WATER QUALITY STATUS REPORT

CONWAY GULCH

CANYON COUNTY, IDAHO

REPORT BY:

WILLIAM H. CLARK

and

STEPHEN B. BAUER

1982

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

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ABSTRACT

The Division of Environment (DOE) conducted a water quality survey of Conway Gulch, Canyon County, Idaho, from April, 1981, through March, 1982. A total of 12,880 critical erosion acres are included in the drainage area of Conway Gulch. Baseline suspended sediment loadings for the mouth of Conway Gulch at Notus were 6,083 tons for an available data base of six years. Suspended sediment was 4,411 tons for the period of this study and bedload sediment was 1,016 tons for a total sediment load of 5,247 tons at Notus. Conway Gulch discharged 9.8 tons of total phosphorus (fifty percent directly attributed to agriculture) and 110 tons of inorganic nitrogen (twenty-one percent directly attributed to agriculture) to the Lower Boise River during this study. The pesticides DDT and toxaphene were found in significant amounts in fish tissue (highs of 1.031 and 4.679 mg/kg respectively). Bridgelip suckers, chiselmouth chubs and rainbow trout were found in Conway Gulch but at low numbers.

INTRODUCTION

AREA DESCRIPTION

Conway Gulch (also known as Conway Drain) is located on the north side of the Boise River and flows through Notus from the northeast to the southwest where it enters the river at about river mile fourteen. It is located in northern Canyon County, Idaho, west of Boise. The irrigation water for the land around Conway Gulch comes from several sources. The Black Canyon Irrigation District administers the water from the "C" Line Canal which originates from the Payette River (Black Canyon Reservoir) just east of Emmett and feeds the upper section of Conway Gulch. The middle portion of the Gulch is fed by the Notus Canal which originates from the southeast near Caldwell and contains both groundwater flow and other irrigation return flows. The irrigation water for the lower portion of the Gulch originates at the Boise River at Caldwell and flows to the area in the Farmer's Cooperative Sebree Canal.

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, described in a general manner, are as follows: Station #1 (Notus) lies in the Greenleaf-Nyssaton-Garbutt Association consisting of well drained silt loams on lake terraces and alluvial fans; Station #3 (Highway 30) is in the Elijah-Lankbush-Vickery Association consisting of well drained silt loams to sandy loams on high uplands; and Station #2 (Stafford Road) lies on the border between these two soil types (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 the groundwater quality and flow for the area just east (upstream) of the Conway Gulch region. 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. 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 the mouth of Conway Gulch. Groundwater quality data as well as drain water quality data were 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 the mouth of Conway Gulch.

In Water Year 1980, the Division of Environment conducted an intensive survey on Sand Hollow Drain and Dixie Drain. The remaining drains within the project area for which data was needed include Parma Drain, West End Drain, Ross East End Drain, and South Boise Drain, and were sampled during Water Year 1981. These data are reported in Clark and Bauer (1983). The results of the water quality survey on Conway Gulch are reported in the present paper.

STUDY PURPOSE AND OBJECTIVES

The monitoring data are to be used by the Division of Environment (DOE) and land management agencies (SCS, SCD) to identify severe pollutant loading areas or sub-drainages along the drains, and to provide background data for grant applications for implementation of Best Management Practices. As part of this study, the U.S. Bureau of Reclamation (BOR) sampled the mouths of selected drains at three locations on the Boise River monthly.

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 below Caldwell in Canyon County was rated as first priority. The Canyon Soil Conservation District has identified their project area within the county as part of the Planning For Implementation of the 208 Project. The land area involved in the Conway Gulch project is 18,220 acres and, of this, there is a net critical acreage for erosion of 12,880 (Glen Nielson, Canyon Soil Conservation District, personal communication). The 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.

Recently, the Lower Boise River Project 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 northeast of Caldwell in Canyon County (see Figures 1 and 2). Information in this report can be used as baseline data to which changes in water quality associated with the State grant can be compared.

MATERIALS AND METHODS

The sample stations chosen to represent Conway Gulch are as follows: (See

Figure 2 for locations).

STATION #1: Conway Gulch, at Highway 20/26 in Notus. Mouth station. Latitude 43° 43' 35" N; Longitude 116° 15" W; River mile 324.3/391.3/14.5/1.0; Elevation 2,308 feet (704 meters); STORET # 2040326.

STATION #2: Conway Gulch, at Stafford Road. Middle station. Latitude 43° 45' 05" N; Longitude 116° 45' 10" W; River mile .../4.4; Elevation 2,380 feet (726 meters); STORET #2040327.

STATION #3: Conway Gulch, at Highway 30. Upper station. Latitude 43° 46' 10" N; Longitude 116° 42' 25" W; River mile .../7.4; Elevation 2,437 feet (743 meters); STORET #2040328.

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. Subsamples 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. Samples were wrapped in aluminum foil and frozen.

Since suspended sediment is of primary concern to this study, we wanted to determine baseline conditions for Conway Gulch. Suspended sediment (SS) loadings were calculated by the following formula:

$$\text{Flow (cfs)} \times \text{SS (concentration, mg/l)} \times 0.0027 = \text{Tons SS/Day}$$

The number of days between sample dates multiplied by the daily loading in tons/day gives the interval loading (which are approximately one month apart). To remove the effect of yearly variation in flows from the calculation of baseline suspended sediment loadings, we estimated a normalized load based on six years of data. This was calculated by dividing measured load by the yearly mean flow, then multiplying by the overall mean flow of fifty (50) cfs for the six years examined.

To attempt to define the effects of irrigated agriculture on the water quality of Conway Gulch, 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). To obtain the difference between these two flow periods, the data for the base flow is subtracted from the corresponding data for the irrigation season. This is the best estimate of the agricultural contribution.

RESULTS AND DISCUSSION

SUSPENDED SEDIMENT

Suspended sediment consists of solid material, either mineral or organic, that is in suspension and is being transported by water. We have selected suspended sediment as an "indicator" or key parameter for irrigation return flows. Suspended sediment is of prime importance to both land management agencies (Soil Conservation Service and Soil Conservation Districts) and the State's Division of Environment. Obviously, if the sediment is retained on the individual farmer's fields, this meets the goals of the SCS-SCD. This in turn provides cleaner water for Conway Gulch, the Lower Boise River and downstream. The data for nutrients, trace metals, organic materials, pesticides, and bacteria are shown in Tables 5-9. Suspended sediment loadings for Conway Gulch are listed in Tables 9-14. Six years data from 1973 to 1982 were used to characterize the sediment in Conway Gulch.

BASELINE SUSPENDED SEDIMENT

There are a variety of factors which can influence the loading calculations. The main varible is probably associated with sample frequency. Increasing sample frequency increases the accuracy of the sediment loading figure by decreasing the number of days for which the data is estimated. Other factors which may influence the estimate include such things as field and laboratory methods, time of day when samples are collected, weather conditions which affect irrigation scheduling and individual farming practices.

