17.7	15.3	36.5	---	---	---	---	---	---	---	---	---
Sand Hollow Dr. at Sebree Canal -	90	63.8	16	---	---	---	---	---	---	---	---	---
Sand Hollow Dr. at Hwy. 20/26 -	57	12	53	6.7	38.3	48.6	59.4	23.1	37.2	0.9	0.95	0.16
Parma Drain at Mouth -	9	0.53	---	0.79	0.91	0.5	46	0.68	17.2	3.14	2.7	0
Sand Hollow Dr. near Mouth -	20.4	4	7	---	---	---	---	---	---	---	---	---
Dixie Drain												
Dixie Drain Mouth -	0.9	---	---	---	---	---	---	---	---	---	---	---
Tributary Stations												
South Drain at Mouth -	0.1	---	---	---	---	---	---	---	---	---	---	---
North Drain at Dixie Rd. -	0.03	---	---	---	---	---	---	---	---	---	---	---
North Drain at Mouth -	4.7	---	---	---	---	---	---	---	---	---	---	---
Mammon Gulch at Hwy 95 -	1.1	7.8	---	---	---	---	---	---	---	---	---	---
Renshaw Canal at Mouth -	4.5	4.6	2.2	---	---	---	---	---	---	---	---	---
Conway Gulch												
Conway Gulch, Mouth at Highway 20/26, Notus -	---	---	---	0.11	1.76	9	6.5	0.9	3.4	3	4.7	140.9
Conway Gulch, at Stafford Rd. -	---	---	---	5.3	0.54	6.89	0.34	4.4	0	10	2.9	2.5
Conway Gulch, at Highway 30 -	---	---	---	0	0.43	0.18	13.2	2.9	0	0.56	0	0.93
West End Drain, above Renshaw -	---	---	---	0	1.1	1.4	0.55	0	0	0	0	0
West End Drain, at Farmway Road, Caldwell -	---	---	---	0	0.25	0	0	0	0	0	0	0
Ross East End Drain, at Bluff Lane, Allendale Road -	---	---	---	0	1.59	3.2	1.4	0	0	0	0	0
South Boise Drain, at Scott Pitt and Brumbach Road -	---	---	---	1.05	0.9	1.2	0	0	0	0	0	0

* = Mean of 2 samples; --- = Not sampled.

TABLE 5. Flow (cfs) in Sand Hollow and Dixie Drains - WY 1980.

SAMPLE STATIONS	'79 Nov. 27-	'80 Jan. 22-	Mar. 12 -	Apr. 29-	May 13-	May 19-	June 30-	July 31-	Aug 25-	Sep. 17
Sand Hollow Drain										
Sand Hollow Dr. at Hwy. 30 -	7	8	6	11	20	20	12	17	11	14
Sand Hollow Dr. at Sebree Canal -	22	24	34	42	52	50	50	60	63	57
Sand Hollow Dr. at Hwy. 20/26 -	34	33	32	87	99	101	88	86	108	98
Parma Drain at Mouth -	7	4	5	6	12	14	31	10	10	9
Sand Hollow Dr. below Parma Dr. -	87	83	60	131	188	186	135	146	182	185
Parma STP Effluent -	0.7	0.44	0.44	0.7	0.34	0.45	0.25	0.7	0.7	0.56
Sand Hollow Dr. Near Mouth -	79	79	70	110	140	130	128	117	170	150
Dixie Drain (Dixie Slough)										
Drain Stations										
Dixie Drain at Guess Gulch -	61	53	46	122	81	104	69	24	34	144
Dixie Drain at Super Lateral Rd. -	74	70	65	200	182	191	226	150	132	306
Dixie Drain Mouth -	80	81	80	261	284	172	247	140	294	467
Tributary Stations										
South Drain at Dixie Rd. -	2	4	3	7	12	9	5	10	9	7
South Drain at Mouth -	5	12	6	29	44	43	22	51	83	47
North Drain at Dixie Rd. -	16	7	5	16	29	37	32	34	70	31
North Drain at Mouth -	14	12	8	50	76	32	76	54	137	47
Mammon Gulch at Hwy. 95 -	5	5	6	6	11	11	22	30	28	12
Drain near Dixie Dr. Mouth -	--	--	--	0	14	8	4	7	2	5
Renshaw Canal at Mouth -	7	14	18	32	34	45	50	50	42	42

--- Data not collected.

TABLE 6. DISSOLVED OXYGEN CONCENTRATION (mg/l) AND PERCENT SATURATION FOR LOWER BOISE DRAINS - WY 1980

SAMPLE STATIONS	'79 Nov. 27	'80 Jan. 22	March 12	April 29	May 13	May 19	June 30	July 31	Aug. 25	Sep. 17
Sand Hollow Drain										
Sand Hollow Drain at Hwy. 30 -	10.1(84.2%)	11.0(98.4%)	11.6(101.3%)	8.8(86.5%)	8.9(86%)	8.8(92.4%)	7.7(84%)	6.3(72.4%)	8.5(89.2%)	8.4(86.5%)
Sand Hollow Dr. at Sebree Canal-	10.1(88%)	10.8(96.4%)	11.0(98.2%)	9.2(94.5%)	8.4(84.7%)	7.1(77.3%)	8.7(97.6%)	7.1(81.4%)	9.1(97.1%)	8.7(91.1%)
Sand Hollow Dr. at Hwy. 20/26 -	10.3(89.5%)	12.0(106.8%)	12.0(106.8%)	8.0(82%)	8.6(86.5%)	7.0(78.4%)	8.3(92.9%)	7.5(86.6%)	5.7(61.9%)	8.2(85.6%)
Parma Drain at Mouth -	11.8(102.3%)	10.4(92.4%)	11.5(99.7%)	6.0(61.3%)	7.9(80.8%)	6.8(78.4%)	8.4(96.8%)	8.1(99.8%)	7.0(80.7%)	8.2(87.1%)
Sand Hollow Dr. below Parma Dr -	11.2(92.7%)	12.0(101.6%)	11.2(94.8%)	7.9(82.3%)	8.5(86.9%)	6.8(78.4%)	8.8(101.5%)	7.5(92.4%)	9.2(102.8%)	8.6(91.4%)
Parma STP Effluent -	3.0(24.1%)	---	14.4(127.9%)	8.8(100.4%)	7.8(89 %)	6.6(77.7%)	8.4(107.1%)	17.0(242.4%)	---	---
Sand Hollow Dr. near Mouth -	11.9(98.4%)	12.0(99.2%)	10.4(88 %)	7.5(78.1%)	8.5(88.5%)	4.8(56.5%)	8.6(101.2%)	7.3(89.8%)	9.5(106.1%)	8.7(92.4%)
Dixie Drain (Dixie Slough)										
Drain Stations										
Dixie Drain at Guess Gulch -	10.8(96.2%)	12.4(113.2%)	14.0(137 %)	8.2(89.1%)	7.7(86.2%)	6.5(70.6%)	9.3(107.5%)	8.5(104.9%)	9.3(101 %)	8.9(96.7%)
Dixie Drain at Super Lat. Rd. -	11.8(102.5%)	13.0(115.7%)	13.7(131.7%)	7.2(80.6%)	6.8(76.1%)	5.8(63 %)	9.6(113.3%)	7.7(92.9%)	9.8(109.7%)	8.5(92.3%)
Dixie Drain Mouth -	12.0(104.2%)	13.4(116.3%)	15.7(150.8%)	6.7(75. %)	8.5(95.1%)	5.3(59.3%)	9.7(117. %)	8.2(102.3%)	10.4(118.8%)	7.1(75.5%)
Tributary Stations										
South Drain at Dixie Rd. -	5.8(53. %)	5.4(52. %)	12.0(120.9%)	7.3(81.9%)	6.7(76.7%)	5.5(57.5%)	3.2(34.1%)	0.8(9. %)	1.0(10.9%)	3.4(38.1%)
South Drain at Mouth -	9.9(82.1%)	11.0(93.4%)	11.7(112.5%)	7.1(77.1%)	6.5(78.5%)	7.3(77.7%)	9.8(113.3%)	7.8(94.1%)	6.8(73.9%)	8.6(93.4%)
North Drain at Dixie Rd. -	10.0(87. %)	13.0(110.4%)	12.0(117.5%)	7.2(82.4%)	6.8(78.6%)	7.9(82.6%)	8.4(94.1%)	7.0(80.9%)	6.9(77.3%)	9.4(107.5%)
North Drain at Mouth -	11.8(100.1%)	14.0(118.7%)	12.9(123.9%)	5.7(63.8%)	7.4(82.8%)	4.8(52.1%)	10.4(122.7%)	7.5(90.5%)	10.0(115.5%)	8.3(90.1%)
Mammon Gulch at Hwy. 95 -	12.4(102.8%)	13.0(110.3%)	12.4(119.2%)	7.5(84. %)	7.8(89.2%)	4.5(55.5%)	8.1(101.1%)	7.2(95.4%)	10.0(120.7%)	9.1(95.1%)
Drain near Dixie Dr. Mouth -	---	---	---	7.8(89.1%)	7.6(86.8%)	5.7(65.1%)	7.2(93. %)	6.7(85.6%)	9.8(115.6%)	6.8(72.4%)
Renshaw Canal at Mouth -	10.4(95. %)	13.2(120.6%)	11.4(109.7%)	6.5(72.9%)	6.0(69.4%)	5.9(64.2%)	9.4(105.4%)	7.9(91.4%)	10.0(108.7%)	7.8(90.2%)

--- Data not collected.

TABLE 7. WATER TEMPERATURE (°C) FOR LOWER BOISE RIVER DRAINS - WY 1980.

SAMPLE STATIONS	'79 Nov. 27-	80 Jan. 22-	Mar. 12-	Apr. 29-	May 13-	May 19-	June 30-	July 31-	Aug 2-	Sept. 17
Sand Hollow Drain										
Sand Hollow Dr. at Hwy. 30 -	4.0	6.5	6.0	11.0	10.0	14.0	15.5	18.0	13.5	13.0
Sand Hollow Dr. at Sebree Canal -	6.0	7.0	7.0	12.5	12.0	16.0	17.0	18.0	15.0	14.0
Sand Hollow Dr. at Hwy. 20/26 -	6.0	7.0	6.5	12.5	12.0	17.0	17.0	19.0	15.5	14.2
Parma Drain at Mouth -	6.0	7.0	6.2	13.0	13.0	19.0	19.0	22.0	18.5	14.5
Sand Hollow Dr. below Parma Dr. -	4.0	5.0	5.2	13.5	13.0	18.5	19.0	22.0	17.0	14.5
Parma STP Effluent -	2.5	---	6.5	18.0	18.0	20.0	23.5	30.0	---	---
Sand Hollow Dr. near Mouth -	3.5	4.0	5.1	14.0	13.5	20.0	19.5	22.0	17.0	15.2
Dixie Drain (Dixie Slough)										
Drain Stations										
Dixie Drain at Guess Gulch -	7.0	7.5	10.8	15.5	17.0	16.0	19.0	22.0	16.0	16.0
Dixie Drain at Super Lateral Rd.-	6.0	7.0	10.0	16.5	17.0	16.0	20.0	21.0	16.5	15.5
Dixie Drain Mouth -	5.5	6.0	9.9	17.0	17.0	17.0	21.0	22.5	18.0	15.0
Tributary Stations										
South Drain at Dixie Rd. -	7.5	10.0	12.0	17.0	18.0	14.0	15.0	17.0	15.5	16.5
South Drain at Mouth -	4.0	5.0	9.9	15.5	21.0	15.0	19.0	21.0	16.0	15.5
North Drain at Dixie Rd. -	5.5	5.0	10.8	17.5	19.0	14.0	17.0	18.5	16.5	17.5
North Drain at Mouth -	5.0	5.0	9.9	16.8	17.0	16.0	20.0	21.0	19.0	15.5
Mammon Gulch at Hwy. 95 -	4.0	5.0	10.4	17.0	18.0	22.0	23.0	26.0	20.5	14.0
Drain near Dixie Dr. Mouth -	---	---	---	17.6	18.0	18.0	25.0	24.0	19.5	15.0
Renshaw Canal at Mouth -	8.0	7.5	10.0	16.5	19.0	16.0	17.0	18.5	15.5	19.0

--- Data not collected.

TABLE 8. PH Values (in standard units) for LOWER BOISE RIVER DRAINS - WY 1980.

SAMPLE STATIONS	'79 Nov. 27-	'80 Jan. 22-	Mar. 12-	Apr. 29-	May 13-	May 19-	June 30-	July 31-	Aug.25-	Sep. 17
Sand Hollow Drain										
Sand Hollow Dr. at Hwy. 30 -	7.9	8.0	8.0	7.7	7.6	7.6	7.8	7.6	7.7	7.8
Sand Hollow Dr. at Sebree Canal -	8.0	8.0	8.2	8.0	7.8	8.2	8.1	8.0	7.9	7.9
Sand Hollow Dr. at Hwy. 20/26 -	8.0	8.2	8.5	8.0	8.1	8.0	8.0	7.9	8.0	8.0
Parma Drain at Mouth -	8.3	8.1	8.3	8.1	8.2	8.2	8.3	8.2	8.2	8.2
Sand Hollow Dr. below Parma Dr. -	8.2	8.1	8.3	8.1	8.1	8.1	8.2	8.1	8.1	8.1
Parma STP Effluent -	7.7	7.7	8.9	9.7	9.5	9.6	9.9	9.0	8.5	8.0
Sand Hollow Dr. near Mouth -	8.2	8.2	8.5	8.1	8.2	8.5	8.4	8.2	8.2	8.1
Dixie Drain (Dixie Slough)										
Drain Stations										
Dixie Drain at Guess Gulch -	8.0	8.3	8.6	8.2	8.1	7.0	8.1	8.2	8.0	8.1
Dixie Drain at Super Lateral Rd. -	8.1	8.2	8.7	8.1	8.1	7.1	8.1	8.0	8.0	8.1
Dixie Drain Mouth -	8.3	8.2	8.6	8.5	8.2	8.0	8.0	7.9	8.1	8.0
Tributary Stations										
South Drain at Dixie Rd. -	7.6	7.6	7.7	7.6	7.8	7.5	7.5	7.3	7.5	7.6
South Drain at Mouth -	8.0	7.9	8.1	7.9	8.2	7.1	7.9	7.9	7.8	7.9
North Drain at Dixie Rd. -	8.0	8.1	8.4	8.1	7.9	8.0	7.5	7.5	7.8	8.1
North Drain at Mouth -	8.1	8.2	8.6	7.8	8.2	7.9	7.9	7.8	8.2	8.0
Mammon Gulch at Hwy. 95 -	8.5	8.3	8.9	8.8	8.7	8.4	8.3	8.15	8.5	8.1
Drain near Dixie Dr. Mouth -	---	---	---	8.4	8.0	8.0	7.8	7.7	8.0	7.9
Renshaw Canal at Mouth -	8.3	8.5	8.9	8.6	8.7	8.3	7.9	7.9	8.2	8.6

--- Data not collected.

TABLE 9. TOTAL PHOSPHORUS LOADING FOR DRAINS, WY 1980.

STATIONS	Mean Flow (cfs)	Mean Concentrations (mg/l)	Phosphorus Load (lbs.)	% Phosphorus Load Ag. Season
Sand Hollow Drain				
Sand Hollow Dr. at Hwy. 30 -	12.5	0.35	7,465	59%
Sand Hollow Dr. at Sebree Canal -	45.5	0.35	28,602	86%
Sand Hollow Dr. at Hwy. 20/26 -	71.3	0.47	58,728	78%
Parma Drain at Mouth -	10.7	0.34	6,734	87%
Sand Hollwo Drain below Parma Drain -	138.3	0.36	88,938	58%
Parma STP Effluent -	1.3	4.81	12,556	
Sand Hollow Dr. near Mouth -	117.4	0.49	102,344	69%
Dixie Drain (Dixie Slough)				
Dixie Drain at Guess Gulch -	73.8	0.49	62,443	68%
Dixie Drain at Super Lateral Rd. -	159.6	0.49	147,271	79%
Dixie Drain Mouth -	210.6	0.44	170,033	79%
Tributary Stations				
South Drain at Dixie Road -	6.9	0.53	5,839	64%
South Drain at Mouth -	34.1	0.46	24,251	75%
North Drain at Dixie Road -	27.7	0.39	16,878	69%
North Drain at Mouth -	50.6	0.33	28,423	78%
Mammon Gulch at Hwy. 95 -	13.6	0.48	12,784	81%
Drain near Dixie Drain Mouth -	5.7	0.45	1,872	N/A
Renshaw Canal at Mouth -	33.4	0.33	21,321	86%

TABLE 10. BACTERIA CONCENTRATIONS IN SAND HOLLOW DRAIN - WY 1980

SAMPLE STATION		Fecal Coliform #/100 ml.	Fecal Streptococcis #/100 ml.	FC/FS Ratio	% Exceedance Of (500/100 ml. Standard)
Sand Hollow Drain					
Sand Hollow Dr. at Hwy. 30 -	N	10	10	3.2	70%
	Mean	537	1,278		
	Min-Max	40-2,700	10-16,000		
Sand Hollow Dr. at Sebree -	N	10	10	4.0	70%
	Mean	564	1,013		
	Min-Max	5-2,700	10-17,000		
Sand Hollow Dr. at Hwy. 20/26 -	N	10	10	0.6	20%
	Mean	309	1,129		
	Min-Max	20-1,100	30-21,000		
Parma Drain at Mouth -	N	10	10	10.7	80%
	Mean	1,043	1,543		
	Min-Max	150-3,000	10-35,000		
Sand Hollow Dr. below Parma Dr. -	N	10	10	1.7	60%
	Mean	784	1,410		
	Min-Max	150-2,500	20-22,000		
Parma STP Effluent -	N	10	10	3.1	60%
	Mean	1,816	2,323		
	Min-Max	100-520,000	100-45,000		
Sand Hollow Dr. Near Mouth -	N	10	10	3.0	70%
	Mean	1,204	1,196		
	Min-Max	320-7,000	20-15,000		

TABLE 11. SUMMARY OF DDT AND TOXAPHENE RESIDUES IN FISH IN LOWER BOISE RIVER DRAINS - WY 1980, WY 1981.