To calculate baseline suspended sediment in Conway Gulch, six years data were used that was available from the Bureau of Reclamation and our survey. Sediment loading by year varies primarily due to the effect of discharge. To decrease the effect of yearly variations in discharge on the suspended solid baseline calculations, the measured loading for each year was adjusted to a normalized flow as shown in Table 14. The measured loading is divided by the mean flow for that irrigation season, then multiplied by the overall mean flow (50 cfs) for the six year period. This procedure was used to compensate for the extremes in discharge between water years. For example, Water Year 1980 experienced high flows (see Table 10), nearly 35 cfs above the overall mean discharge for the six years.

The baseline sediment loading for the irrigation season in Conway Drain calculated by this procedure is 6,083 tons. Sediment loadings for an irrigation season following a Best Management Practices (BMP) implementation program can be compared to this figure to gauge the success of the program in improving water quality.

BEDLOAD SEDIMENT

Bedload sediment is that sediment that is moving on or near the streambed. In Conway Gulch the bedload is made up primarily of medium to coarse sands (see Table 21).

Bedload sediment has an important influence on the aquatic life of a stream. Petran and Kothe (1978) reviewed the works of several authors who reported a decrease in abundance and number of benthic species. In Petran and Kothe's (1978) own research, they demonstrated that most macroinvertebrate species were not able to colonize areas of moving substrate. The adverse effects of granitic bedload sediment in Idaho on fish and aquatic insect populations was demonstrated by Bjornn _et al_. (1977). Hansen _et al_. (1982) and Alexander and Hansen (1982) point out the importance of sand bedload sediment to trout fisheries and have presented a method of instream removal of bedload.

Bedload sediment load was calculated by multiplying dry weight obtained in the sampler (three inch Helley-Smith), times stream width, times a factor to convert the result to tons per day as follows:

$$\underset{\text{(tons/day)}}{\text{Bedload Sediment}} = \text{grams/minute} \times \underset{\text{(feet)}}{\text{Stream Width}} \times 0.00635$$

The raw data for the samples taken are shown in Table 19. These data were then converted to total tons of bedload sediment for the irrigation season and for the non-irrigation season using the above formula (Table 20). A separate calculation of an estimated loading of bedload sediment showing only the agricultural contribution was not made since the quantity and duration of bedload storage in Conway Gulch is not known and would require a separate hydrological study. Bedload sediment may be stored as instream storage in a fluvial system for several to many years on both the stream channel bottom and in bars. The bedload sediment at Station #1 (Notus) comprised 19% of the total sediment load for the year. At Station #2 (Stafford Road) bedload was 35% of the total, and at Station #3 (Highway 30) it made up 33% of the total sediment load. These data compare to the 24-68 percent range of bedload sediment composition to the total sediment load reported in Leopold and Maddock (1953). Leopold and Maddock (1953) also state that the average bedload loading in several large rivers ranged from 49-55 percent. These large rivers may have a greater capacity to move bedload sediment.

TOTAL SEDIMENT

The total sediment load for Conway Gulch is estimated by adding the total bedload sediment and the total suspended sediment loads (Table 20). Station #1 (Notus) produced an annual total sediment load to the Lower Boise River of 5,427 tons. That is approximately one-half ton of sediment produced by each acre per year (using the 12,880 critical erosion acres described earlier). This is low compared to the average erosion rate of eight/tons/acre/year estimated by the Soil Conservation Service for this area. This difference is due to the fact that we are only measuring sediment delivered to the stream. The majority of eroded sediment is deposited at the bottom end of a field or to the delivery system. At Station #2 (Stafford Road) the total sediment yield was 3,066 tons for the year. This value gives a greater per acre sediment yield because the station is located about midway on Conway Gulch. Station #3 (Highway 30) had a total sediment yield of 1,063 tons and may more accurately define soil loss from a relatively small area.

PHYSICAL PARAMETERS

Dissolved oxygen (DO) data (in mg/l and percent saturation) for the survey are shown in Table 1. Only two violations of State standards (Idaho Department of Health and Welfare 1980a) were found (5.4 mg/l at Station #3 in June and 4.8 mg/l at Station #2 during August). Dissolved oxygen values ranged from 6.3-16.0 mg/l for Station #1; 4.8-14.0 mg/l for Station #2; and 5.4-12.0 mg/l for Station #3. Dissolved oxygen increases in a downstream order due to increased re-aeration caused by turbulance, and more aquatic plant growth (see Table 2). Generally, higher dissolved oxygen values were found during the winter (non-irrigation season) period due to lower water temperatures. Many of the summer values were relatively low (except for the July survey when the samples were collected later in the day). There are probably severe dissolved oxygen problems at night during the irrigation season in Conway Gulch. The Idaho Water Quality Standards and Wastewater Treatment Requirements (Idaho Department of Health and Welfare 1980a) protect the Lower Boise River for salmonid spawning. The standards state that a dissolved oxygen level of 6 mg/l or 75% saturation, whichever is greater must be maintained. The levels at Station #1 were always above this standard.

Water temperatures (see Table 2) ranged from 8°-19° C at Station #1; 8°-21°C at Station #2; and 8°-26°C at Station #3. The drain does not freeze and has fairly constant temperature during the winter due to groundwater inflow.

pH values in Conway Gulch were well within the State standards (Idaho Department of Health and Welfare 1980a) of 6.5-9.0 (see Table 3).

Flow (measured in cubic feet per second - cfs) varies considerably between years (see Tables 9 and 10). Table 4 shows the annual variation in flow at the three sample stations. The table shows a yearly flow although it is greatly reduced during the winter (non-irrigation season). Station #1 has a mean winter flow of 21 cfs; Station #2, 15 cfs; Station #3, 2 cfs. As can be seen from the table, the downstream flows at Stations #2 and #3 increase greatly once irrigation has begun in mid-April.

CHEMICAL PARAMETERS

The general water chemistry of Conway Gulch is shown in Tables 5-7 for the Water Year 1981 survey. More complete analyses (minerals and metals) were run on Station #1 (Conway Gulch near its confluence with the Boise River). These were analyzed quarterly to provide more detailed information concerning this input to the Lower Boise River.

Most parameters increased in value between the upstream Station #3 and the mouth Station #1. There are some differences in concentration of chemical parameters, however, due to the variable nature of small agricultural drains.

NUTRIENTS

Nutrients are a major concern when examining the water quality of a stream. An excess supply of nutrients may cause a "polluted" stream containing an over abundance of plant and animal biomass, especially of undesirable species or communities. The nutrients examined during this survey are ammonia, nitrate, nitrite, kjeldahl nitrogen, phosphorus, and ortho phosphate.

PHOSPHORUS

Total phosphorus concentrations for each sample date and station are shown in Tables 5-6. Table 17 shows the total phosphorus loadings and the percentage of the loading that occurs during the irrigation season. Total phosphorus loadings increased from the head (1,928.4 lbs.) of the drain to the mouth (19,610.8 lbs.). This increase appears to be due to the increased flows observed during the irrigation season since the mean concentrations for phosphorus are essentially the same (0.23-0.25 mg.l). The percentage of the total phosphorus loadings that were found during the irrigation season were 70%, 56%, and 77% for Stations #3, #2, and #1 respectively. This large percentage of the total is due to the increased flows during the irrigation season compared to the non-irrigation (base flow) season rather than to increases in the concentration of phosphorus. Total phosphorus concentrations were only slightly higher during the irrigation season compared to the non-irrigation season. Therefore, this shows little phosphorus enrichment due to irrigation.

This is in contrast to the situation found in the Twin Falls irrigation tract in which phosphorus concentrations increase substantially during the irrigation season. For example, the mean concentration for total phosphorus in Rock Creek in Twin Falls County (0.22 mg/l) (Martin and Bauer 1982) is similar to the mean concentration in Conway Gulch at the mouth (0.25 mg/l). The difference, however, in these two streams is that ortho phosphate in Conway Gulch makes up the majority of the total phosphorus, while in Rock Creek a substantial amount of the phosphorus is tied up with sediment particles. This is indicated by a high total phosphorus concentration and a low ortho phosphate concentration. Ortho phosphate is the dissolved form.

To prevent the development of biological nuisances and to control accelerated or cultural eutrophication, total phosphorus as phosphorus (P) should not exceed 0.05 mg/l in a stream where it enters a lake or reservoir

(U.S. Environmental Protection Agency 1977). Since the Conway Gulch water will enter the Lower Boise River, then the Snake River and eventually several reservoirs, this criteria could have some significance. A desired goal for the prevention of plant nuisances in streams or other flowing waters not discharging directly to lakes or impoundments is 0.1 mg/l total phosphorus (MacKenthun 1973). Although instream criteria are difficult to obtain and may not apply equally to all surface waters, a range of between 0.05-0.10 mg/l of total phosphorus is probably a good indicator concentration for Conway Gulch. Currently, the total phosphorus levels exceed this value at all sample stations for all dates sampled (Tables 5, 6, and 17).

The quality of the groundwater that flows into Conway Gulch appears to have a dominant effect on phosphorus concentrations. The movement of groundwater in this area is down gradient and generally towards the west (Dion 1972, and Burnham 1979).

Since the groundwater is partly recharged from irrigation water it is expected to contain significant amounts of nutrients. This proves to be the case for phosphate. Dion (1972) gives a range of 0-0.8 mg/l (median 0.24 mg/l, n = 80) for groundwater sampled during 1970.

As shown in Table 17, the majority of the total phosphorus loading occurs during the irrigation season. Station #1 (Notus) has 77% of its phosphorus loading during the irrigation season with an estimated 50% of the total actually attributed to irrigation return flows (this figure takes into account the estimated contribution of the groundwater flow during the agricultural season). Station #2 (Stafford Road) had 56% and 10% respectively and Station #3 (Highway 30) had 70% and 44% respectively.

Dorich <u>et al</u>. (1980) found that approximately twenty-one percent of the total phosphorus found in suspended sediment samples taken in Indiana was actually available for algal uptake. If the annual total phosphorus loading of 9,805 pounds resulting from agricultural return flows were eliminated from the Boise River, it would mean that approximately 2,059 pounds would not be available for nuisance plant growth.

In addition to the pollution effects of phosphorus to Conway Gulch and the Lower Boise River, the fertilizer value of the nutrient should be considered. By using the following formula, we can estimate the 1982 value of the total phosphorus discharged into the Boise River at Notus:

TP X 2.3 X $0.25 = Fertilizer value of TP

TP = Total phosphorus in pounds. This is only the agricultural contribution (50% of the load in Table 17), with the TP loading of the base flow subtracted.

2.3 = Factor which converts the TP to its fertilizer equivalent of P_2O_5.

$0.25 = Current (1982) cost per pound of the fertilizer.

An annual estimated value (based on current application costs for the TP) is $5,638.00. If we divide the number of critical farm acres (12,880 acres) into this amount, we obtain a value of $0.44 per acre per year. This is a significant amount when multiplied by the number of acres in the farms in the area and the number of years the farms are in production (an increase in fertilizer costs will only increase this estimate). Current application costs average $4.50-$5.50/acre, so a nearly ten percent savings could theoretically be realized.

INORGANIC NITROGEN

Nitrogen is another important nutrient and can cause water quality problems when it occurs in excess. A concentration of total inorganic nitrogen (nitrate, nitrite, and ammonia) of 0.3 mg/l is considered the limit for preventing the development of biological nuisances and the acceleration of cultural eutophication (Idaho Department of Health and Welfare 1980b). Nitrate usually comprises the major portion of total inorganic nitrogen and is often the only form of nitrogen considered when evaluating the 0.3 mg/l limit. Tables 6 and 7 show that nitrate nitrogen always exceeded the 0.3 mg/l limit and often by ten times or more. Concentrations were higher during the non-irrigation season which suggests high groundwater concentrations. Surface water from irrigation dilutes the high groundwater concentrations during the agricultural season. Nitrates are usually high in Boise Valley groundwater. Dion (1972) reported a range of 0-58 mg/l (median 12 mg/l, n = 188) for groundwater sampled during 1970. These concentrations are the build up of nitrates in the perched water table during the irrigation season. These high concentrations affect the inorganic nitrogen concentrations of Conway Gulch significantly (Tables 5, 6, 7, and 18).

The mean concentration for the mouth of Conway Gulch (Station #1) was 3.43 mg/l for our survey. This is higher than the mean of 2.28 mg/l reported for the mouth of Rock Creek (Martin and Bauer 1982). The main differences between these two studies is that the upper Station (#2, Highway 30) had a mean concentration of 2.17 mg/l compared to a mean of 0.40 mg/l nitrate nitrogen for the uppermost station on Rock Creek. Conway Gulch increased by approximately thirty-three percent and Rock Creek eighty-two percent. These differences may be partly attributed to differences in the soils of these two areas.

In addition to the pollution effects of inorganic nitrogen to Conway Gulch and the Lower Boise River, the fertilizer value of nitrogen should be considered. By using the following formula, we can estimate the 1982 value of inorganic nitrogen discharged into the Boise River at Notus by Conway Gulch.

TIN X \$0.30 = Fertilizer value of TIN.

TIN = Total inorganic nitrogen (here we are using only nitrate and nitrite) in pounds. This is only the agricultural contribution.

\$0.30 = Current (1982) cost per pound of the fertilizer.

An annual estimated value (based on the current application costs for the TIN) is \$13,903.00. If we divide the number of critical farm acres (12,880 acres) into this amount we obtain a value of \$1.08 per acre per year. There is considerable variation in the cost of nitrogen application in the area and it can apparently range from \$35-\$100/acre (1982 costs). Using these estimates, about one to three percent of nitrogen application costs could be saved per acre if the nitrogen were retained on the land and not discharged into Conway Gulch via irrigation return flow.

Nutrient concentrations in Conway Gulch are greater than those reported for Rock Creek and many of its tributary irrigation drains (Martin and Bauer 1982).

METALS

Of the ten trace metals examined at Station #1, only five (arsenic, boron, iron, manganese, and zinc) were found in measureable amounts. All of these materials may be toxic to aquatic life if found in high enough concentrations. The range of concentrations found for arsenic (10-15.5 μg/l) are below the criteria of 50 μg/l for domestic water supplies and 100 μg/l for irrigation of crops (U.S. Environmental Protection Agency 1977). The ranges found for boron (150-390 μg/l) are below the criterion of 750 μg/l for long-term irrigation on sensitive crops (U.S. Environmental Protection Agency 1977). The concentrations of iron found in Conway Gulch ranged from 280-930 μg/l and are below the criterion of 1,000 μg/l for fresh water aquatic life (U.S. Environmental Protection Agency 1977). The levels of manganese found (range 20-65 μg/l) slightly exceed the criterion of 50 μg/l established for domestic water supplies (U.S. Environmental Protection Agency 1977). The zinc concentrations (range 1.5-16.0 μg/l) were well below the Environmental Protection Agency 1977, criteria.