	SAND HOLLOW			DIXIE DRAIN			SOUTH BOISE		
	% Lipid	DDT	Toxaphene	% Lipid	DDT	Toxaphene	% Lipid	DDT	Toxaphene
NUMBER	21	21	7	28	28	11	7	7	
MINIMUM	0.2	0.012	0.540	0.1	0.002	0.068	0.18	0.020	NONE
MAXIMUM	3.2	2.699	16.970	4.9	1.295	2.829	0.96	0.559	DETECTED
MEAN	1.5	0.423	3.539	1.8	0.224	0.745	0.56	0.151	
OVERALL MEAN									
NUMBER	56	56	18						
MEAN	1.5	0.29	1.83						
CRITERIA - % EXCEEDENCE									
FDA CRITERIA[1] 5 ppm		0%	14%		0%	0%		0%	
AFS REDBOOK[2] DDT - 0.2 ppm		61%	---		32%	---		14%	
MAYER & MEHRLE[3] Toxaphene - 0.4 ppm		---	100%		---	36%		---	

NOTE: Units are mg/kg (ppm)

REFERENCES:
1. FDA (1979)
2. Miller et al. (1979)
3. Mayer, F.L. and P.M. Mehrle (1977)

TABLE 12. SUMMARY OF SUSPENDED SEDIMENT DATA FOR DIXIE DRAIN DRAINAGE (WY 1980)

SAMPLE STATION	ANNUAL			AGRICULTURAL SEASON			
	MEAN FLOW (cfs)	MEAN CONC. (mg/l)	LOAD (tons)	MEAN FLOW (cfs)	MEAN CONC. (mg/l)	LOAD (tons)	PERCENT OF TOTAL LOAD
Dixie Drain, mouth	168.2	57.2	11,906	266.5	91.9	8,210	69
N. Drain, mouth	44.0	37.8	1,801	67.4	50.8	1,111	62
N. Drain, Dixie Rd.	24.6	50.0	1,075	35.5	57.1	756	70
Dixie Drain, Super Lateral Road	144.6	71.5	11,624	198	108.1	8,336	72
S. Drain, mouth	30.1	49.6	1,375	45.5	68.4	899	65
S. Drain, Dixie Rd.	6.3	25.4	126	8.4	25.0	73	58
Dixie Drain, Guess Gulch	70.4	74.8	5,984	82.3	130.3	3,713	62
Renshaw Canal	30.0	229.0	8,369	42.0	362.0	7,173	86
*W. End Drain, Notus Road	64.4	100.2	7,784	73.4	129.9	6,516	84
*W. End Drain, Farmway Road	25.0	78.2	2,189	21.6	82.9	1,490	68

*Sampled WY 1981

TABLE 13. BACTERIA IN DIXIE DRAIN AND TRIBUTARIES - WY 1980

SAMPLE STATION		Fecal Coliform #/100 ml.	Fecal Streptococcus #/100 ml.	Mean FC/FS Ratio	% Exceedance of (500/100 ml. Stand.)
Dixie Drain					
Dixie Drain at Guess Gulch -	Number	10	10	0.8	70%
	Mean	1,206	2,727		
	Min-Max	10- 31,000	50-130,000		
Dixie Drain at Super Lateral Road -	Number	10	10	1.3	80%
	Mean	2,475	3,360		
	Min-Max	70-510,000	20,160,000		
Dixie Drain Mouth -	Number	10	10	1.0	70%
	Mean	1,550	2,075		
	Min-Max	70-200,000	65-215,000		
Tributary Stations					
South Drain at Dixie Rd. -	Number	10	10	0.4	30%
	Mean	479	1,630		
	Min-Max	100- 6,700	280- 20,000		
South Drain at Mouth -	Number	10	10	1.4	70%
	Mean	2,121	2,011		
	Min-Max	200- 31,100	110- 27,000		
North Drain at Dixie Rd. -	Number	10	10	18.1*	80%
	Mean	2,201	716		
	Min-Max	200- 48,000	130- 4,000		
North Drain at Mouth -	Number	10	10	2.7	70%
	Mean	893	664		
	Min-Max	280- 3,100	90- 4,500		
Mammon Gulch at Highway 95 -	Number	10	10	0.9	70%
	Mean	1,369	2,554		
	Min-Max	160- 14,400	50- 57,000		
Drain near Dixie Drain Mouth	Number	7	7	0.8	100%
	Mean	1,636	2,328		
	Min-Max	920- 7,500	470- 11,000		
Renshaw Canal at Mouth -	Number	10	10	2.8	50%
	Mean	467	1,183		
	Min-Max	190- 1,500	10- 22,000		

*Median FC/FS ratio is 1.9

TABLE 14. SUMMARY OF SUSPENDED SEDIMENT DATA FOR DRAINS (WY 1981)

SAMPLE STATION	ANNUAL			AGRICULTURAL SEASON			
	MEAN FLOW (cfs)	MEAN CONC. (mg/l)	LOAD (tons)	MEAN FLOW (cfs)	MEAN CONC. (mg/l)	LOAD (tons)	PERCENT OF TOTAL LOAD
Ross E. End Drain	24.1	141.8	4,158	24.8	132.6	2,806	67
*Mammon Gulch	12.2	153.2	2,681	17.0	213.0	2,468	92
S. Boise Drain	49.5	70.5	3,262	56.2	100.0	2,989	92
Conway Gulch, Notus	40.0	94.7	4,412	43.3	127.3	4,198	95
Conway Gulch, Stafford Rd.	24.5	72.1	2,004	28.9	80.6	1,356	68
Conway Gulch, Highway 30	3.3	142.8	733	3.8	214.5	698	95

*Sampled WY 1980

TABLE 15. FLOW (cfs) FOR LOWER BOISE RIVER DRAINS - WY 1981

SAMPLE STATION	SAMPLE DATES									
	'81- Apr. 13	May 13	May 28	June 10	July 28	Aug. 27	Oct. 6	Nov. 24	'82- Feb. 24	March 18
Conway Gulch, Mouth at Highway 20/26, Notus -	16.0	48.0	5.9	59.0	52.0	55.0	60.0	19.0	30.0	16.0
Conway Gulch, at Stafford Rd. -	4.8	29.0	43.0	49.0	23.0	25.0	30.0	24.0	25.0	14.0
Conway Gulch, at Highway 30 -	2.3	5.6	4.5	5.0	4.0	3.0	3.0	2.8	2.8	1.9
Parma Drain, at Highway 20/26, Parma -	5.7	11.4	15.0	8.4	16.0	27.0	15.0	2.6	3.0	2.0
West End Drain, above Renshaw -	24.0	70.0	70.0	103.0	85.0	72.0	85.0	80.0	30.0	30.0
West End Drain, at Farmway Road, Caldwell -	5.3	28.0	23.0	28.0	38.0	25.0	33.0	21.0	25.0	24.0
Ross East End Drain, at Bluff Lane, Allendale Road -	9.5	29.0	24.0	24.0	38.0	24.0	25.0	25.0	20.0	25.0
South Boise Drain, at Scott Pitt and Brumbach Road -	11.7	43.0	62.0	79.0	52.0	60.0	75.0	46.0	44.0	15.0
Sand Hollow Drain at Highway 20/26 Crossing -	49.0	62.0	86.0	95.0	50.0	89.0	100.0	35.0	70.0	30.0

TABLE 16. DISSOLVED OXYGEN CONCENTRATION (mg/l) AND PERCENT SATURATION FOR LOWER BOISE RIVER DRAINS - WY 1981

SAMPLE STATION	SAMPLE DATES									
	'81- Apr. 13	May 13	May 28	June 10	July 28	Aug. 27	Oct. 6	Nov. 24	'82- Feb. 24	Mar. 18
Conway Gulch, Mouth at Highway 20/26, Notus -	16.0(144.1%)	9.9(89.2%)	9.2(90.2%)	8.4(80.8%)	12.4(131.9%)	7.0(70 %)	6.3(56.8%)	9.0(81.1%)	9.8(82.4%)	8.2(72.6%)
Conway Gulch, at Stafford Road -	14.0(132.1%)	9.4(84.7%)	9.2(90.2%)	8.2(82 %)	11.6(128.9%)	4.8(51.1%)	6.9(62.2%)	9.4(84.7%)	9.8(82.4%)	10.6(95.5%)
Conway Gulch, at Highway 30 -	11.6(102.7%)	9.6(80.7%)	8.8(81.5%)	5.4(57.4%)	12.0(146.3%)	6.6(64.7%)	7.8(69 %)	9.1(82 %)	10.4(87.4%)	10.6(93.8%)
Parma Drain at Highway 20/26, Parma -	16.0(144.1%)	10.2(98.1%)	8.5(89.5%)	8.2(80.4%)	8.4(93.3%)	7.0(74.5%)	5.6(49.6%)	8.8(79.3%)	8.8(73.9%)	10.2(90.3%)
West End Drain, Above Renshaw -	15.8(154.9%)	8.9(87.3%)	8.1(83.5%)	6.1(61 %)	11.4(114%)	6.0(60 %)	6.8(61.3%)	7.0(63.1%)	10.6(84.8%)	8.5(73.3%)
West End Drain, at Farmway Road, Caldwell -	7.8(75 %)	4.2(41.2%)	7.9(83.2%)	5.0(49 %)	6.8(68 %)	6.2(63.9%)	3.2(30.2%)	7.3(67.6%)	7.5(66.4%)	9.1(84.3%)
Ross East End Drain, at Bluff Lane, Allendale Rd. -	11.4(114 %)	10.7(110.3%)	8.6(95.6%)	6.7(70.5%)	11.8(125.5%)	6.8(70.1%)	6.3(59.4%)	8.3(71.6%)	10.7(83.6%)	10.4(85.2%)
South Boise Drain, at Scott Pitt & Brumbach Rd. -	11.4(120 %)	9.1(91 %)	6.7(74.4%)	6.2(63.9%)	9.0(100 %)	4.8(49.5%)	6.5(60.2%)	8.3(73.5%)	10.6(84.8%)	12.4(99.2%)
Sand Hollow Drain at Highway 20/26 Crossing -	17.4(156.8%)	6.6(61.1%)	9.5(95 %)	6.4(61.5%)	11.3(120.2%)	7.1(73.2%)	7.7(69.4%)	9.5(84.1%)	10.0(78.1%)	12.3(106 %)

TABLE 17. WATER TEMPERATURES (°C) FOR LOWER BOISE RIVER DRAINS - WY 1981

SAMPLE STATION	SAMPLE DATES									
	'81- Apr. 13	May 13	May 28	June 10	July 28	Aug. 27	Oct. 6	Nov. 24	'82- Feb. 24	March 18
Conway Gulch, Mouth at Highway 20/26, Notus -	11.0	11.0	14.5	13.5	19.0	16.0	11.0	11.0	8.0	10.0
Conway Gulch, at Stafford Rd. -	13.0	10.5	14.5	16.0	21.0	19.0	11.0	11.0	8.0	10.5
Conway Gulch, at Highway 30 -	9.5	8.0	12.0	19.0	26.0	15.0	10.0	10.5	8.0	9.5
Parma Drain, at Highway 20/26, Parma -	11.0	13.7	18.0	15.0	21.0	19.0	10.0	11.0	8.0	10.0
West End Drain, above Renshaw -	15.0	15.0	17.0	15.5	16.0	16.0	11.0	11.0	6.0	9.0
West End Drain, at Farmway Road, Caldwell -	14.0	15.0	18.0	15.0	16.0	17.0	13.0	12.0	10.0	11.5
Ross East End Drain, at Bluff Lane, Allendale Road -	16.0	17.0	21.0	18.0	19.0	16.5	13.0	9.0	5.0	7.0
South Boise Drain, at Scott Pitt and Brumbach Road -	18.0	16.0	21.0	16.8	21.0	17.0	12.0	10.0	6.0	6.0
Sand Hollow Drain at Highway 20/26 Crossing -	11.0	12.0	16.0	13.8	19.0	16.5	11.0	10.0	5.0	9.0

TABLE 18. PH VALUES FOR LOWER BOISE RIVER DRAINS - WY 1981

SAMPLE STATION	SAMPLE DATES									
	'81- Apr. 13	May 13	May 28	June 10	July 28	Aug. 27	Oct. 6	Nov. 24	'82- Feb. 24	Mar. 18
Conway Gulch, Mouth at Highway 20/26, Notus -	8.3	8.0	8.1	7.6	7.9	7.9	7.8	8.1	8.3	8.4
Conway Gulch, at Stafford Rd. -	8.2	8.0	8.0	8.3	7.8	7.6	7.9	8.1	8.1	8.1
Conway Gulch, at Highway 30 -	7.9	7.9	8.1	8.3	7.6	7.8	7.7	8.1	7.9	8.1
Parma Drain, at Highway 20/26, Parma -	8.4	8.1	8.2	8.4	7.9	8.0	8.0	8.2	8.1	8.0
West End Drain, above Renshaw -	8.1	8.3	8.1	8.2	7.8	7.8	7.9	8.0	8.0	7.9
West End Drain, at Farmway Road, Caldwell -	8.4	8.0	8.1	8.4	8.1	7.9	7.8	7.9	8.3	8.0
Ross East End Drain, at Bluff Lane, Allendale Road -	8.7	8.2	8.0	8.3	8.3	7.85	8.15	7.85	8.2	8.3
South Boise Drain, at Scott Pitt and Brumbach Road -	8.5	8.2	8.1	8.1	7.7	7.9	8.1	8.3	8.2	8.3
Sand Hollow Drain at Highway 20/26 Crossing -	8.4	8.0	8.0	8.1	7.8	7.8	8.1	8.2	8.1	8.3

TABLE 19. TOTAL PHOSPHORUS LOADING FOR DRAINS, WY 1981.

STATION	Mean Flow (cfs)	Mean Concentrations (mg/l)	Phosphorus Load (lbs.)	% Phosphorus Load Agric. Season
Conway Gulch, Mouth at Highway 20/26, Notus	38.8	0.25	19,610	77%
Gonway Gulch, at Stafford Rd.	26.4	0.23	11,470	56%
Conway Gulch, at Highway 30	3.3	0.25	1,928	70%
Parma Drain, at Highway 20/26, Parma	10.6	0.36	8,540	96%
West End Drain, above Renshaw	64.9	0.38	50,834	71%
West End Drain, at Farmway Road, Caldwell	25.0	0.26	13,475	74%
Ross East End Drain, at Bluff Lane, Allendale Road	24.4	0.43	22,780	66%
South Boise Drain, at Scott Pitt and Brumbach Road	48.8	0.37	35,377	81%
Sand Hollow Drain at Highway 20/26 Crossing	66.6	0.32	38,238	67%

TABLE 20. TOTAL NITRATE LOADING FOR DRAINS, WY 1981.

STATION	Mean Flow (cfs)	Mean Concentrations (mg/l)	Nitrate Load (lbs.)	% Nitrate Load Ag. Season
Conway Gulch, Mouth at Highway 20/26, Notus -	38.3	3.4	220,678	60%
Conway Gulch, at Stafford Rd. -	26.4	2.4	115,186	47%
Conway Gulch, at Highway 30 -	3.3	2.2	13,308	43%
Parma Drain, at Highway 20/26, Parma -	10.6	2.9	42,109	73%
West End Drain, above Renshaw -	64.9	2.8	353,996	63%
West End Drain, at Farmway Road, Caldwell -	25.0	3.6	177,923	57%
Ross East End Drain, at Bluff Lane, Allendale Road -	24.4	4.8	230,971	43%
South Boise Drain, at Scott Pitt and Brumbach Road -	48.8	3.7	334,380	56%
Sand Hollow Drain at Highway 20/26 Crossing -	66.6	3.2	361,276	50%

TABLE 21. BACTERIA IN LOWER BOISE VALLEY DRAINS - WY 1981

SAMPLE STATION		Fecal Coliform #/100 ml.	Fecal Streptococcus #/100 ml.	Mean FC/FS Ratio	% Exceedance of (500/100 ml. Stand.)
Conway Gulch, at Mouth -	Number	10	10	0.2	40%
	Mean	207	1,689		
	Min-Max	10- 900	130-14,500		
Conway Gulch, at Stafford Rd. -	Number	10	10	0.2	40%
	Mean	152	1,418		
	Min-Max	10- 1,700	150-13,000		
Conway Gulch, at Highway 30 -	Number	10	10	0.2	50%
	Mean	268	2,552		
	Min-Max	10- 1,800	400-10,000		
Parma Drain, at Highway 20/26 -	Number	10	10	2.6	60%
	Mean	1,229	3,329		
	Min-Max	150-46,000	400-30,000		
West End Drain, above Renshaw -	Number	10	10	0.7	70%
	Mean	1,919	6,923		
	Min-Max	150-23,000	1800-42,000		
West End Drain, at Farmway Rd. -	Number	10	10	0.4	40%
	Mean	392	2,138		
	Min-Max	10- 7,400	200-24,000		
Ross East End Drain -	Number	10	10	0.4	60%
	Mean	656	2,388		
	Min-Max	50- 9,000	230-24,000		
South Boise Drain -	Number	9	9	0.7	44%
	Mean	476	1,298		
	Min-Max	20- 3,500	130-20,000		
Sand Hollow Drain at Highway 20/26 -	Number	10	10	0.6	20%
	Mean	309	1,129		
	Min-Max	20- 1,100	30-21,000		

TABLE 22. Nutrient And Suspended Sediment Data For The Boise River Near Parma (WY 1980 - 1982).