PESTICIDES

Fish are normally chosen for pesticide analysis because they accumulate these substances in their tissue making them good indicators. An additional reason for choosing fish is that they are consumed by people and thus subject to U.S. Food and Drug Administration (FDA 1979) standards and recommendations for contaminants.

Few fish could be found in Conway Gulch for pesticide analysis but three species (two rainbow trout, one chiselmouth chub, and eight bridgelip suckers) and a bullfrog were collected for study.

Tables 15 and 16 show the results of the pesticide analysis. The data show that DDT and its analogs, along with the insecticide toxaphene, are present in the fish of Conway Gulch. The U.S. Food and Drug Administration (1979) action levels for toxaphene and DDT and its analogs is 5.0 ppm. The action level represents the level at which the FDA would take legal action to have a contaminated product removed from the market. While the levels of the individual pesticides in Conway Gulch do not exceed the 5 ppm limit, their presence does give some cause for concern since the synergistic and cumulative effects are unknown and could be significant. No pesticide residues were found in the bullfrog. The DDT levels found correspond to others for the Southwest Basin of Idaho, but the values for toxaphene exceeded any reported for the State (Bauer 1979).

The levels of pesticides found in Conway Gulch are similar in magnitude to the levels found in the other Lower Boise River drains except for the high toxaphene value of 16.97 mg/kg for a chiselmouth found in Parma Drain (Clark and Bauer 1983). Toxaphene is a chlorinated hydrocarbon insecticide as is DDT and is quite toxic to fish and other aquatic life. Rohrer (1982) reports that it is so toxic to fish that it was considered for use as a pisicide, but that it caused test lakes to remain toxic for up to six years after treatment. Rohrer (1982) also reported a bioconcentration factor of 76,000 times for brook trout fry. It would seem necessary and desirable to reduce or remove completely the amounts of pesticides (especially DDT and toxaphene) from Conway Gulch to enhance other potential uses of that stream as well as the entire Lower Boise River.

Twenty-five percent of the samples for total DDT were above the 0.2 mg/kg criteria suggested by Miller et al. (1979). Toxaphene levels exceeded the 0.4 mg/kg criteria reported in Bauer (1979) in forty percent of the samples (Tables 15 and 16). For comparison with a non-agricultural area, Chaney (1981) reports data for fishes from National Forest areas in the Pacific Northwest. Background levels of DDT residues in fish from Owhi Lake, Washington, averaged about 0.01 mg/kg. After the area was sprayed for the Douglas-Fir Tussock moth, fish residues rose to an average of 0.018 mg/kg. Chaney (1981) noted a sharp rise in DDT residue levels in fish immediately after spraying and then a decline to 0.02 to 0.08 mg/kg above pre-spray levels. All of the total DDT residue levels found in Conway Gulch exceeded the above mentioned 0.01

mg/kg level. Thirty-eight percent of the fish residue levels for Conway Gulch greatly exceeded the levels shown by Chaney (1981) for an area that had just been sprayed with concentrations of 0.75 pounds/acre.

It has now been ten years since the national ban on uses of DDT, but because of its persistence and movement in the environment, it will be present as an environmental contaminant for many years to come.

TURBIDITY

Turbidity is a measure of the amount of suspended material carried in a stream. Although the Idaho Water Quality Standards and Wastewater Treatment Requirements (Idaho Department of Health and Welfare 1980a) discuss turbidity in relation to point source wastewater discharges and not in relation to non-point sources such as irrigation return flows, the standards may be used to place the turbidity values into perspective. The standards state that "the wastewater must not increase the turbidity of the receiving water outside the mixing zone by more than five NTU (Nephelometric Turbidity Units) over background turbidity, when background turbidity is fifty (50) NTU or less; or more than ten percent (10%) increase in turbidity when background turbidity is more than fifty (50) NTU, not to exceed a maximum increase of twenty-five (25) NTU".

Tables 5, 6, and 7 show that turbidity levels increased significantly during the irrigation season as compared to the non-irrigation period. The turbidity at Station #1 (Notus) had a range of 0.8-8.0 NTU (mean 3.5 NTU, n = 4) for the non-irrigation season and a range of 12.5-56.6 NTU (mean 28.3 NTU, n = 6); Station #2 (Stafford Road) had a range of 1.0-5.7 NTU (mean 3.1 NTU, n = 4) during the non-irrigation season and a range of 4.2-38.0 NTU (mean 16.7 NTU, n = 6) for the irrigation season; and Station #3 (Highway 30) a range of 1.8-4.8 NTU (mean 3.25 NTU, n = 4) for the non-irrigation season and a range of 15.0-170.0 NTU (mean 59.0 NTU, n = 6) for the irrigation season. These data also show the variability of the turbidity values taken during the irrigation season. The values are dependent on weather conditions, individual farm irrigation schedules and instream conditions. To place these values in some perspective, the turbidity of the Boise River at its confluence with the Snake River had a mean value of 9.9 NTU (range 0.7-25.0 NTU, n = 12, October, 1981, through September, 1982).

BIOLOGICAL PARAMETERS

BACTERIOLOGICAL WATER QUALITY

Fecal coliform bacteria are found in the intestinal tract of warm-blooded animals, and are therefore used as indicators of contamination and the possible presence of other disease causing organisms. Fecal Streptococci bacteria (Fecal Strep) are pathogenic bacteria and indicate fecal contamination by livestock. The bacteriological water quality of Conway Gulch is shown in Table 8. Since the Lower Boise River is protected for primary contact (Idaho Department of Health and Welfare, 1980a), this data can be compared to the State standards which state that fecal coliform bacteria concentrations are not to exceed 500/100 ml.

During the agricultural season most samples exceed this value. None of the sample stations exceeded the 500/100 ml. level during the non-irrigation season (November-April). For May through October, Station #1 exceeded the standard forty-three percent of the time; Station #2, fifty percent; and Station #3, eighty percent.

Using the fecal coliform/fecal strep ratio, we can point to the source(s) of the contamination (Clausen et al. 1977). A fecal coliform/fecal strep ratio of less than 0.7 usually indicates livestock contamination. As would be expected, all of the samples taken during this survey fell into this category.

Martin and Bauer (1982) also found higher bacterial counts during the summer in Rock Creek and its tributary drains, probably due to both seasonal input and the influence of warmer water temperature. Along Conway Gulch, any type of confined livestock or grazing could contribute to the bacteria levels found.

FISH SURVEY

We sampled the fish population of Conway Gulch on November 25, 1981, and on March 22, 1982. Numbers found were extremely low. A total of four fish were collected for pesticide analysis (see next section and Table 15 for the results). Three of the fish collected by electro-fishing were at Station #1 (near the mouth at Notus). Two of these fish were collected during the November survey. One of these was a chiselmouth chub, *Acrocheilus glutaceus* Agassiz and Pickering; the second was an eighteen inch (46 cm) rainbow trout, *Salmo gairdneri* Richardson. The trout was not a hatchery fish but a wild male in spawning condition. The March survey yielded one rainbow trout at Station #1 as well as one adult bullfrog. At Station #2 (Stafford Road), eight bridgelip suckers, *Catostomous columbianus* (Eigenmann and Eigenmann) were collected.

Several unproductive electro-fishing hours were spent between Station #1 and #2. At the Notus Road bridge in Notus, we tried electro-fishing as well as explosive charges (M-80's) with no fish being seen or collected. The same was tried at the bridge on Purple Sage Road with the same negative results. These areas looked like they could support some fish, but none were found.

It appears that much of the year Conway Gulch would be suitable for cold water biota (temperatures below 18°C). Afternoon temperatures rise above this during the summer. A reduction of the suspended sediment load in Conway Gulch and an increase in riparian vegetation could easily improve conditions for a more viable fishery. We have collected rainbow trout, chiselmouth chub, and bridgelip suckers in Conway Gulch.

QUALITY CONTROL

The chemical results for Station #1 listed in Table 5 represent the average of two duplicate samples. The raw data demonstrated very little difference between samples. The sampling and laboratory methods used appear to be adequate for this survey and for similar future studies. The results of the duplicate sampling effort for fecal coliform and fecal strep bacteria show a great range of variability (see Table 8). Some sample results were the same (February and March) and others differed greatly (August, 800 vs. 10,000 colonies/100 ml.; and November, 70 and 1,000 colonies/100 ml.). This extreme difference must be attributed to the fact that true split samples were not taken since individual sterile bottles were used in sample collection. Since the stream is a moving dynamic system, each sample therefore examined a slightly different portion of the flow. However, this illustrates the natural variation of the bacterial population.

CONCLUSIONS AND RECOMMENDATIONS

Conway Gulch is a major contributor of sediment and nutrients to the Boise River system. The pesticides DDT and toxaphene were found in fish tissue in significant amounts. A marginal fishery presently exists in Conway Gulch which could probably be improved with reduced pollutant loadings and improved habitat. The water quality of the Lower Boise River could be improved with corresponding improvements in Conway Gulch and other tributary drains.

Conway Gulch is presently managed as an agricultural drain. It requires periodic cleaning by the drainage district because of excessive sediment deposition. With a reduction of the sediment load as a result of the State cost share grant, the drain cleaning can be done less frequently or eliminated.

If the need for ditch cleaning can be eliminated, Conway Gulch could be managed for such uses as swimming and fishing. A minimal present use of the Gulch for swimming and fishing indicates the potential that the stream has for such uses. The Idaho Department of Fish and Game has indicated an interest in increasing the fishery potential of the drains in the Lower Boise River area.

Based on the water quality survey the following recommendations are made:

1. The present State cost share grant project in Conway Gulch be completed. Installation of Best Management Practices (BMP's) on the farms within the Conway Gulch drainage will both preserve the soil for agricultural purposes and reduce significantly the pollution input into Conway and the Lower Boise River .

2. That the Canyon Soil Conservation District, as a part of the State cost share program, work with the local landowners to manage pesticide use according to the manufacturer's label instructions and the Environmental Protection Agency's guidelines for container disposal.
3. A buffer strip of streamside vegetation be allowed to grow on the banks of Conway Gulch. This will help reduce sediment in the stream, will help stabilize the banks and provide fish habitat. This will also have the additional advantage of providing wildlife habitat.
4. Any drainage from confined livestock operations that presently discharge into the Gulch be eliminated. This would eliminate bacteria, nutrients and sediment to the Gulch and ultimately the Lower Boise River.
5. That efforts be made to control bedload sediment in the stream. We found significant levels of bedload sediment in Conway Gulch which would prevent development of fisheries. In addition to the Best Management Practices on farmland, this may require installation of instream sediment basins.
6. That the water quality study on Conway Gulch be repeated after the current State cost share project is completed to determine the success of the project in improving the water quality of Conway Gulch.

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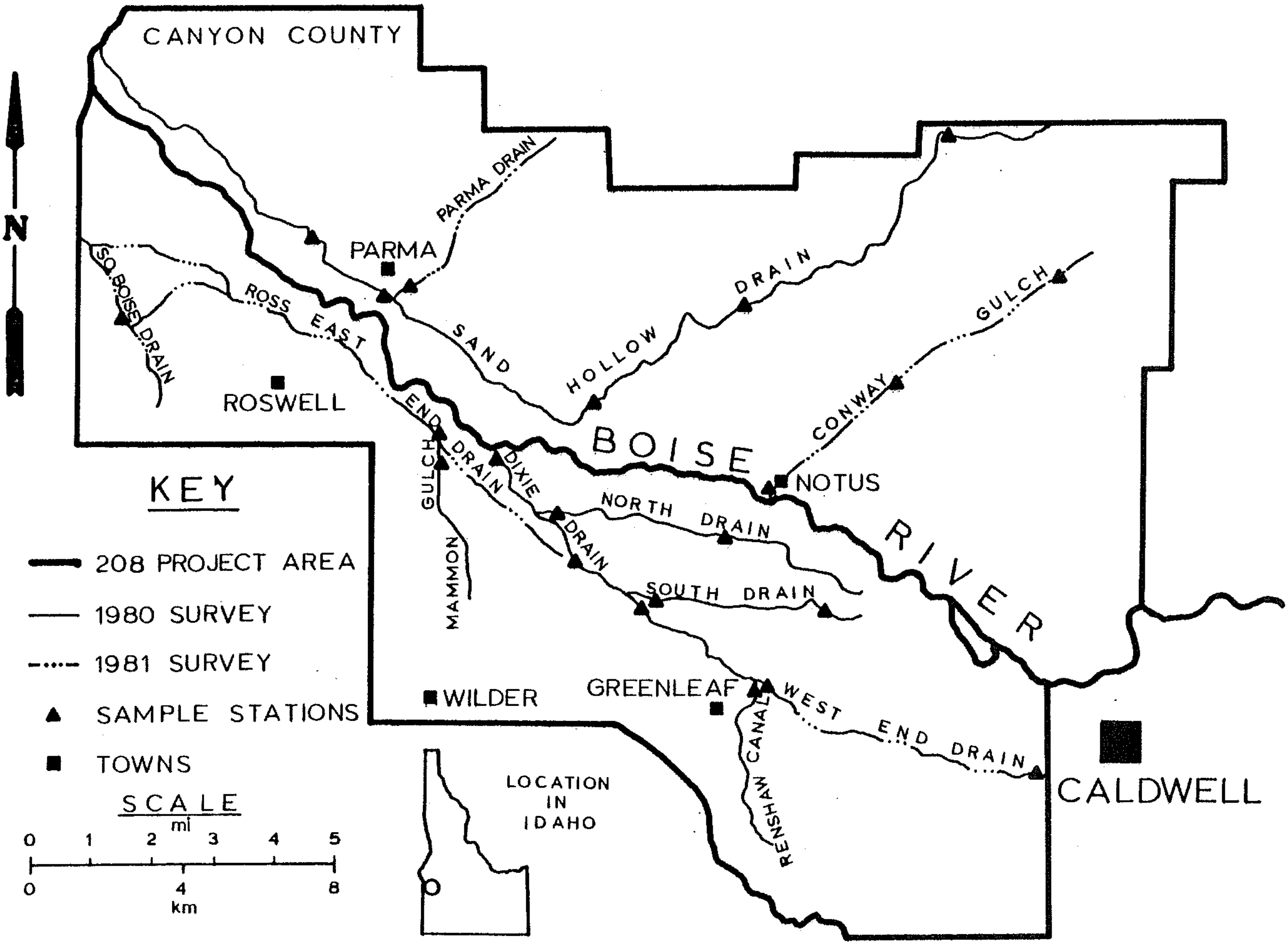
FIGURE 1. MAP OF LOWER BOISE RIVER 208 PROJECT, CANYON COUNTY, IDAHO