DATE	FLOW (CFS)	T. PHOSPHORUS (mg/l)	NITRATES* (mg/l)	S. SEDIMENT (mg/l)	S. SEDIMENT LOAD (TONS)
Water Year 1980					
79/10/11	10,400	0.27	1.90	50	1,404
79/11/06	954	0.33	3.30	19	49
79/12/06	840	----	----	--	-----
80/01/09	805	0.39	2.80	27	59
80/02/12	762	0.37	2.90	21	43
80/04/09	674	0.48	2.50	48	87
80/05/01	4,500	0.17	0.52	51	620
80/06/12	2,740	----	----	--	-----
80/07/15	938	0.38	2.10	40	101
80/08/12	723	0.34	1.80	18	35
80/09/04	1,060	0.28	1.60	36	103
Average		0.33	2.15	34.4	
Annual Sediment Load					52,504
Water Year 1981					
80/10/07	779	0.41	2.10	8	17
80/11/06	990	0.36	2.80	25	67
80/12/03	965	0.74	3.00	34	89
81/01/06	841	0.40	3.10	37	84
81/02/04	809	0.47	0.10	33	72
81/03/04	798	0.51	2.60	22	47
81/04/08	1,240	0.27	1.50	19	64
81/05/06	1,460	0.32	0.90	46	181
81/06/01	4,580	0.14	0.44	22	272
81/06/10	6,120	0.21	0.44	129	2,131
81/07/08	885	0.39	1.60	86	206
81/08/03	587	0.36	1.40	54	86
81/09/02	708	0.34	1.30	1	2
Average		0.38	1.64	35.0	
Annual Sediment Load					52,422
Water Year 1982					
81/10/08	1,350	0.36	2.09	41.8	1,066
81/11/05	1,065	0.07	3.67	13.3	38
81/12/01	1,220	0.34	4.08	19.4	64
82/01/18	1,100	0.44	2.85	47	140
82/02/10	5,250	0.15	0.69	16.9	241
82/03/15	7,370	0.14	0.66	9.5	189
82/04/20	6,970	0.41	0.14	20	376
82/05/05	7,370	0.37	0.12	22	438
82/06/15	2,220	0.97	0.34	98	587
82/07/12	2,790	1.00	0.20	50	376
82/08/05	1,200	2.40	0.31	56	181
82/09/09	1,220	1.93	0.38	24	79
Average		0.72	1.30	34.8	
Annual Sediment Load					85,426

* Nitrate = NO_2 + NO_3

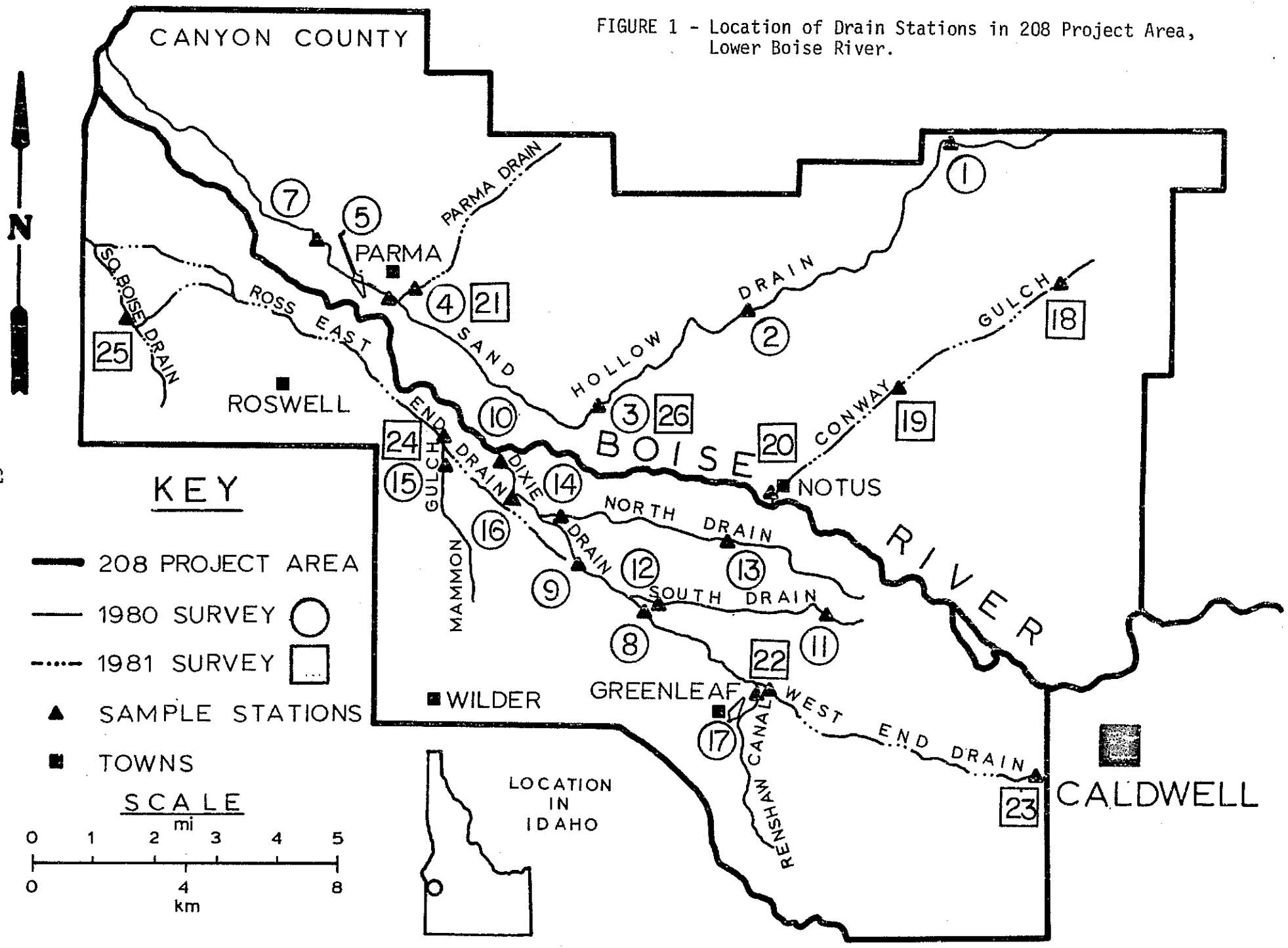
TABLE 23. STATION RANK BASED ON AVERAGE SUSPENDED SEDIMENT CONCENTRATION (mg/l), IRRIGATION SEASON

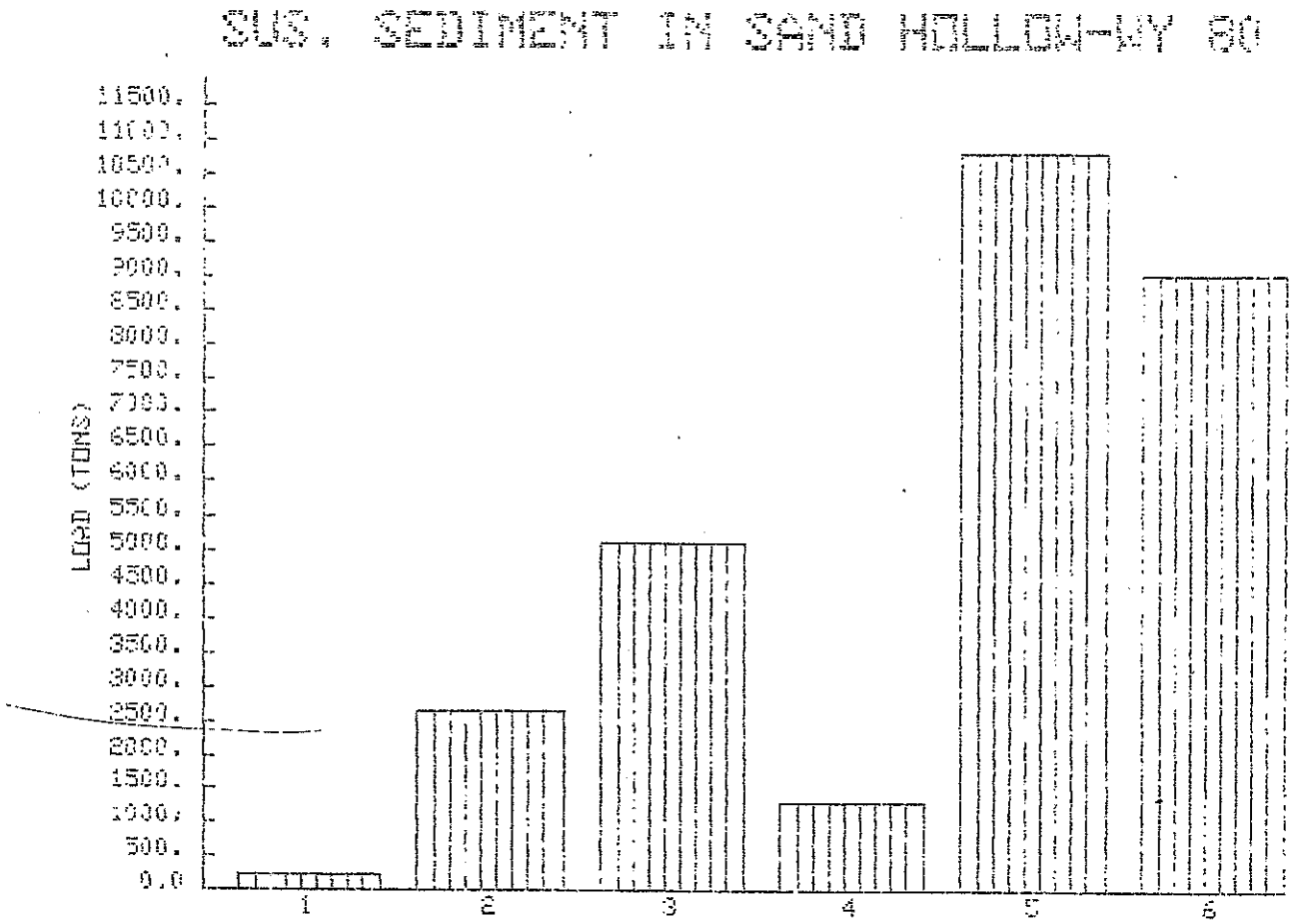
Rank	Sediment Concentration	Station
1	25	S. Drain - Dixie Rd.
2	38	Sand Hollow - Hiway 30
3	51	N. Drain - Mouth
4	57	N. Drain - Dixie Rd.
5	68	S. Drain - Mouth
6	81	Conway Dr. - Stafford Rd.
7	83	West End Dr. - Farmway Rd.
8	92	Dixie Dr. - Mouth
9	98	Sand Hollow Dr. - Sebree
10	100	South Boise Drain
11	108	Dixie Drain - Super Lateral
12	127	Conway Drain - Notus
13	130	West End Drain - Notus Rd.
14	130	Dixie Drain - Guess Gulch
15	133	Ross E. End Drain
16	134	Sand Hollow - Hiway 20/26
17	155	Sand Hollow - Mouth
18	163	Sand Hollow - Parma
19	196	Parma Drain
20	213	Mammon Gulch
21	214	Conway Drain - Hiway 30
22	362	Renshaw Canal
Number	22	
Mean	125	
Median	118	

TABLE 24. STATION RANK BASED ON AVERAGE SUSPENDED SEDIMENT LOADING, TONS, DURING THE IRRIGATION SEASON

Rank	Sediment Load	Station
1	73	South Drain - Dixie Rd.
2	244	Sand Hollow - Hiway 30
3	756	North Drain - Dixie Rd.
4	899	South Drain - Mouth
5	1111	North Drain - Mouth
6	1312	Parma Drain
7	1356	Conway Gulch - Stafford Rd.
8	1490	West End Drain - Farmway
9	2468	Mammon Gulch
10	2659	Sand Hollow Dr. - Sebree
11	2806	Ross East End Drain
12	2989	South Boise Drain
13	3717	Dixie Drain - Guess Gulch
14	4198	Conway Gulch - Notus
15	5090	Sand Hollow Dr. - Hiway 20/26
16	5698	Conway Gulch - Hiway 30
17	6516	West End Drain - Notus
18	7173	Renshaw Canal
19	8210	Dixie Drain - Mouth
20	8336	Dixie Drain - Super Lateral
21	9059	Sand Hollow Dr. - Mouth
22	10802	Sand Hollow Dr. - Parma
Number	22	
Mean	3953	
Median	2898	

FIGURE 1 - Location of Drain Stations in 208 Project Area, Lower Boise River.





1. Sand Hollow Drain at Hwy 30
2. Sand Hollow Drain at Sebree Canal
3. Sand Hollow Drain at Hwy 20/26
4. Parma Drain
5. Sand Hollow Drain below Parma Drain
6. Sand Hollow Drain near Mouth

Figure 2. Suspended Sediment Load in Sand Hollow Drain at Mouth - WY 1980.

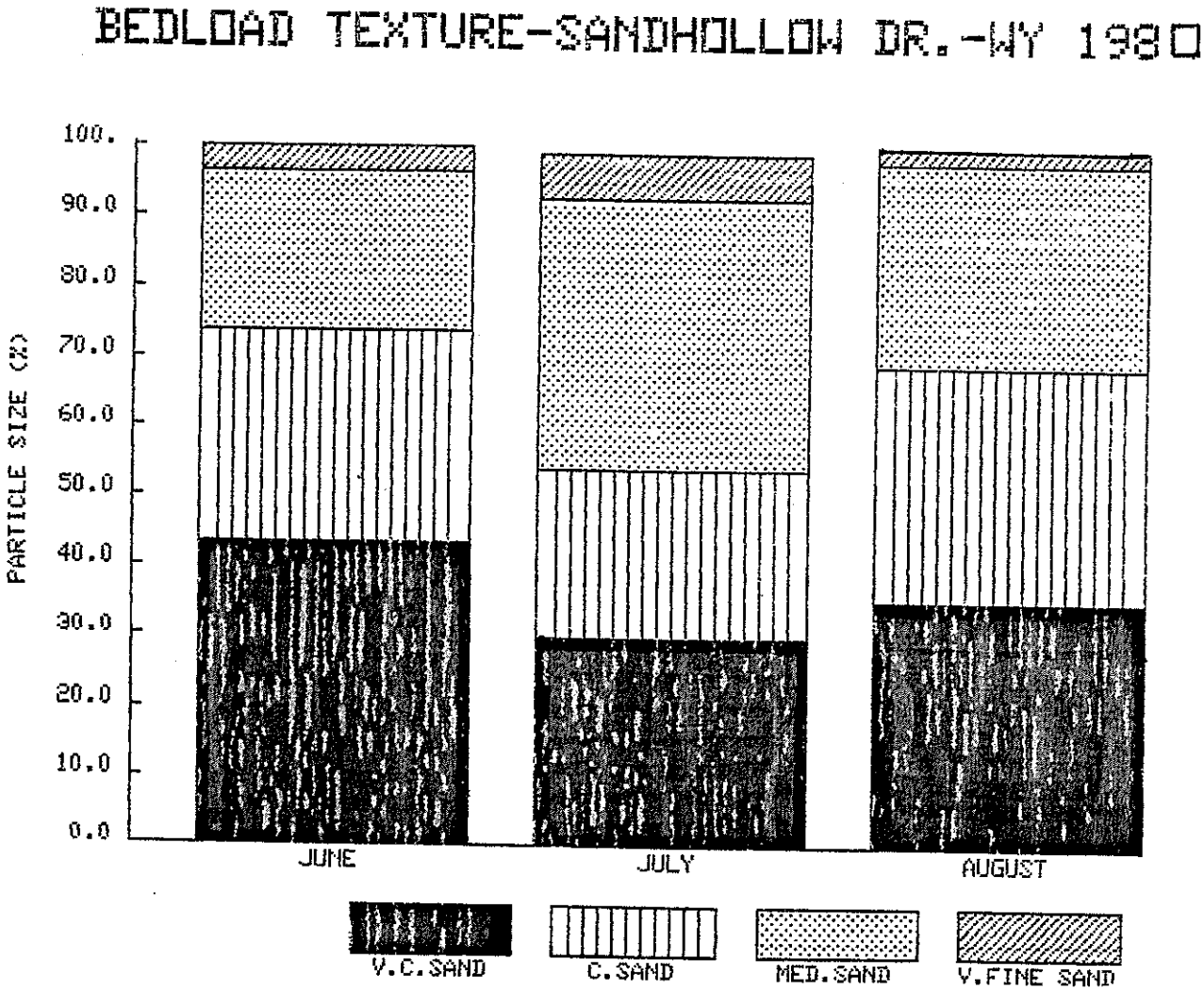
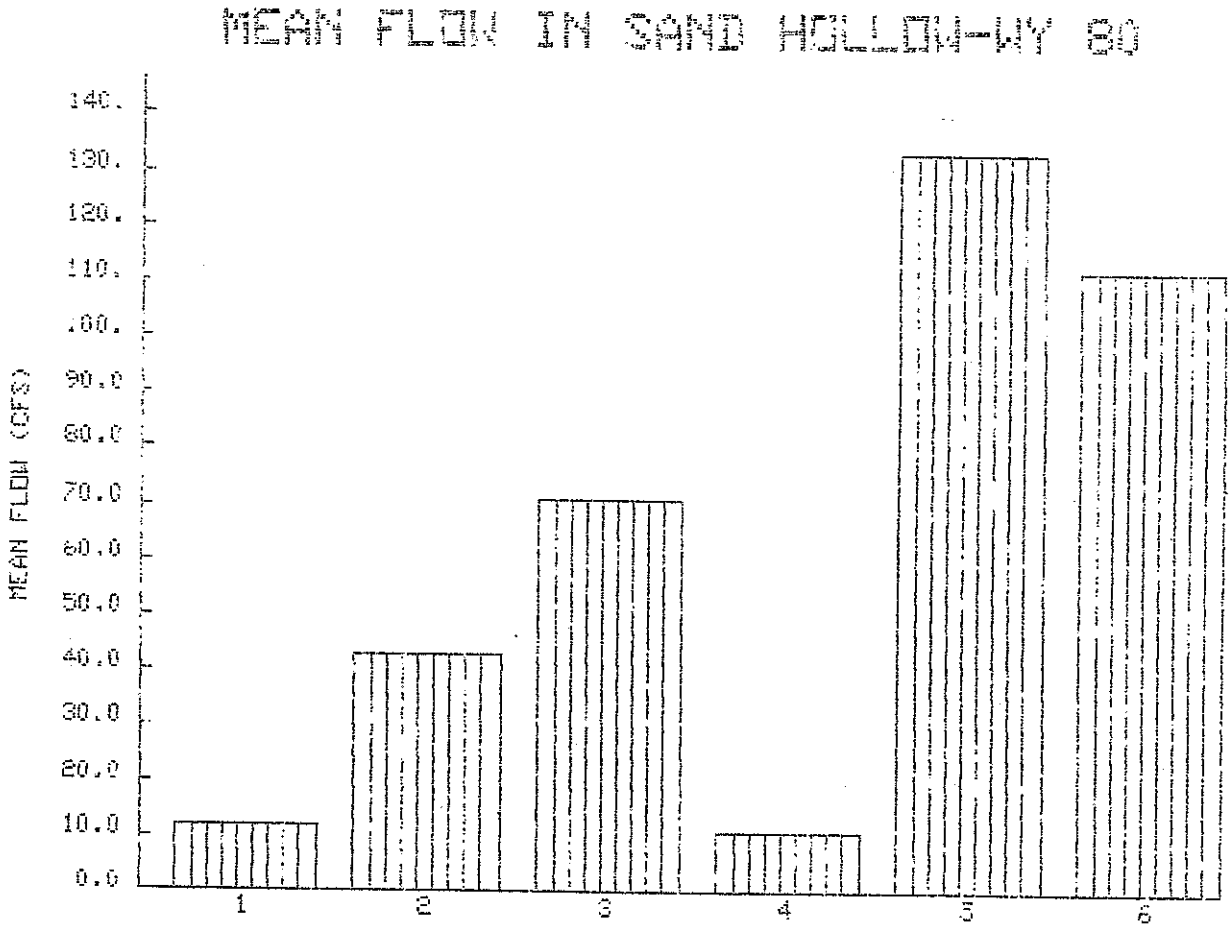
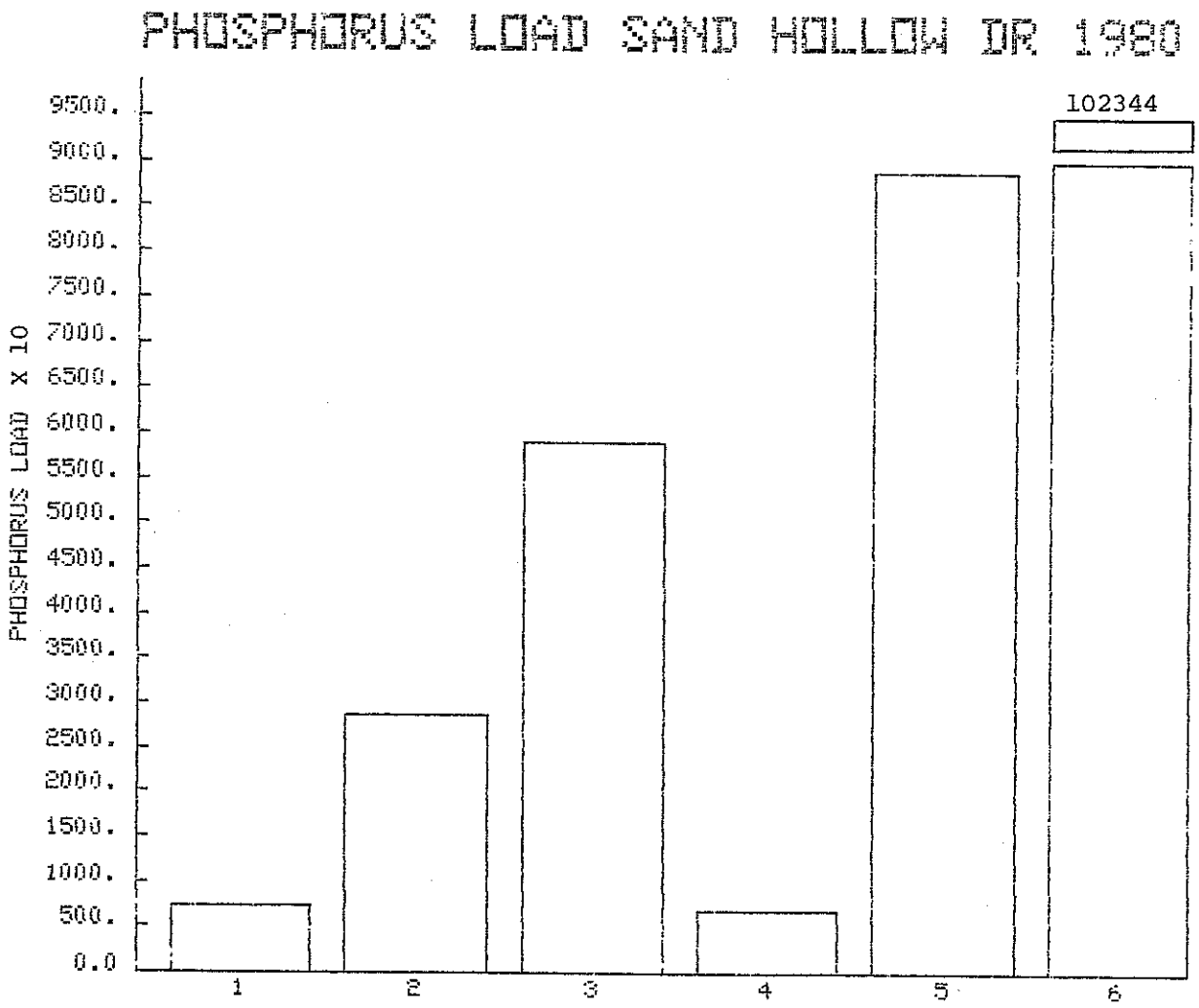