CANYON COUNTY
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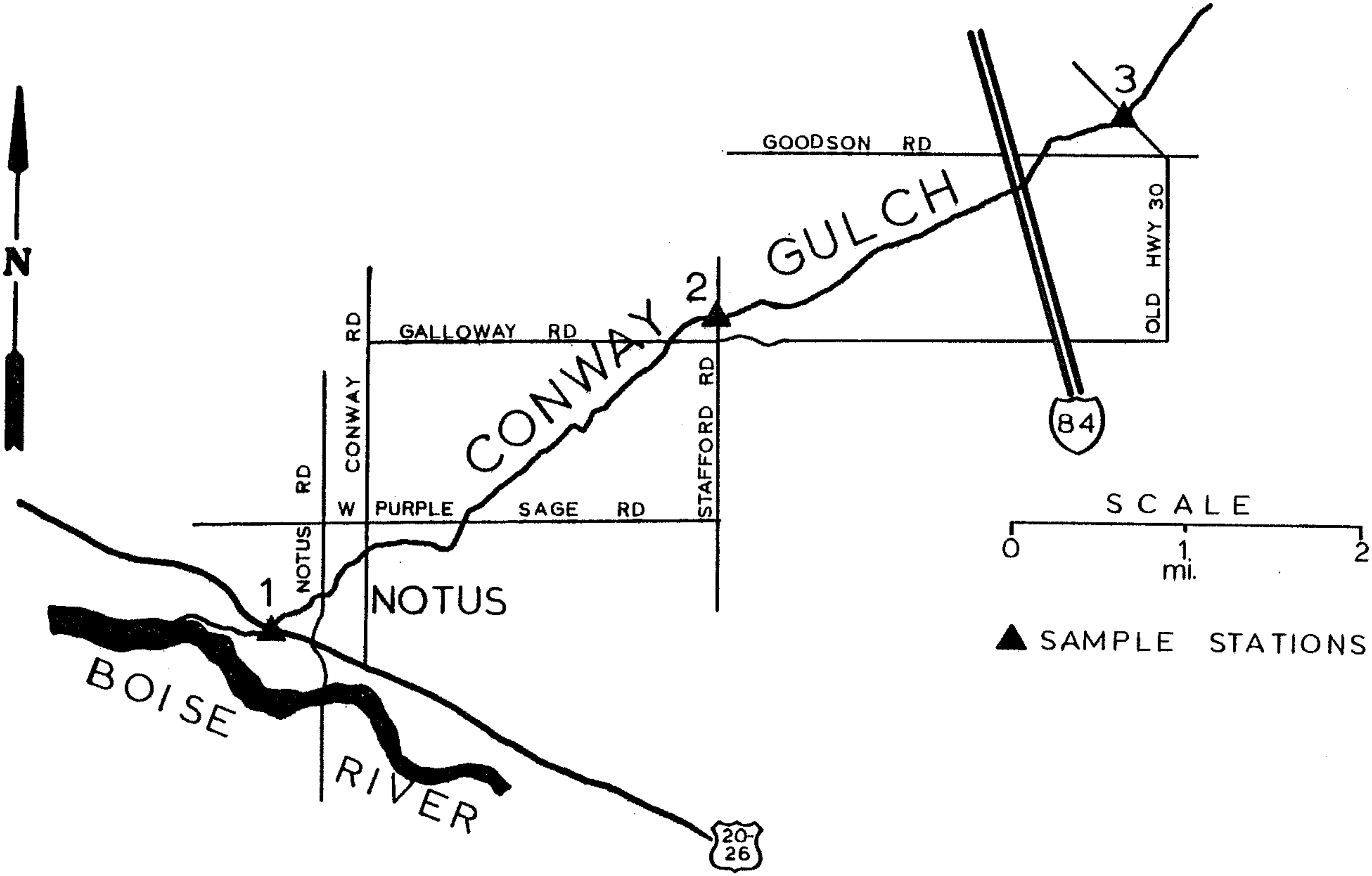
PARMA
PARMA DRAIN
ROSWELL
SO. BOISE DRAIN
ROSS EAST END DRAIN
SAND HOLLOW DRAIN
CONWAY GULCH
BOISE RIVER
NOTUS
GULCH
MAMMON
DIXIE DRAIN
NORTH DRAIN
SOUTH DRAIN
WILDER
GREENLEAF
RENSHAW CANAL
WEST END DRAIN
CALDWELL
LOCATION IN IDAHO
KEY
208 PROJECT AREA
1980 SURVEY
1981 SURVEY
SAMPLE STATIONS
TOWNS
SCALE
mi
0 1 2 3 4 5
0 4 8
km