Figure 3. Bedload Texture in Sand Hollow Drain - WY 1980.



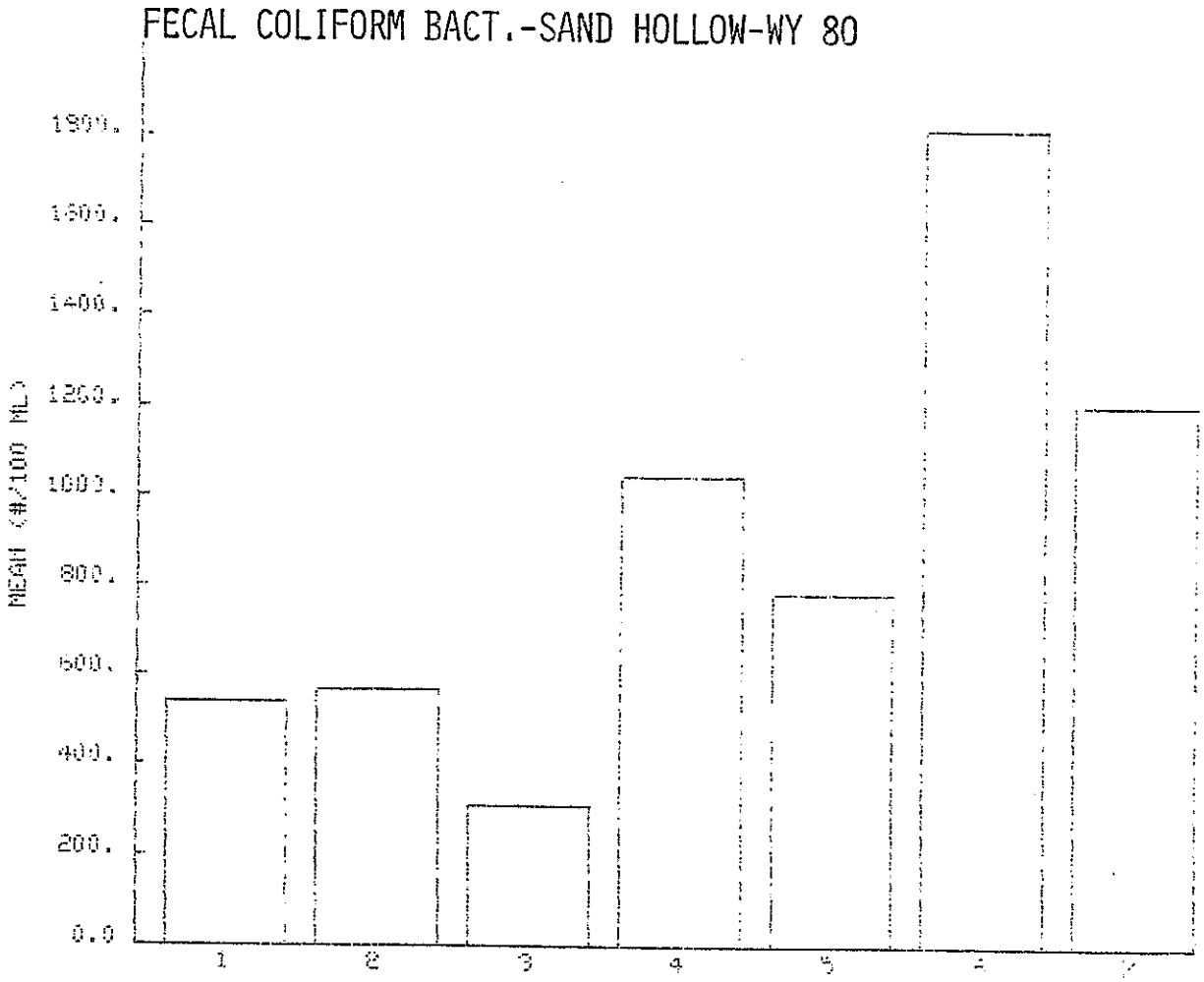
1. Sand Hollow Drain at Hwy 30
2. Sand Hollow Drain at Sebree Canal
3. Sand Hollow Drain at Hwy 20/26
4. Parma Drain
5. Sand Hollow Drain below Parma Drain
6. Sand Hollow Drain near Mouth

Figure 4. Mean Flow (cfs) in Sand Hollow Drain - WY 1980.



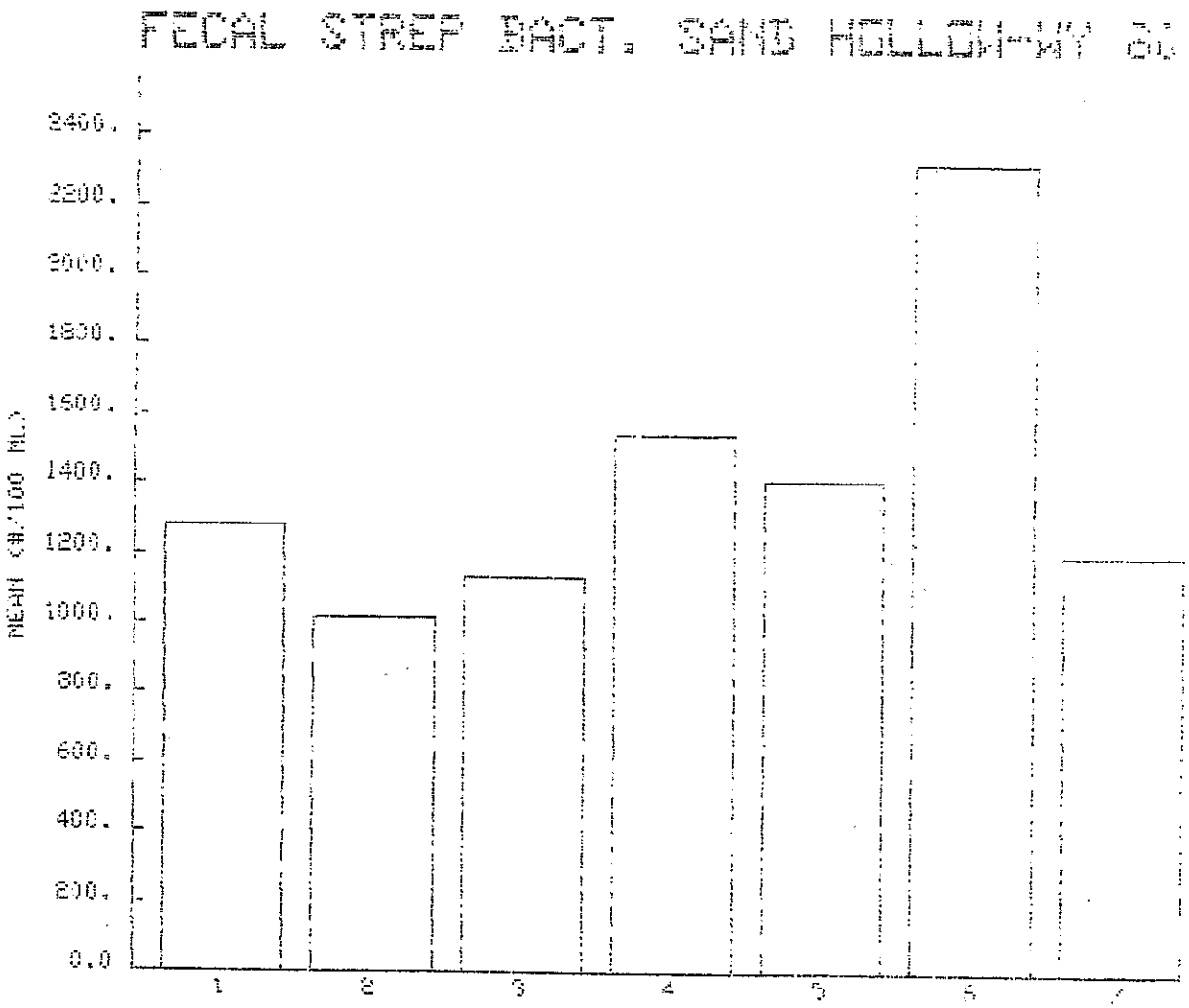
1. Sand Hollow Drain at Hwy 30
2. Sand Hollow Drain at Sebree Canal
3. Sand Hollow Drain at Hwy 20/26
4. Parma Drain
5. Sand Hollow Drain below Parma Drain
6. Sand Hollow Drain near Mouth

Figure 5. Phosphorus Load (pounds) in Sand Hollow Drain - WY 1980.



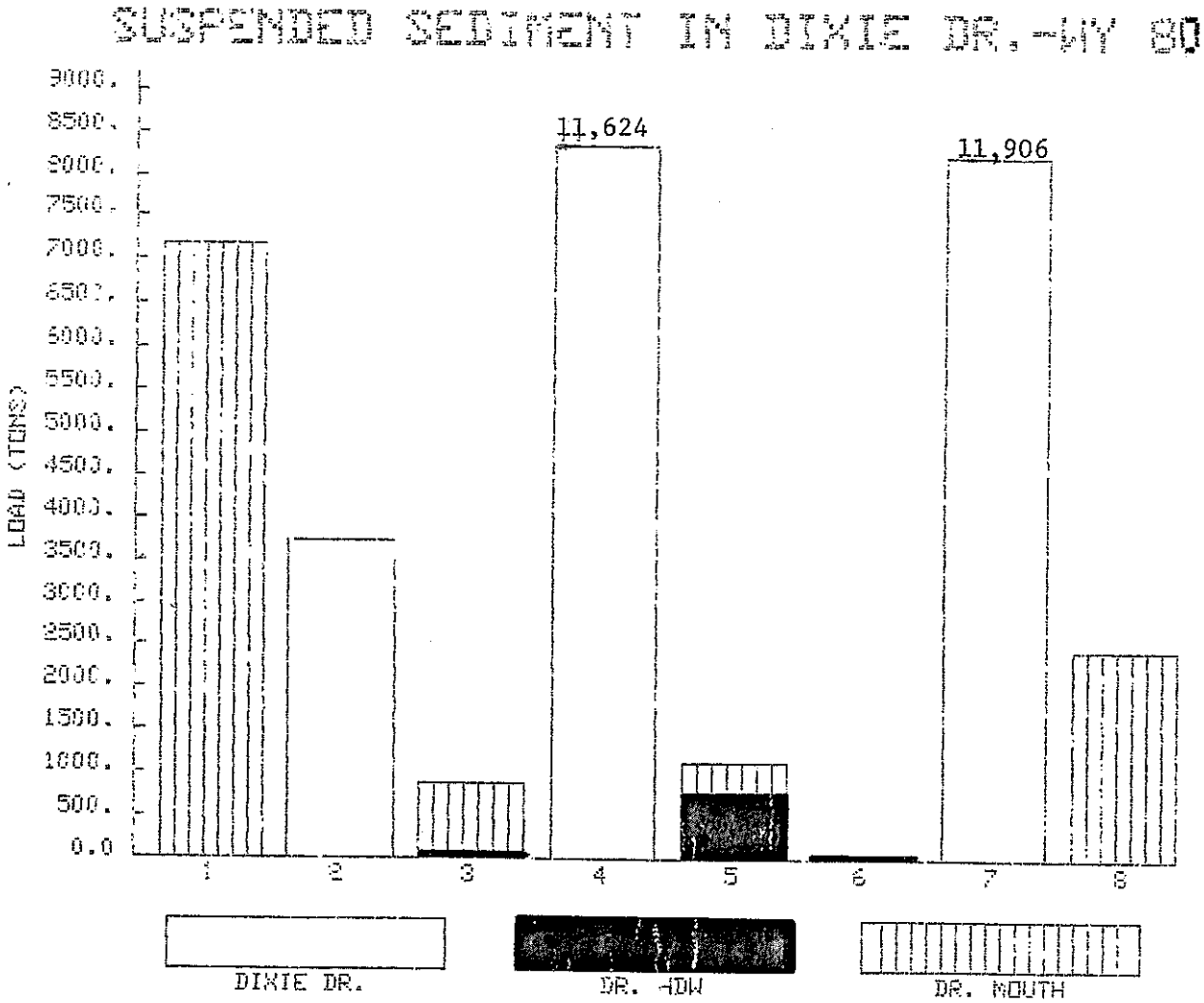
1. Sand Hollow Drain at Hwy 30
2. Sand Hollow Drain at Sebree Canal
3. Sand Hollow Drain at Hwy 20/26
4. Parma Drain
5. Sand Hollow Drain below Parma Drain
6. Parma STP Effluent
7. Sand Hollow Drain near Mouth

Figure 6. Fecal Coliform Bacteria in Sand Hollow Drain - WY 1980.