FIGURE 2. MAP OF CONWAY GULCH



N
GOODSON RD
3
CONWAY GULCH
2
GALLOWAY RD
CONWAY RD
OLD HWY 30
84
STAFFORD RD
NOTUS RD
W PURPLE SAGE RD
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0
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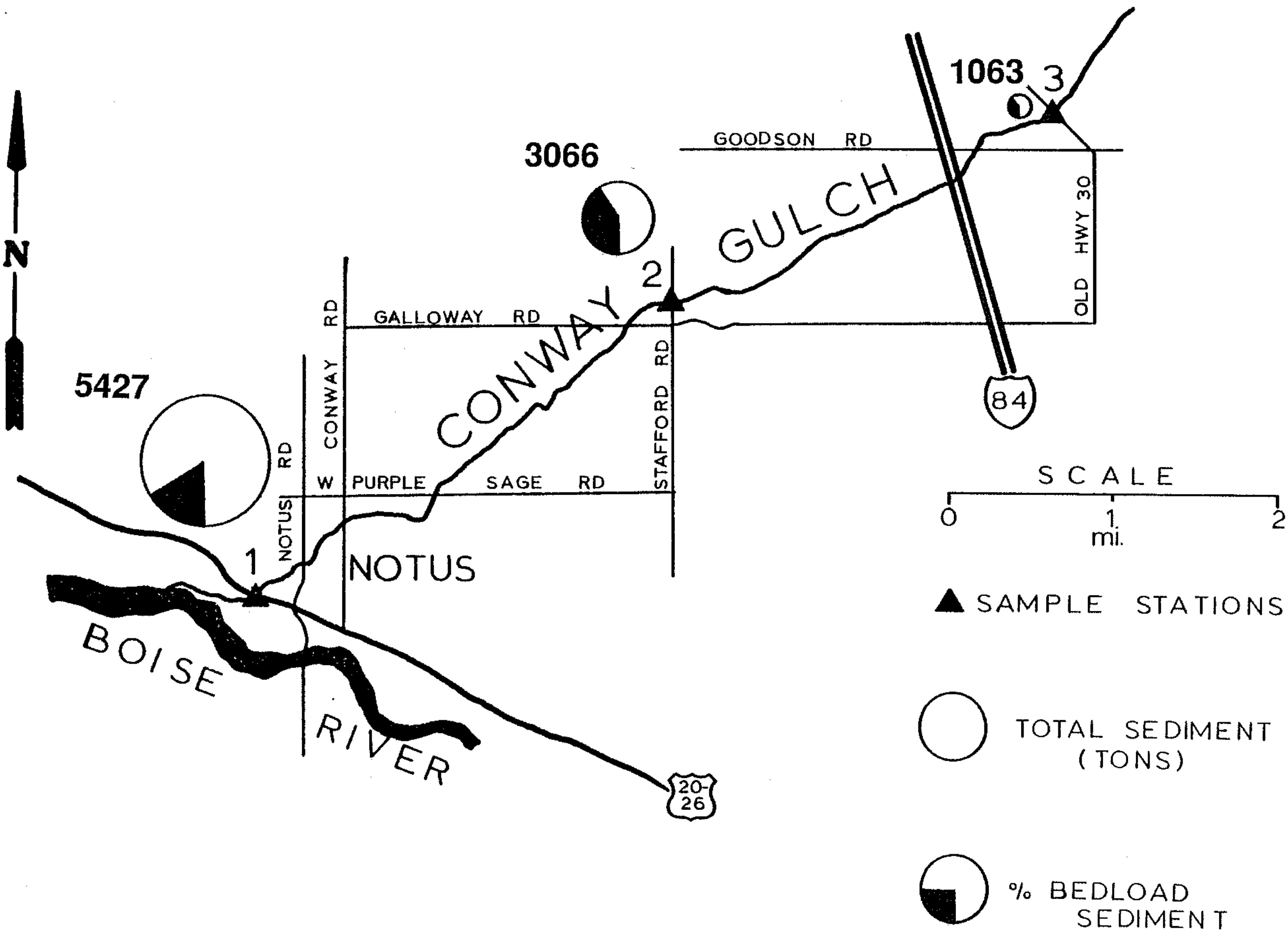
mi.
1
NOTUS
SAMPLE STATIONS
BOISE RIVER
20-26

FIGURE 3. TOTAL SEDIMENT LOADINGS IN TONS FOR CONWAY GULCH (1981-1982) WITH PERCENT BEDLOAD SEDIMENT CONTRIBUTION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NOTUS RD
CONWAY RD
STAFFORD RD
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20-26
SCALE
0
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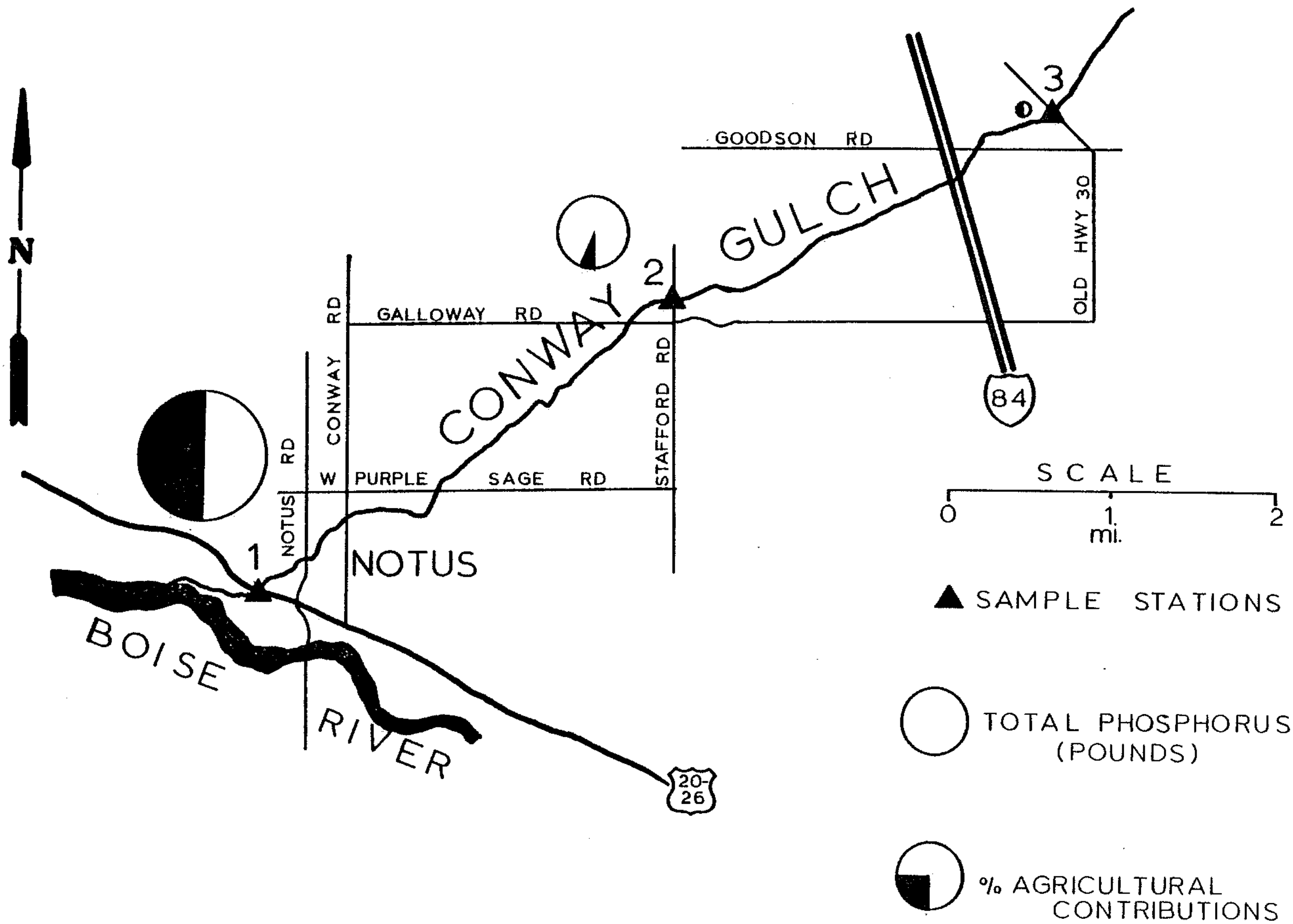
mi.
SAMPLE STATIONS
TOTAL SEDIMENT (TONS)
% BEDLOAD SEDIMENT