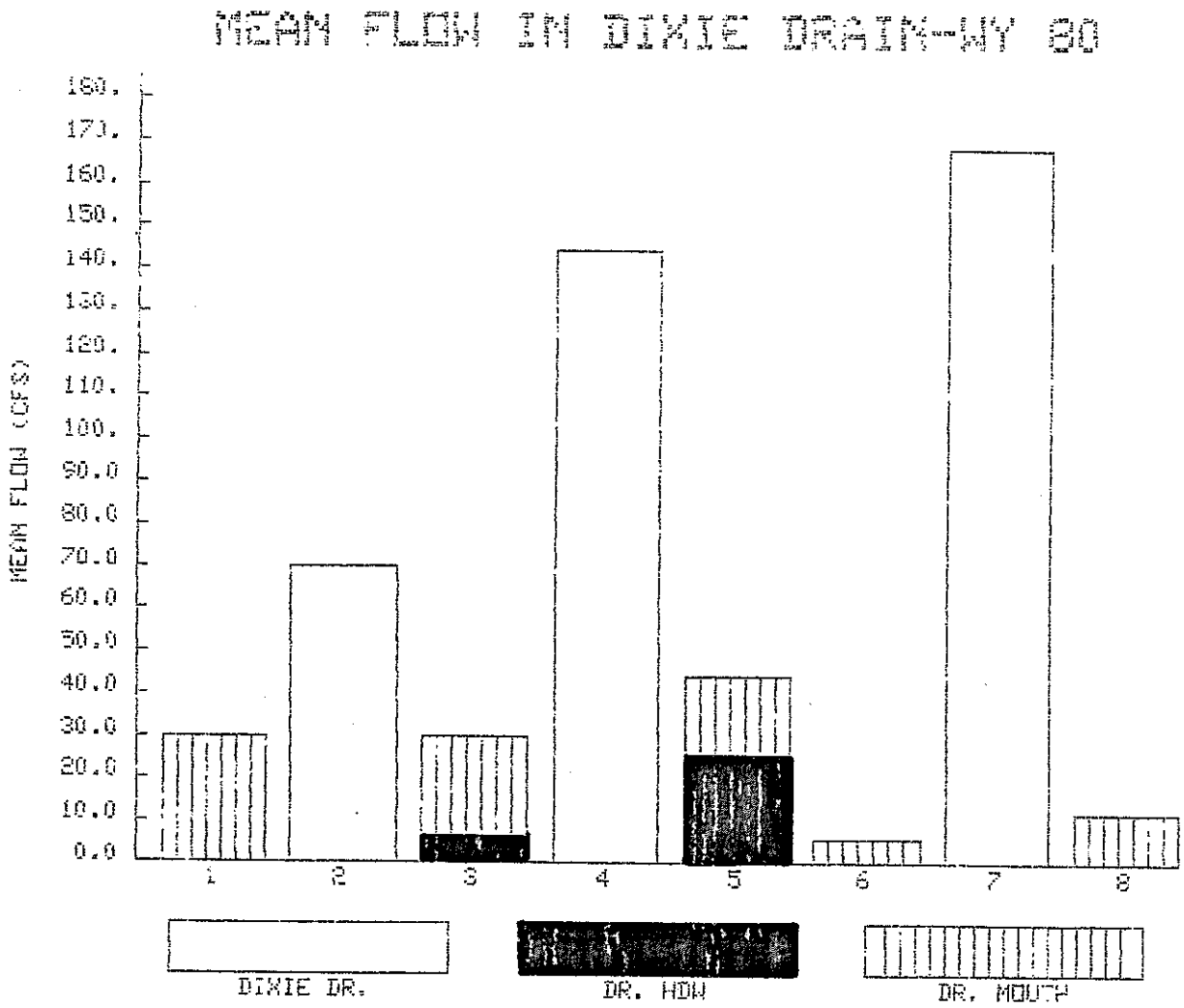
1. Sand Hollow Drain at Hwy 30
2. Sand Hollow Drain at Sebree Canal
3. Sand Hollow Drain at Hwy 20/26
4. Parma Drain
5. Sand Hollow Drain below Parma Drain
6. Parma STP Effluent
7. Sand Hollow Drain near Mouth

Figure 7. Fecal Streptococcus Bacteria in Sand Hollow Drain - WY 1980.



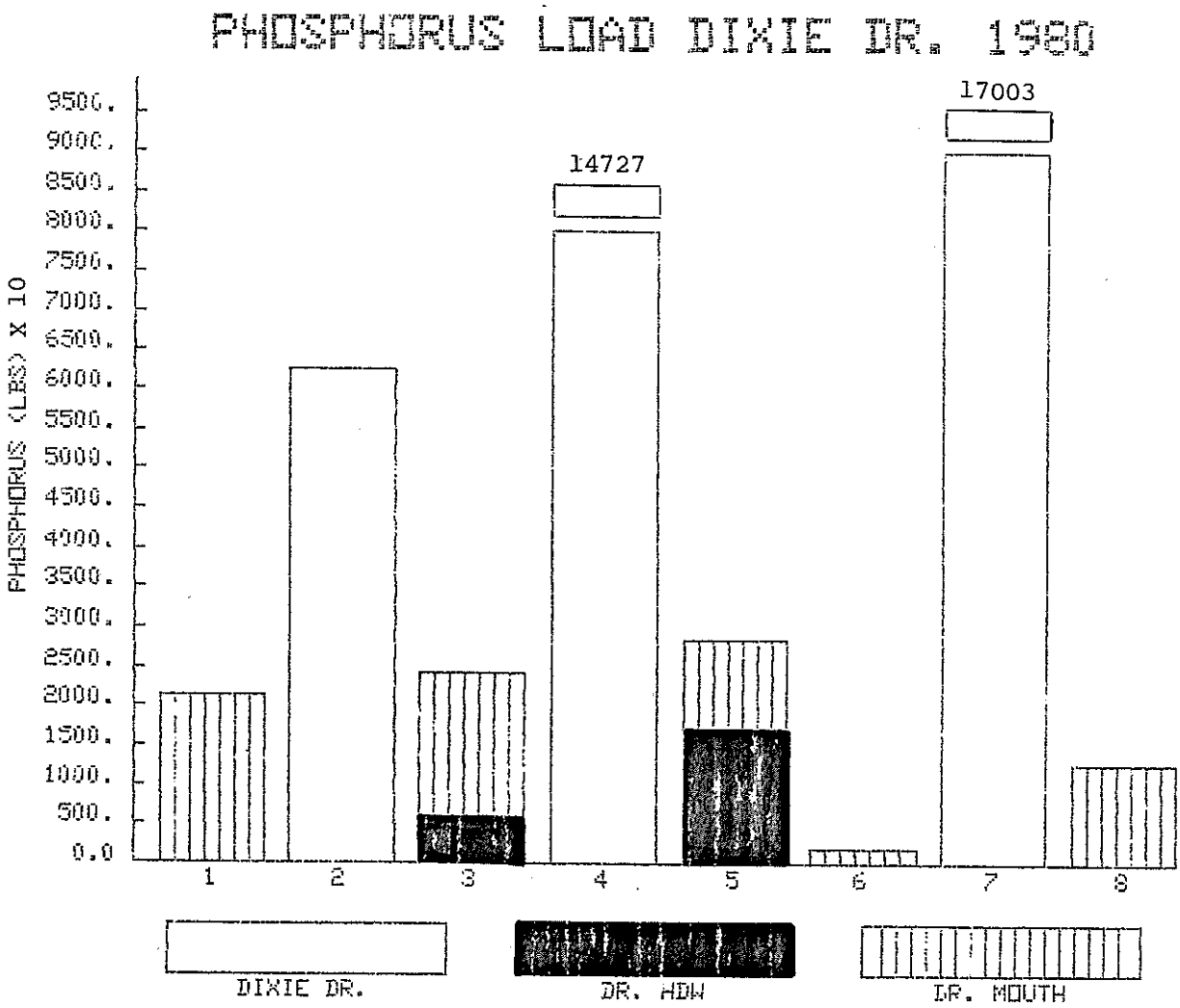
1. Renshaw Canal at Mouth
2. Dixie Drain at Guess Gulch
3. South Drain at Dixie Road (HDW)
   South Drain at Mouth
4. Dixie Drain at Super Lateral Road
5. North Drain at Dixie Road (HDW)
   North Drain at Mouth
6. Drain near Dixie Drain Mouth
7. Dixie Drain Mouth
8. Mammon Gulch at Hwy 95

Figure 8. Suspended Sediment Load (tons) in Dixie Drain - WY 1980.



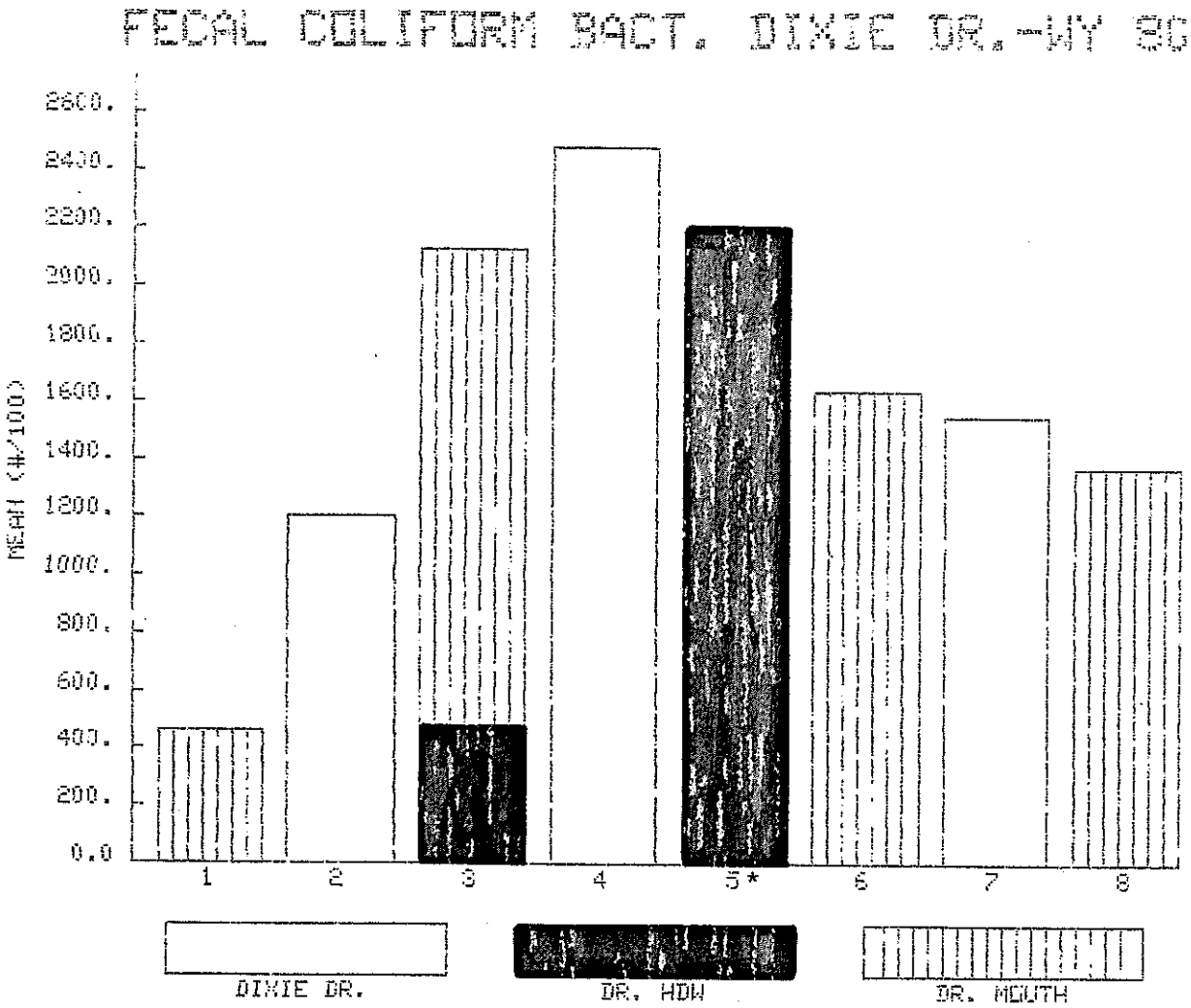
1. Renshaw Canal at Mouth
2. Dixie Drain at Guess Gulch
3. South Drain at Dixie Road (HDW)
   South Drain at Mouth
4. Dixie Drain at Super Lateral Road
5. North Drain at Dixie Road (HDW)
   North Drain at Mouth
6. Drain near Dixie Drain Mouth
7. Dixie Drain Mouth
8. Mammon Gulch at Hwy 95

Figure 9. Mean Flow (cfs) in Dixie Drain - WY 1980.



1. Renshaw Canal at Mouth
2. Dixie Drain at Guess Gulch
3. South Drain at Dixie Road (HDW)
   South Drain at Mouth
4. Dixie Drain at Super Lateral Road
5. North Drain at Dixie Road (HDW)
   North Drain at Mouth
6. Drain near Dixie Drain Mouth
7. Dixie Drain Mouth
8. Mammon Gulch at Hwy 95

Figure 10. Phosphorus Load (pounds) in Dixie Drain - WY 1980.



* Station at Mouth is less than at headwaters, mean of 893/100 ml.

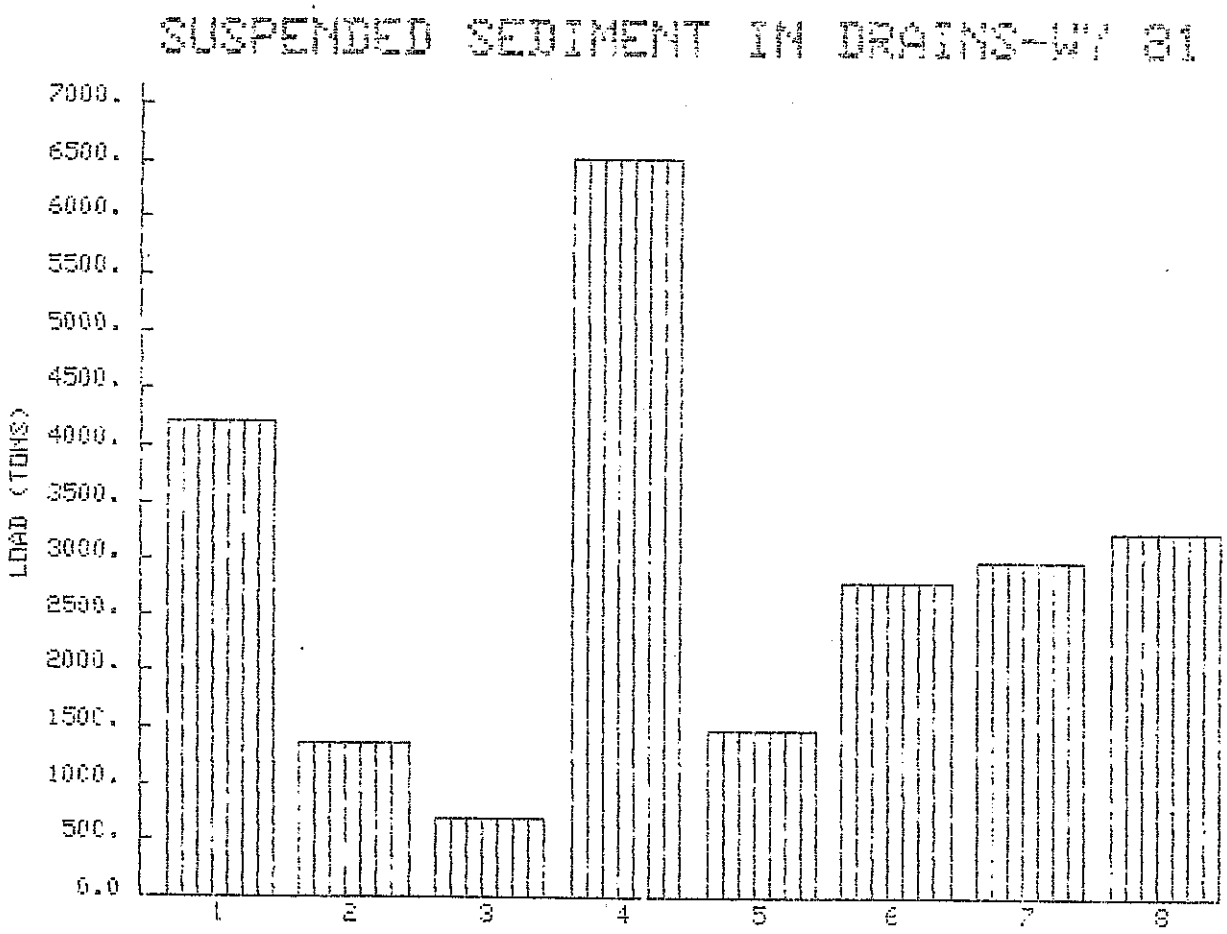
1. Renshaw Canal at Mouth
2. Dixie Drain at Guess Gulch
3. South Drain at Dixie Road (HDW)
   South Drain at Mouth
4. Dixie Drain at Super Lateral Road
5. North Drain at Dixie Road (HDW)
   North Drain at Mouth
6. Drain near Dixie Drain Mouth
7. Dixie Drain Mouth
8. Mammon Gulch at Hwy 95

Figure 11. Fecal Coliform Bacteria in Dixie Drain - WY 1980.

* Station at Mouth is less than at headwaters, mean of 664/100 ml.

1. Renshaw Canal at Mouth
2. Dixie Drain at Guess Gulch
3. South Drain at Dixie Road (HDW)
   South Drain at Mouth
4. Dixie Drain at Super Lateral Road
5. North Drain at Dixie Road (HDW)
   North Drain at Mouth
6. Drain near Dixie Drain Mouth
7. Dixie Drain Mouth
8. Mammon Gulch at Hwy 95

Figure 12. Fecal Streptococcus Bacteria in Dixie Drain - WY 1980.

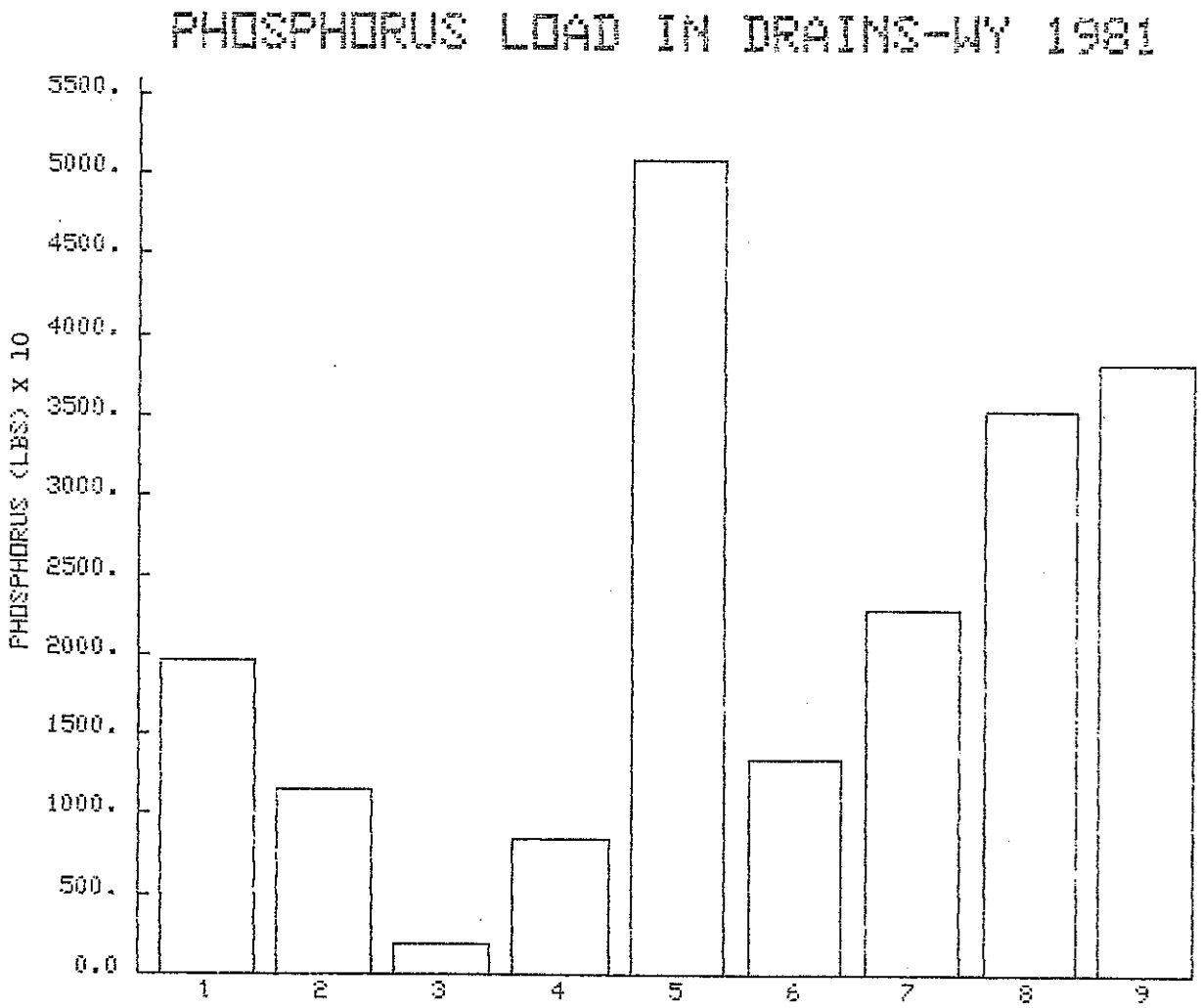


1. Conway Gulch, Notus
2. Conway Gulch at Stafford Road
3. Conway Gulch at Hwy 30
4. West End Drain above Renshaw
5. West End Drain at Farmway Road
6. Ross East End Drain
7. South Boise Drain
8. Sand Hollow Drain at Hwy 20/26

Figure 13. Suspended Sediment Load (tons) in Drains - WY 1981.

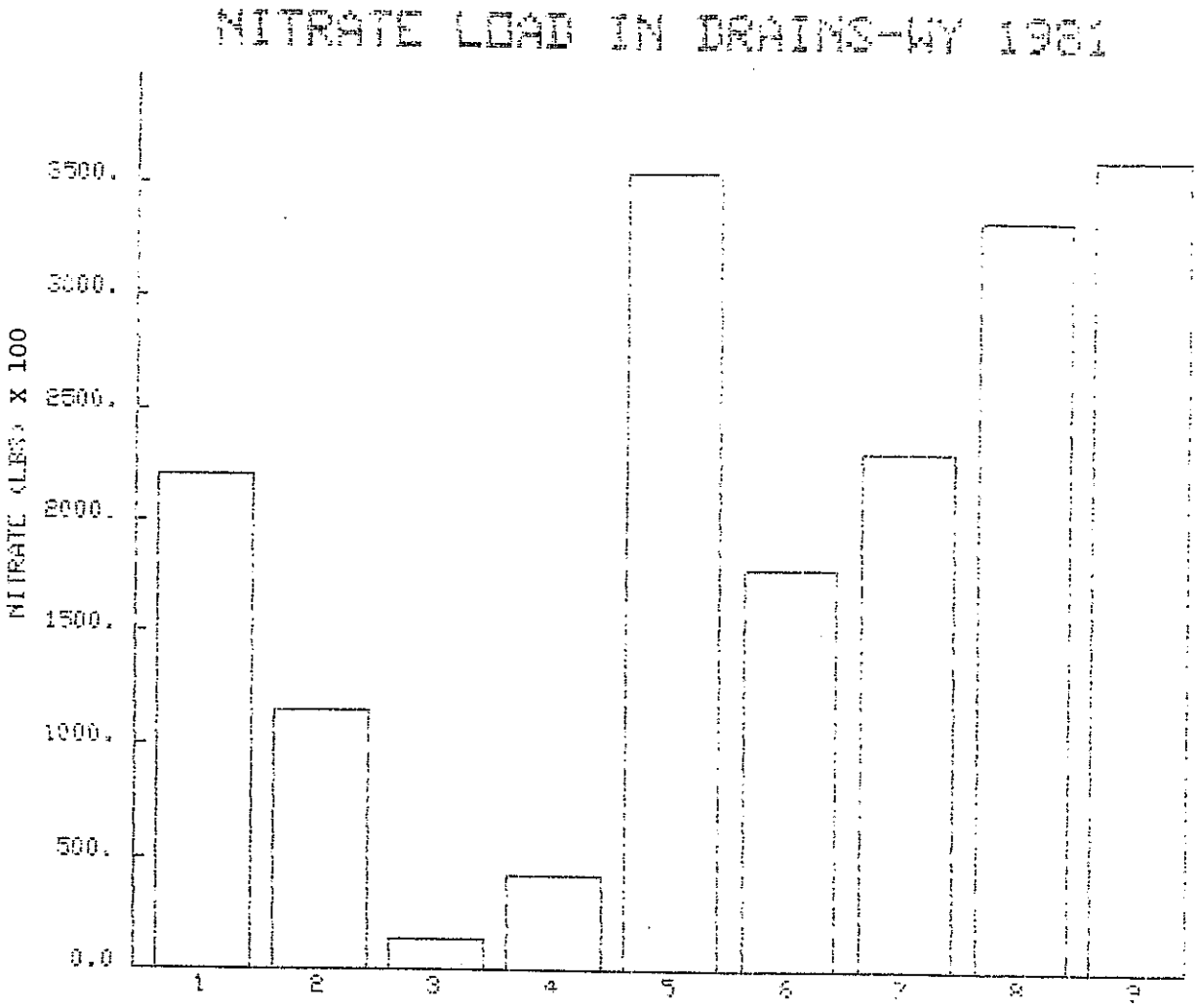
1. Conway Gulch, Notus
2. Conway Gulch at Stafford Road
3. Conway Gulch at Hwy 30
4. West End Drain above Renshaw
5. West End Drain at Farmway Road
6. Ross East End Drain
7. South Boise Drain
8. Sand Hollow Drain at Hwy 20/26

Figure 14. Mean Flow (cfs) in Drains - WY 1981.



1. Conway Gulch, Notus
2. Conway Gulch at Stafford Road
3. Conway Gulch at Hwy 30
4. Parma Drain
5. West End Drain above Renshaw
6. West End Drain at Farmway Road
7. Ross East End Drain
8. South Boise Drain
9. Sand Hollow Drain at Hwy 20/26

Figure 15. Phosphorus Load (pounds) in Drains - WY 1981.



1. Conway Gulch, Notus
2. Conway Gulch at Stafford Road
3. Conway Gulch at Hwy 30
4. Parma Drain
5. West End Drain above Renshaw
6. West End Drain at Farmway Road
7. Ross East End Drain
8. South Boise Drain
9. Sand Hollow Drain at Hwy 20/26

Figure 16. Nitrate Load (pounds) in Drains - WY 1981.

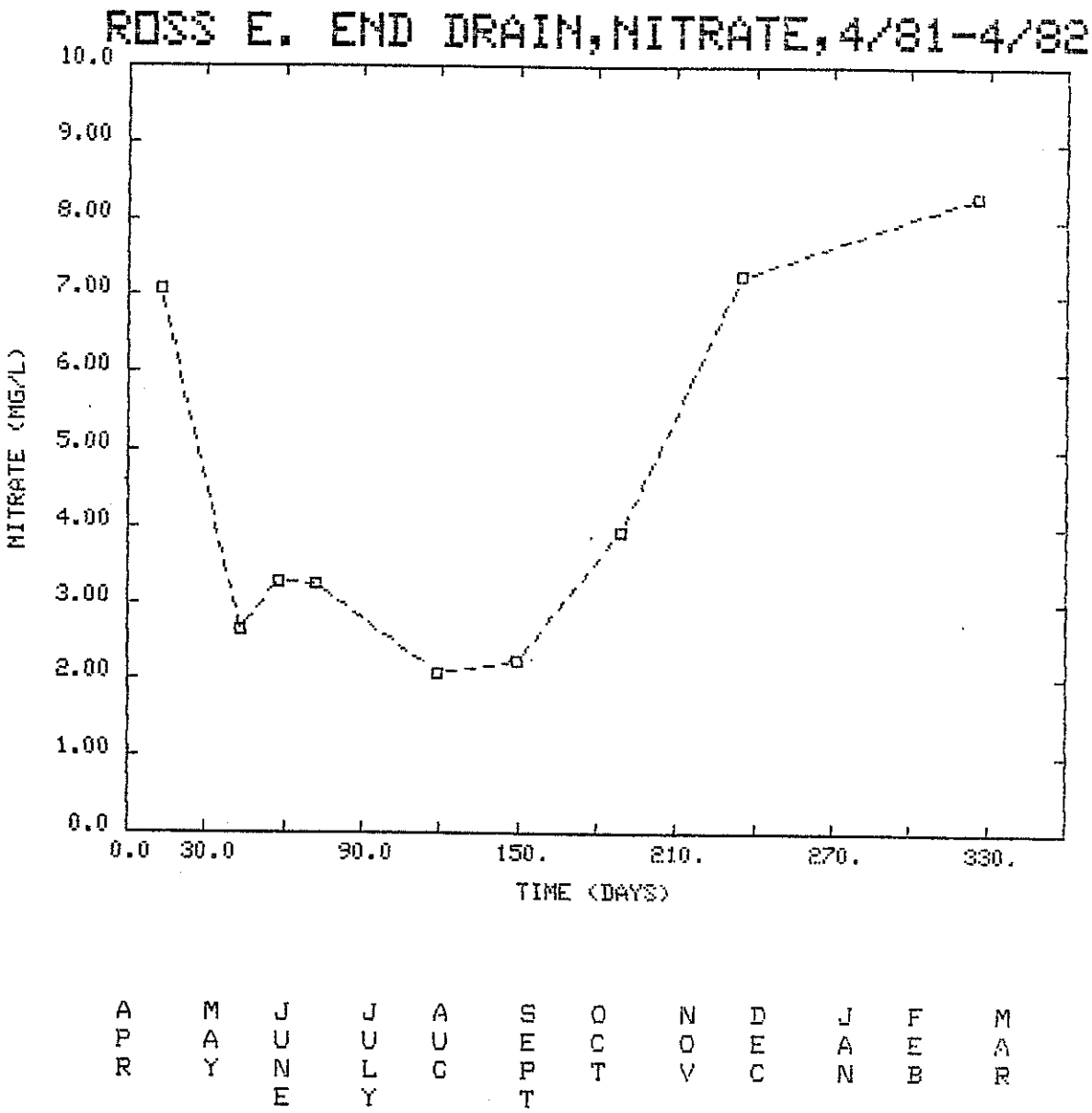
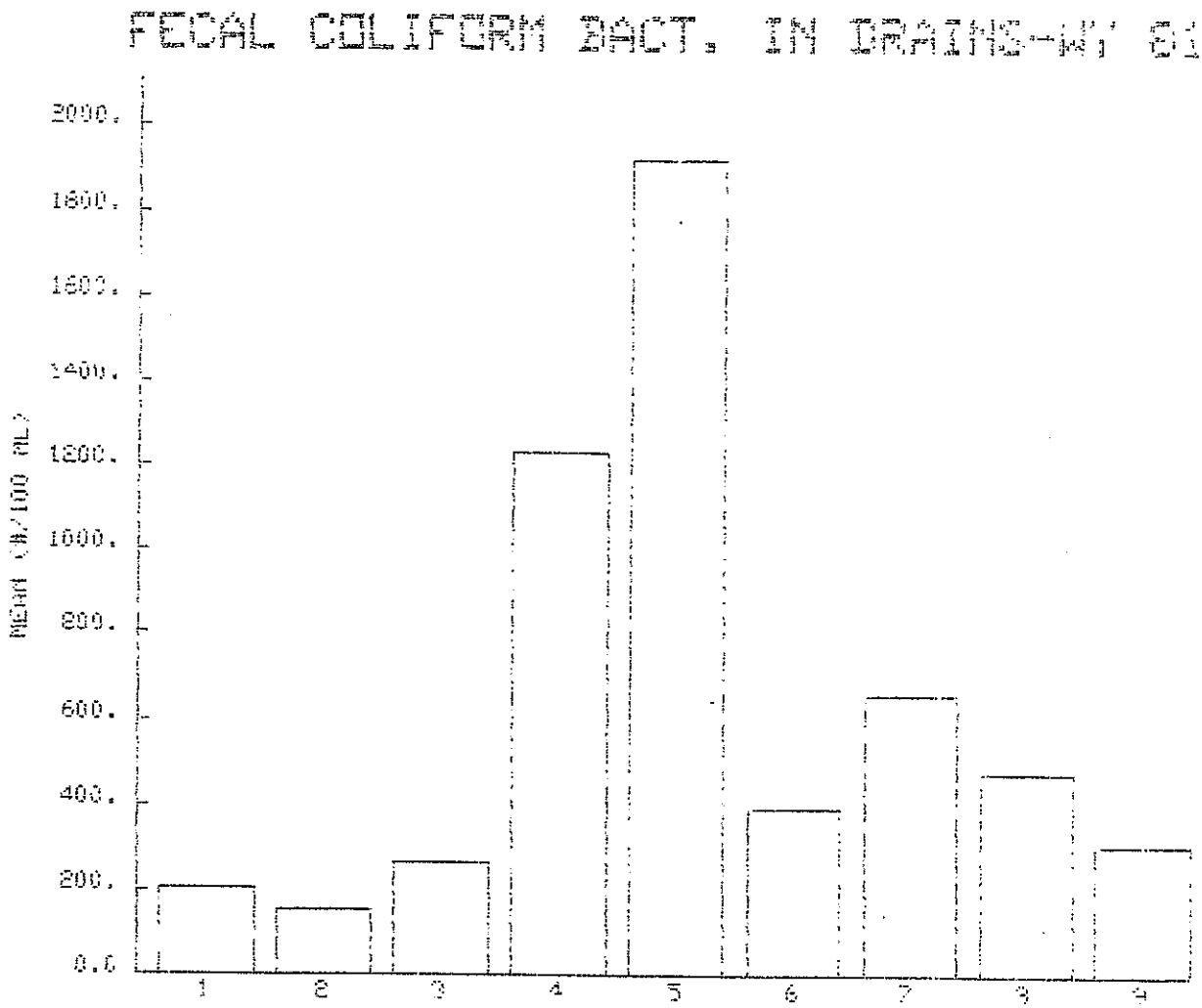
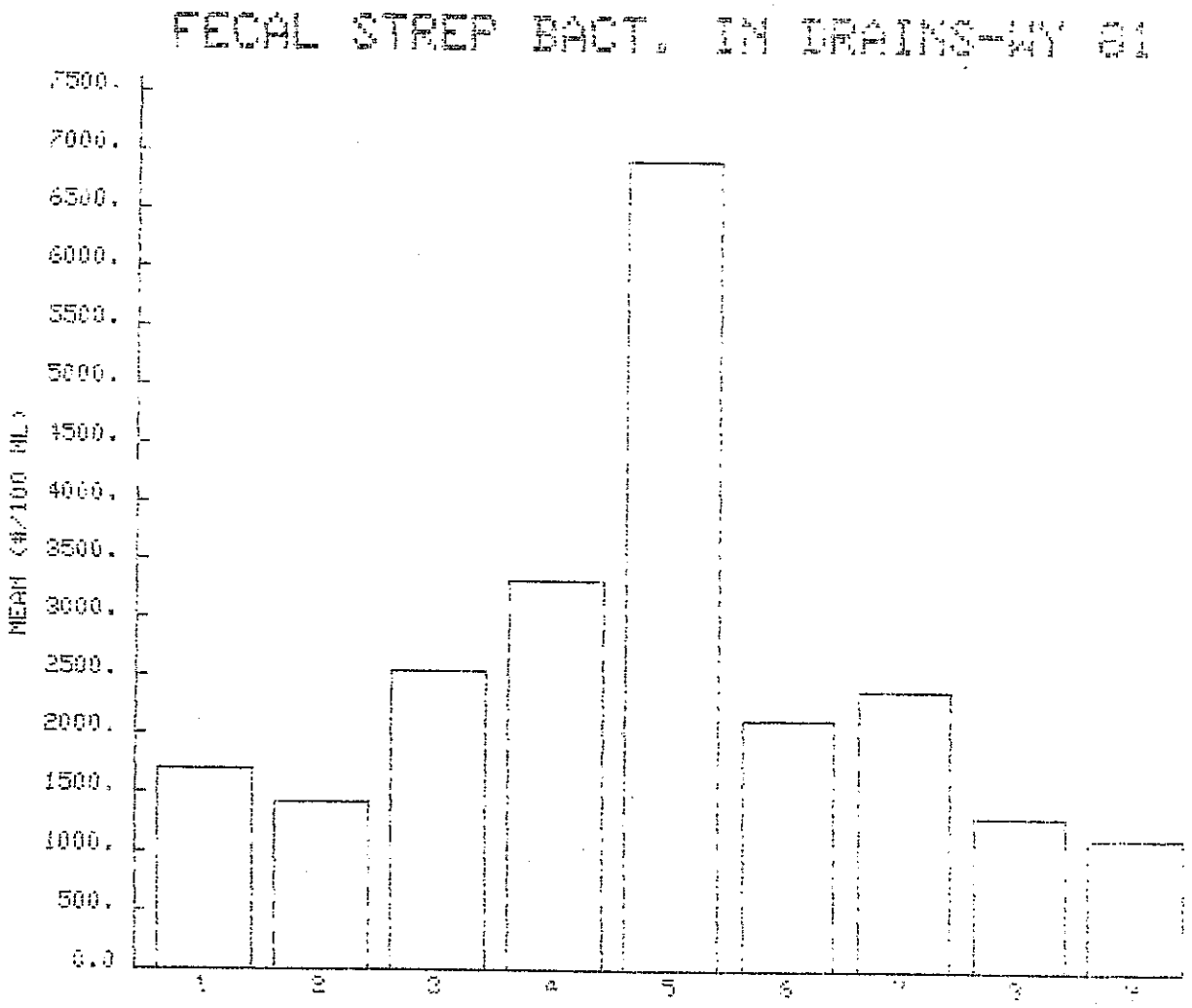


Figure 17. Nitrate Concentration in Ross East End Drain, April, 1981 to April, 1982.



1. Conway Gulch, Notus
2. Conway Gulch at Stafford Road
3. Conway Gulch at Hwy 30
4. Parma Drain
5. West End Drain above Renshaw
6. West End Drain at Farmway Road
7. Ross East End Drain
8. South Boise Drain
9. Sand Hollow Drain at Hwy 20/26

Figure 18. Fecal Coliform Bacteria in Drains - WY 1981.



1. Conway Gulch, Notus
2. Conway Gulch at Stafford Road
3. Conway Gulch at Hwy 30
4. Parma Drain
5. West End Drain above Renshaw
6. West End Drain at Farmway Road
7. Ross East End Drain
8. South Boise Drain
9. Sand Hollow Drain at Hwy 20/26

Figure 19. Fecal Streptococcus Bacteria in Drains - WY 1981.

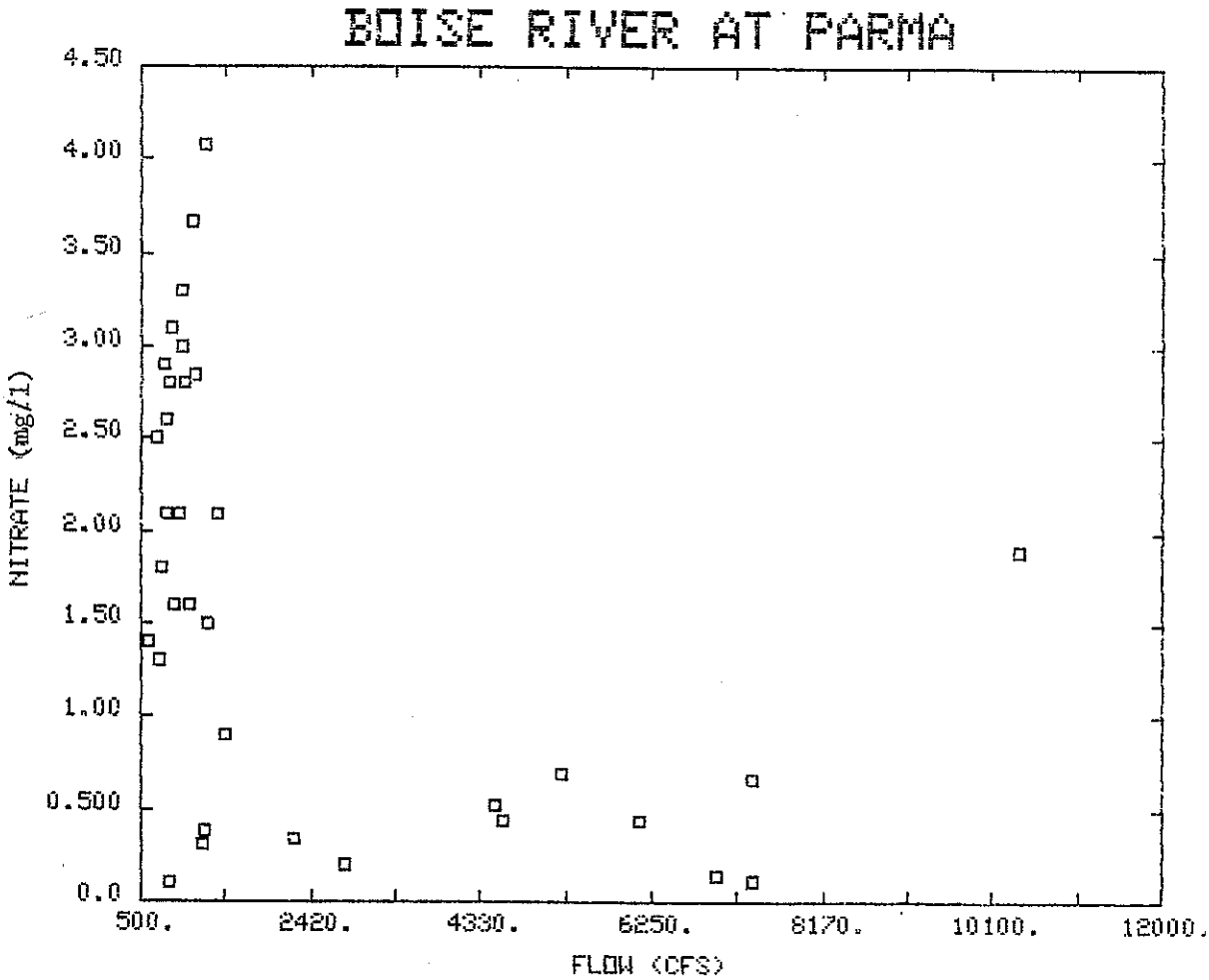


Figure 20. Nitrates in Boise River at Parma, November, 1979 to September, 1982.

APPENDIX A - Textural Analysis of
Bedload Sediment Samples.

TABLE A-1. TEXTURAL ANALYSIS (weight in Grams) of BEDLOAD SEDIMENT FOR SAND HOLLOW DRAIN (Continued) IRRIGATION SEASON, WY 1980.

	SAMPLE STATION At Highway 20/26					
PARAMETERS	Weight(g) June	% of Tot. Weight	Weight(g) July	% of Tot. Weight	Weight(g) August	% of Tot. Weight
Dry Weight (g) -	1505		319		1400	
Ash Weight (g) -	0.0		1.0	< 1 %	50	3.6%
Sieve Size (wgt. in (g))						
#20 (very coarse sand) -	762	48.5%	136	42.6%	562	40.1%
#35 (coarse sand) -	507	32.3%	95.7	30 %	477	34.1%
#60 (medium sand) -	286	18.2%	79.8	25 %	293	21 %
#140 (very fine sand) -	14.0	< 1 %	6.45	2 %	20.4	1.4%
#200 (silt) -	.254	< 1 %	.072	< 1 %	.304	< 1 %
Past #200 (clay) -	1.08	< 1 %	.172	< 1 %	.447	< 1 %

TABLE A-1. TEXTURAL ANALYSIS (weight in grams) OF BEDLOAD SEDIMENT FOR SAND HOLLOW DRAIN - IRRIGATION SEASON, WY 1980.

SAMPLE STATIONS

PARAMETERS	At Highway 30						At Sebree Canal					
	Wgt.(g) June	% of Tot. Weight	Wgt. (g) July	% of Tot. Weight	Wgt.(g) Aug.	% of Tot. Weight	Wgt.(g) June	% of Tot. Weight	Wgt.(g) July	% of Tot. Weight	Wgt.(g) Aug.	% of Tot. Weight
Dry Weight (g) -	467		404		95.9		2375		1675		434	
Ash Weight (g) -	1.50	< 1 %	1.25	< 1 %	.550	< 1%	0.0	< 1 %	0.0	< 1 %	1.80	< 1%
Sieve Size (wgt. in (g))												
#20 (very coarse sand) -	183	39.2%	65.3	16.2%	16.5	17.2%	1309	55 %	676	40.3%	193	44.5%
#35 (coarse sand) -	141	30.2%	189	46.8%	31.7	33 %	641	26.9%	619	37 %	109	25.1%
#60 (medium sand) -	127	27.2%	140	34.6%	40.4	42.1%	439	18.5%	359	21.4	120	27.6%
#140 (very fine sand) -	11.1	2.4%	5.61	1.4%	5.43	5.7%	18.2	< 1 %	20.1	1.2%	10.0	2.3%
#200 (silt) -	.435	< 1 %	.270	< 1 %	0.676	< 1 %	.394	< 1 %	.559	< 1 %	.177	< 1 %
Past #200 (clay) -	2.32	< 1 %	1.07	< 1 %	.398	< 1 %	1.51	< 1 %	1.18	< 1 %	.338	< 1 %

TABLE A-1. TEXTURAL ANALYSIS (weight in grams) OF BEDLOAD SEDIMENT FOR SAND HOLLOW DRAIN AND PARMA DRAIN DURING IRRIGATION SEASON, WY 1980. (Continued)

	SAND HOLLOW at MOUTH						PARMA DRAIN MOUTH			
PARAMETERS	Weight (g) June	% of Total Weight	Weight (g) July	% of Total Weight	Weight (g) August	% of Total Weight	Weight (g) June	% of Total Weight	Weight (g) July	% of Total Weight
Dry Weight (g) -	533		64		1225		236		13.8	
Ash Weight (g) -	2.05	< 1%	.434	< 1%	0.0		1.8	< 1%	.677	4.9%
Sieve Size (wgt. in (g))										
#20 (very coarse sand) -	231	43.3%	19.0	29.7%	432	35%	23.4	9.9%	1.87	13.6%
#35 (coarse sand) -	163	30.6%	15.6	24.4%	417	34%	64.1	27.2%	3.74	17.2%
#60 (medium sand) -	120	22.5%	24.7	38.6%	364	29%	132	56 %	6.08	44 %
#140 (very fine sand) -	15.9	3.0%	3.92	6.1%	27.6	2.2%	13.3	5.6%	1.72	12.5%
#200 (silt) -	.274	< 1 %	.053	< 1 %	.593	< 1 %	.396	< 1 %	.115	< 1 %
Past #200 (clay) -	.481	< 1 %	.090	< 1 %	.742	< 1 %	1.33	< 1 %	.207	1.5%

TABLE A-2. TEXTURAL ANALYSIS OF BEDLOAD SEDIMENT FOR THE DRAINS ON THE SOUTH SIDE OF THE BOISE RIVER - WY 1980-1981.

WEIGHT IN GRAMS

PARAMETERS	So. Boise Dr., Mouth	% of Tot. Weight	South Dr., Mouth	% of Tot. Weight	North Dr., Dixie Rd.	% of Tot. Weight	North Dr., Mouth	% of Tot. Weight	Mammon Gulch, Mouth June 1980	% of Tot. Weight	Mammon Gulch, Mouth July 1980	% of Tot. Weight
Dry Weight (g)	18.4		4.94		1.055		216		28.4		205	
Ash Weight (g)	0.380	2	0.085	2	0.209	20	1.05	0.5	1.37	5	2.6	1
Sieve Size (wgt. in (g))												
#20 (very coarse sand) -	1.63	9	0.233	5	0.076	7	3.50	2	9.48	33	119	58
#35 (coarse sand) -	5.09	28	0.945	19	0.176	17	51.6	24	5.47	19	34.8	17
#60 (medium sand) -	8.25	45	2.62	53	0.457	43	147	68	9.92	35	37.7	18
#140 (very fine sand) -	1.93	10	0.684	14	0.105	10	10.5	5	1.56	5	7.72	4
#200 (silt) -	0.333	2	0.099	2	0.009	1	0.430	< 1	0.146	1	0.732	< 1
Past #200 (clay) -	0.605	4	0.216	5	0.015	2	0.939	< 1	0.287	2	2.11	1

PARAMETERS	Dixie Drain, Mouth	% of Total Weight	Renshaw Canal, Mouth June 1980	% of Total Weight	Renshaw Canal, Mouth July 1980	% of Total Weight	Renshaw Canal, Mouth Aug. 1980	% of Total Weight
Dry Weight (g)	6.87		88.7		122		61.6	
Ash Weight (g)	0.931	14	0.775	1	2.55	2	0.465	1
Sieve Size (wgt. in (g))								
#20 (very coarse sand) -	0.670	10	2.74	3	7.19	6	8.78	14
#35 (coarse sand) -	1.02	15	27.3	31	31.9	26	19.9	32
#60 (medium sand) -	3.09	45	54.5	61	68.4	56	30.0	49
#140 (very fine sand) -	0.823	13	2.71	3	10.5	9	2.26	3
#200 (silt) -	0.081	1	0.079	< 1	0.478	< 1	0.068	< 1
Past #200 (clay) -	0.111	2	0.161	1	0.950	1	0.168	< 1

TABLE A-3. TEXTURAL ANALYSIS OF BEDLOAD SEDIMENT FOR THE DRAINS ON THE NORTH SIDE OF THE BOISE RIVER - APRIL 1981.

PARAMETERS	SAMPLE STATION #1 - Notus Conway Gulch	% of Total Weight	SAMPLE STATION #2 Stafford Road Conway Gulch	% of Total Weight	SAMPLE STATION #3 Parma Drain	% of Total	SAMPLE STATION #4 - Sand Hollow Drain @ Hwy 20/26	% of Total Weight
		WEIGHT	IN	GRAMS				
Dry Weight (g) -	7.46		276.0		5.42		166	
Ash Weight (g) -	0.216	3%	1.20	< 1%	0.064	1.18%	0.850	0.051%
Sieve Size (wgt. in (g))								
#20 (very coarse sand) -	1.08	14%	76.1	28%	1.05	19.37%	52.0	31.32%
#35 (coarse sand) -	1.80	24%	88.4	32%	1.74	32.1%	57.9	34.89%
#60 (medium sand) -	4.11	55%	103.0	37%	2.32	42.8%	51.7	31.14%
#140 (very fine sand) -	0.220	3%	6.37	2%	0.227	4.2%	3.19	1.92%
#200 (silt) -	0.010	< 1%	0.108	< 1%	0.004	< 1 %	0.082	< 1 %
Past #200 (clay) -	0.029	< 1%	0.164	< 1%	0.010	< 1 %	0.192	< 1 %

APPENDIX B - Trace Organic (Pesticide) Residues in Fish

TABLE B-1. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM SAND HOLLOW DRAIN, MOUTH
(mg/kg, wet weight)

SPECIES:	Carp	Large Scale Sucker	Brown Bullhead
DATE:	10/28/80	10/28/80	10/28/80
WEIGHT (g):	-	-	-
Lipid Content (%):	2.0	1.3	1.3
Total PCB's (1,254)	0.030	0.033	0.030
PCB (1,260)	0	0	0
Aldrin	0	0	0
Dieldrin	0.017	0	0
Total DDT & Analogs	0.945	0.760	1.094
o.p. DDE	0	0	0
p.p' DDE	0.849	0.556	0.810
o.p. DDD	0	0	0
p.p' DDD	0.066	0.138	0.140
o.p. DDT	0	0	0
p.p' DDT	0.030	0.066	0.144
Endrin	0	0	0
Methoxyclor	0	0	0
Hexachlorobenzene	0.005	0.033	0.001
Pentachlorophenol	0	0	0
Total Chlordane	0	0	0
cis is. of chlordane	0	0	0
trans is of chlordane	0	0	0
cis is. of nonachlor	0	0	0
trans is. of chlordane	0	0.036	0.038
Hexachlorocyclohexane alpha BHC isomer	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0
Toxaphene	0.671	0.540	0.516
Dacthal	0	0	0

0 Value less than 0.001 mg/kg detection limit.

TABLE B-2. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM PARMA DRAIN, MOUTH
(mg/kg, wet weight)

SPECIES:	Large Scale Sucker	Redside Shiners	Carp	Chiselmouth
DATE:	11/25/81	03/22/82	11/25/81	11/25/81
WEIGHT (g):	234.0	30.0	669.0	137.0
Lipid Content (%):	0.3	0.85	2.1	3.2
Total PCB's (1,254)	0.080	0.021	0	0.075
PCB (1,260)	0	0	0.097	0
Aldrin	0	0	0	0
Dieldrin	0.003	0	0.034	0.044
Total DDT & Analogs	0.601	0.267	0.279	2.699
o.p. DDE	0	0	0	0
p.p' DDE	0.346	0.244	0.279	2.699
o.p. DDD	0	0	0	0
p.p' DDD	0.063	0.022	0	0
o.p. DDT	0.039	0	0	0
p.p' DDT	0.153	0	0	0
Endrin	0	0	0	0
Methoxychlor	0	0	0	0
Hexachlorobenzene	0.002	0.001	0.007	0.015
Pentachlorophenol	0	0	0	0
Total Chlordane	0	0	0	0
cis is. of chlordane	0	0	0	0
trans is. of chlordane	0	0	0	0
cis is. of nonachlor	0	0	0	0
trans is. of nonachlor	0	0	0	0
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0
Toxaphene	1.441	0	3.344	16.970
Dacthal	0.004	0	0.008	0.025

0 Value less than 0.001 mg/kg detection limit.

TABLE B-3. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM SAND HOLLOW DRAIN, HIGHWAY 20/26
(mg/kg, wet weight)

SPECIES:	Bridgelip Sucker	Bridgelip Sucker	Bridgelip Sucker	Bridgelip Sucker
DATE:	03/23/82	03/23/82	03/22/83	03/22/82
WEIGHT (g):	461.0	494.0	492.4	863.2
Lipid Content (%):	0.3	1.9	0.98	1.64
Total PCB's (1,254)	0	0	0	0
PCB (1,260)	0	0	0	0
Aldrin	0	0	0	0
Dieldrin	0	0.004	0.002	0.005
Total DDT & Analogs	0.015	0.476	0.025	0.014
o.p. DDE	0	0	0	0
p.p' DDE	0.010	0.213	0.015	0.007
o.p. DDD	0	0	0	0
p.p' DDD	0.002	0.105	0.003	0.003
o.p. DDT	0	0.064	0	0
p.p' DDT	0.003	0.094	0.007	0.004
Endrin	0	0	0	0
Methoxychlor	0	0	0	0
Hexachlorobenzene	0	0.001	0	0
Pentachlorophenol	0	0	0	0
Total Chlordane	0	0	0	0
cis is. of chlordane	0	0	0	0
trans is. of chlordane	0	0	0	0
cis is. of nonachlor	0	0	0	0
trans is. of nonachlor	0	0	0	0
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0
Toxaphene	0	1.291	0	0
Dacthal	0	0	0	0
Heptachlor	0.001	0	0.007	0.012

0 Value less than 0.001 mg/kg detection limit.

TABLE B-3. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM SAND HOLLOW DRAIN, HIGHWAY 20/26
(mg/kg, wet weight)

SPECIES:	Rainbow Trout	Large Scale Sucker	Large Scale Sucker	Large Scale Sucker	Large Scale Sucker
DATE:	03/22/82	03/22/82	03/22/82	03/22/82	03/22/82
WEIGHT (g):	345.0	875.0	1,479.0	1,124.0	111.0
Lipid Content (%):	0.2	2.3	2.2	1.6	0.68
Total PCB's (1,254)	0	0	0	0	0.017
PCB (1,260)	0	0	0	0.031	0
Aldrin	0	0	0	0	0
Diedrin	0	0.010	0.003	0.005	0
Total DDT & Analogs	0.013	0.368	0.346	0.335	0.016
o.p. DDE	0	0	0	0	0
o.p' DDE	0.013	0.247	0.223	0.246	0.016
o.p. DDD	0	0	0	0	0
p.p' DDD	0	0.024	0.023	0.012	0
o.p. DDT	0	0.010	0.020	0.010	0
p.p' DDT	0	0.087	0.080	0.067	0
Endrin	0	0	0	0	0
Methoxychlor	0	0	0	0	0
Hexachlorobenzene	0	0.001	0.001	0.001	0
Pentachlorophenol	0	0	0	0	0
Total Chlordane	0	0	0	0	0
cis is. of chlordane	0	0	0	0	0
trans is. of chlordane	0	0	0	0	0
cis is. of nonachlor	0	0	0	0	0
trans is. of nonachlor	0	0.007	0.009	0.006	0
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0	0
Toxaphene	0	0	0	0	0
Dacthal	0	0	0	0	0

0 Value less than 0.001 mg/kg detection limit.

TABLE B-3. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM SAND HOLLOW DRAIN, HIGHWAY 20/26
(mg/kg, wet weight)

SPECIES:	Large Scale Sucker	Large Scale Sucker	Bridgelip Sucker	Bridgelip Sucker	Bridgelip Sucker
DATE:	03/22/82	03/22/82	03/22/82	03/22/82	03/22/82
WEIGHT (g):	1,032.0	1,099.0	339.9	64.0	58.0
Lipid Content (%):	1.2	2.1	1.66	2.0	2.0
Total PCB's (1,254)	0	0	0	0	0
PCB (1,260)	0.022	0	0	0	0
Aldrin	0	0	0	0	0
Dieldrin	0.002	0.007	0.009	0	0
Total DDT & Analogs	0.340	0.224	0.033	0.012	0.016
o.p. DDE	0	0	0	0	0
p.p' DDE	0.282	0.108	0.021	0.012	0.016
o.p. DDD	0	0	0	0	0
p.p' DDD	0.006	0.016	0.003	0	0
o.p. DDT	0.004	0.015	0.001	0	0
p.p' DDT	0.048	0.085	0.009	0	0
Endrin	0	0	0	0	0
Methoxychlor	0	0	0	0	0
Hexachlorobenzene	0	0.001	0	0	0
Pentachlorophenol	0	0	0	0	0
Total Chlordane	0	0	0	0	0
cis is. of chlordane	0	0	0	0	0
trans is. of chlordane	0	0	0	0	0
cis is. of nonachlor	0	0	0	0	0
trans is. of nonachlor	0.001	0.006	0	0	0
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0	0
Toxaphene	0	0	0	0	0
Dacthal	0	0	0	0	0

0 Value less than 0.001 mg/kg detection limit.

TABLE B-4. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM DIXIE DRAIN, MOUTH
(mg/kg, wet weight)

SPECIES:	Small Mouth Bass	Large Scale Sucker	Brown Bullhead
DATE:	10/28/80	10/28/80	10/28/80
WEIGHT (g):	-	-	-
Lipid Content (%):	2.2	1.1	1.5
Total PCB's (1,254)	0	0	0
PCB (1,260)	0.050	0.144	0.009
Aldrin	0	0	0
Dieldrin	0.005	0.010	0.003
Total DDT & Analogs	0.331	1.295	0.080
o.p. DDE	0	0	0
p.p' DDE	0.259	0.997	0.069
o.p. DDD	0	0	0
p.p' DDD	0.028	0.089	0.008
o.p. DDT	0	0.041	0
p.p' DDT	0.044	0.168	0.003
Endrin	0	0	0
Methoxychlor	0	0	0
Hexachlorobenzene	0.001	0	0.001
Pentachlorophenol	0	0	0
Total Chlordane	0	0	0
cis is. of chlordane	0	0	0
trans is. of chlordane	0	0	0
cis is. of nonachlor	0	0	0
trans is. of nonachlor	0.037	0.077	0.010
Hexachlorocyclohexane alpha BHC isomer	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0
Toxaphene	0.204	0.374	0.068
Dacthal	0.003	0	0.001

0 Value less than 0.001 mg/kg detection limit.

TABLE B-5. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM DIXIE DRAIN, GUESS GULCH
(mg/kg, wet weight)

SPECIES:	Chisel-mouth	Chisel-mouth	Chisel-mouth	Bridgelip Sucker	Carp	Lg. Scale Sucker	Lg. Scale Sucker	Lg. Scale Sucker	Lg. Scale Sucker	Lg. Scale Sucker
DATE:	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82
WEIGHT (g):	87.5	51.0	151.0	22.5	1,518.0	1,040.0	982.0	568.0	554.0	1,062.0
Lipid Content (%):	0.8	0.4	1.00	2.2	0.2	2.07	2.79	5.26	1.6	3.06
Total PCB's (1,254)	0	0	0	0	0	0.026	0.028	0.014	0.011	0.073
PCB (1,260)	0	0	0	0	0.035	0	0	0	0	0
Aldrin	0	0	0	0	0	0	0	0	0	0
Dieldrin	0.001	0	0.001	0.001	0.004	0.014	0.009	0.009	0.007	0.034
Total DDT & Analogs	0.056	0.015	0.026	0.118	0.111	0.238	0.456	0.193	0.097	0.464
o.p. DDE	0	0	0	0	0	0	0	0	0	0
p.p' DDE	0.050	0.011	0.023	0.018	0.097	0.168	0.235	0.154	0.065	0.351
o.p. DDD	0	0	0	0	0	0	0	0	0	0
p.p' DDD	0.006	0.004	0.003	0	0.014	0.038	0.100	0.038	0.016	0.053
o.p. DDT	0	0	0	0	0	0	0.033	0	0	0
p.p' DDT	0	0	0	0	0	0.032	0.088	0.001	0.016	0.060
Endrin	0	0	0	0	0	0	0	0	0	0
Methoxychlor	0	0	0	0	0	0	0	0	0	0
Hexachlorobenzene	0	0	0	0	0.001	0.006	0.001	0.001	0.006	0.050
Pentachlorophenol	0	0	0	0	0	0	0	0	0	0
Total Chlordane	0	0	0	0	0	0	0	0	0	0
cis is. of chlordane	0	0	0	0	0	0	0	0	0	0
trans is. of chlordane	0	0	0	0	0	0	0	0	0	0
cis is of nonachlor	0	0	0	0	0	0	0	0	0	0
trans is. of nonachlor	0	0	0	0	0	0.005	0.012	0.005	0.003	0.012
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0	0	0	0	0.001	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0	0	0	0	0	0	0
Toxaphene	0	0	0	0	0	0.213	0.393	0.398	0	0
Dacthal	0	0	0	0	0	0	0	0	0	0

0 Value less than 0.001 mg/kg detection limit.

TABLE B-6. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM DIXIE DRAIN, SUPER LATERAL ROAD
(mg/kg, wet weight)

SPECIES:	Bridgelip Sucker	Bridgelip Sucker	Bridgelip Sucker	Bridgelip Sucker
DATE:	03/23/82	03/23/82	03/23/82	03/23/82
WEIGHT (g):	155.0	181.0	33.0	151.0
Lipid Content (%):	0.1	1.13	1.6	0.65
Total PCB's (1,254)	0	0	0	0
PCB (1,260)	0	0	0	0
Aldrin	0	0	0	0
Dieldrin	0	0.004	0.006	0.003
Total DDT & Analogs	0.009	0.049	0.128	0.042
o.p. DDE	0	0	0.001	0
p.p' DDE	0.004	0.031	0.062	0.032
o.p. DDD	0	0	0.001	0
p.p' DDD	0.003	0.012	0.033	0.011
o.p. DDT	0	0	0.001	0
p.p' DDT	0.002	0.006	0.033	0.009
Endrin	0	0	0	0
Methoxychlor	0	0	0	0
Hexachlorobenzene	0	0	0	0
Pentachlorophenol	0	0	0	0
Total Chlordane	0	0	0	0
cis is. of chlordane	0	0	0	0
trans is. of chlordane	0	0	0	0
cis is. of nonachlor	0	0	0	0
trans is. of nonachlor	0	0	0.004	0.001
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0
Toxaphene	0	0	0	0
Dacthal	0	0	0	0

0 Value less than 0.001 mg/kg detection limit.

TABLE B-7. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM WEST END DRAIN, ABOVE RENSHAW
(mg/kg, wet weight)

SPECIES:	Yellow Perch	Yellow Perch	Bridgelip Sucker	Bridgelip Sucker	Bridgelip Sucker
DATE:	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82
WEIGHT (g):	52.0	27.0	336.0	396.5	225.6
Lipid Content (%):	0.2	0.44	3.4	0.95	1.12
Total PCB's (1,254)	0	0	0	0.007	0.010
PCB (1,260)	0	0	0.031	0	0
Aldrin	0	0	0	0	0
Dieldrin	0	0.001	0.031	0.002	0.002
Total DDT & Analogs	0.002	0.108	0.090	0.093	0.105
o.p. DDE	0	0	0	0	0
p.p' DDE	0.002	0.087	0.050	0.051	0.070
o.p. DDD	0	0	0	0	0
p.p' DDD	0	0.012	0.011	0.017	0.015
o.p. DDT	0	0.002	0.006	0	0.001
p.p' DDT	0	0.007	0.023	0.025	0.019
Endrin	0	0	0	0	0
Methoxychlor	0	0	0	0	0
Hexachlorobenzene	0	0	0.009	0	0
Pentachlorophenol	0	0	0	0	0
Total Chlordane	0	0	0	0	0
cis is. of chlordane	0	0	0	0	0
trans is. of chlordane	0	0	0	0	0
cis is. of nonachlor	0	0	0	0	0
trans is. of nonachlor	0	0.002	0.004	0.004	0.003
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0	0
Toxaphene	0	0	0	0	0
Dacthal	0	0	0	0	0
Oxychlordane			0.003	0	0
Heptachlor	0	0	0	0.002	0

0 Value less than 0.001 mg/kg detection limit.

TABLE B-7. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM WEST END DRAIN, ABOVE RENSHAW
(mg/kg , wet weight)

SPECIES:	Bridgelip Sucker	Bridgelip Sucker	Carp	Carp	Carp	Carp
DATE:	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82	03/23/82
WEIGHT (g):	257.6	370.0	2,096.0	1,197.0	1,410.0	580.0
Lipid Content (%):	1.5	1.5	4.93	2.32	2.78	3.93
Total PBC's (1,254)	0.009	0	0.056	0.026	0.027	0.072
PCB (1,260)	0	0.011	0	0	0	0
Aldrin	0	0	0	0	0	0
Dieldrin	0.005	0.007	0.075	0.028	0.039	0.055
Total DDT & Analogs	0.252	0.191	0.572	0.185	0.504	0.559
o.p. DDE	0	0	0	0	0	0
p.p' DDE	0.141	0.104	0.471	0.132	0.504	0.463
o.p. DDD	0	0	0	0	0	0
p.p' DDD	0.040	0.038	0.065	0.022	0	0
o.p. DDT	0.011	0.016	0	0	0	0
p.p' DDT	0.060	0.033	0.036	0.031	0	0.096
Endrin	0	0	0	0	0	0
Methoxychlor	0	0	0	0	0	0
Hexachlorobenzene	0	0.002	0.002	0.003	0.003	0.002
Pentachlorophenol	0	0	0	0	0	0
Total Chlordane	0	0	0	0	0	0
cis is. of chlordane	0	0	0	0	0	0
trans is. of chlordane	0	0	0	0	0	0
cis is. of nonachlor	0	0	0	0	0	0
trans is. of nonachlor	0.004	0.019	0.025	0	0	0.036
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0	0	0
Toxaphene	0.295	0.376	1.600	0	0.840	2.829
Dacthal	0	0	0	0	0	0
Heptachlor Epoxide	0	0.001	0	0	0	0

0 Value less than 0.001 mg/kg detection limit.

TABLE B-8. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM SOUTH BOISE DRAIN, SCOTT PITT ROAD
(mg/kg, wet weight)

SPECIES:	Carp	Carp	Carp	Carp	Carp
DATE:	03/22/82	03/22/82	03/22/82	03/22/82	03/22/82
WEIGHT (g):	430.0	432.0	226.0	81.0	277.0
Lipid Content (%):	0.814	0.66	0.62	0.35	0.4
Total PCB's (1,254)	0	0	0	0	0
PCB (1,254)	0	0	0	0	0
Aldrin	0	0	0	0	0
Dieldrin	0.001	0	0.001	0	0
Total DDT & Analogs	0.098	0.146	0.060	0.020	0.095
o.p. DDE	0	0	0	0	0
p.p' DDE	0.080	0.133	0.049	0.016	0.075
o.p. DDD	0	0	0	0	0
p.p' DDD	0.016	0.011	0.009	0.003	0.020
o.p. DDT	0	0	0	0	0
p.p' DDT	0.002	0.002	0.002	0.001	0
Endrin	0	0	0	0	0
Methoxychlor	0	0	0	0	0
Hexachlorobenzene	0	0	0	0	0.001
Pentachlorophenol	0	0	0	0	0
Total Chlordane	0	0	0	0	0
cis is. of chlordane	0	0	0	0	0
trans is. of chlordane	0	0	0	0	0
cis is. of nonachlor	0	0	0	0	0
trans is. of nonachlor	0.002	0.002	0.002	0	0.002
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0	0
Toxaphene	0	0	0	0	0
Dacthal	0	0	0	0	0

0 Value less than 0.001 mg/kg detection limit.

TABLE B-9. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH FROM ROSS EAST END DRAIN, HIGHWAY 95
(mg/kg, wet weight)

SPECIES:	Redside Shiners	Tui Chub
DATE:	03/23/82	03/23/82
WEIGHT (g):	17.0	32.0
Lipid Content (%):	0.96	0.18
Total PCB's (1,254)	0.007	0
PCB (1,260)	0	0
Aldrin	0	0
Dieldrin	0.004	0.001
Total DDT & Analogs	0.559	0.079
o.p. DDE	0	0
p.p' DDE	0.529	0.071
o.p. DDD	0	0
p.p' DDD	0.030	0.006
o.p. DDT	0	0.002
p.p' DDT	0	0
Endrin	0	0
Methoxyclor	0	0
Hexachlorobenzene	0	0
Pentachlorophenol	0	0
Total Chlordane	0	0
cis is. of chlordane	0	0
trans is. of chlordane	0	0
cis is. of nonachlor	0	0
trans is. of nonachlor	0.005	0.001
Hexachlorocyclohexane alpha BHC isomer	0	0
Hexachlorocyclohexane gamma isomer	0	0
Toxaphene	0	0
Dacthal	0	0
Heptachlor	0.003	0
Heptachlor Epoxide	0.001	0

0 Value less than 0.001 mg/kg detection limit.

APPENDIX C - Linear Regression of DDT and Toxaphene Residues in Fish

APPENDIX C. LINEAR REGRESSION OF DDT AND TOXAPHENE RESIDUES IN FISH TO WEIGHT OF FISH AND LIPID CONTENT

	Variable	Mean	Standard Deviation	Correlation(r) X vs. Y	Regression Coefficient(m)	Multiple Correlation
			SAND HOLLOW DRAIN (N=18)			
X	Weight(g)	550.38	437.67	-0.119	0	
X	Lipid(%)	1.51	0.82	0.526*	0.445	0.585
Y	DDT(mg/kg)	0.34	0.62			
			LOWER BOISE DRAINS, INCLUDES SAND HOLLOW (N=50)			
X	Weight(g)	498.11	488.87	0.142	0	
X	Lipid(%)	1.54	1.20	0.399**	0.144	0.403
Y	DDT(mg/kg)	0.23	0.40			
			LOWER BOISE DRAINS, INCLUDES SAND HOLLOW (N=18)			
X	Lipid(%)	2.31	1.31	0.218 N.S.	0.647	
Y	Toxaphene (mg/kg)	1.80	3.89			

*=5% level of significance
**=1% level of significance
N.S.=Not significant