FIGURE 4. TOTAL PHOSPHORUS LOADINGS IN POUNDS FOR CONWAY GULCH (1981-1982) WITH PERCENT AGRICULTURAL CONTRIBUTION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CONWAY GULCH
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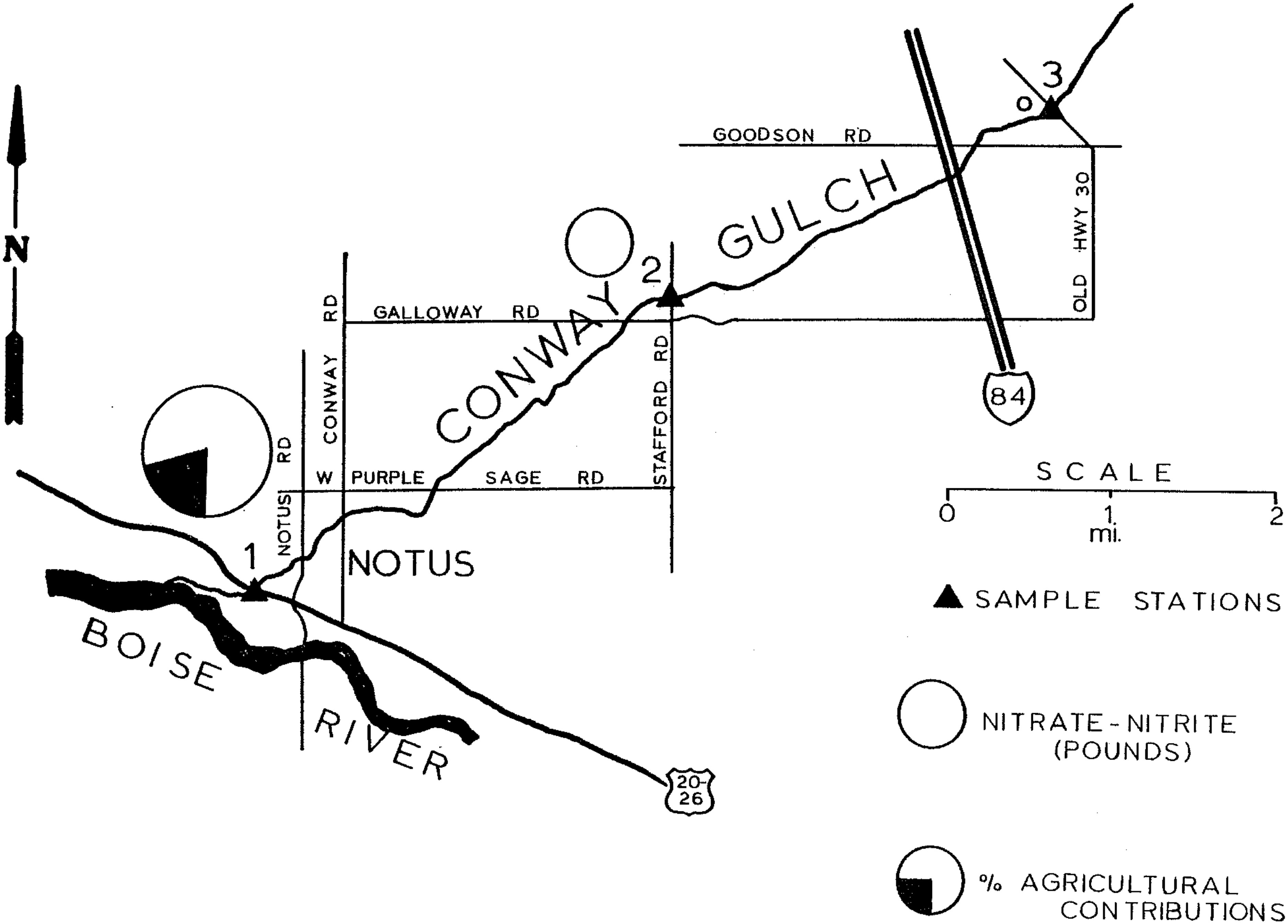
NOTUS RD
STAFFORD RD
W PURPLE SAGE RD
NOTUS
84
20-26
BOISE RIVER
SCALE
0
1
mi.
2
SAMPLE STATIONS
TOTAL PHOSPHORUS (POUNDS)
% AGRICULTURAL CONTRIBUTIONS

FIGURE 5. INORGANIC NITROGEN (NITRATE AND NITRITE) LOADINGS (1981-1982) WITH PERCENT AGRICULTURAL CONTRIBUTION: STATIONS #2 AND #3 HAD GREATER LOADINGS DURING THE NON-IRRIGATION SEASONS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GOODSON RD
OLD HWY 30
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GULCH
CONWAY
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GALLOWAY RD
CONWAY RD
STAFFORD RD
84
NOTUS RD
W PURPLE SAGE RD
1
NOTUS
BOISE
RIVER
20-26
SCALE
0
1
2
mi.
SAMPLE STATIONS
NITRATE-NITRITE
(POUNDS)
% AGRICULTURAL
CONTRIBUTIONS

TABLE 1
DISSOLVED OXYGEN
(mg/l and Percent Saturation)

Conway Gulch

	STATION #1		STATION #2		STATION #3	
	mg/l	% Sat.	mg/l	% Sat.	mg/l	% Sat.
April 13, 1981	16.0	144.1	14.0	132.1	11.6	102.7
(Time)	(1115)		(1000)		(0930)	
May 13, 1981	9.9	89.2	9.4	84.7	9.6	80.7
(Time)	(1115)		(1025)		(0815)	
May 28, 1981	9.2	90.2	9.2	90.2	8.8	81.5
(Time)	(1100)		(1015)		(0815)	
June 10, 1981	8.4	80.8	8.2	82.0	5.4	57.4
(Time)	(0915)		(1330)		(1430)	
July 29, 1981	12.4	131.9	11.6	128.9	12.0	146.3
(Time)	(1515)		(1700)		(1830)	
August 28, 1981	7.0	70.0	4.8	51.1	6.6	64.7
(Time)	(1245)		(1330)		(0830)	
October 6, 1981	6.3	56.8	6.9	62.2	7.8	69.0
(Time)	(0930)		(0915)		(0830)	
November 24, 1981	9.0	81.1	9.4	84.7	9.1	82.0
(Time)	(1100)		(1015)		(0915)	
February 24, 1982	9.8	82.4	9.8	88.8	10.4	95.9
(Time)	(1130)		(1000)		(0830)	
March 18, 1982	8.2	72.6	10.6	103.5	10.6	100.3
(Time)	(1100)		(1030)		(0830)	

TABLE 2

TEMPERATURE (^{o}C)

Conway Gulch

	STATION #1	STATION #2	STATION #3
April 13, 1981	11.0	13.0	9.5
(Time)	(1115)	(1000)	(0930)
May 13, 1981	11.0	10.5	8.0
(Time)	(1115)	(1025)	(0815)
May 28, 1981	14.5	14.5	12.0
(Time)	(1100)	(1015)	(0815)
June 10, 1981	13.5	16.0	19.0
(Time)	(0915)	(1330)	(1430)
July 29, 1981	19.0	21.0	26.0
(Time)	(1515)	(1700)	(1830)
August 28, 1981	16.0	19.0	15.0
(Time)	(1245)	(1330)	(0830)
October 6, 1981	11.0	11.0	10.0
(Time)	(0930)	(0915)	(0830)
November 24, 1981	11.0	11.0	10.5
(Time)	(1100)	(1015)	(0915)
February 24, 1982	8.0	8.0	8.0
(Time)	(1130)	(1000)	(0830)
March 18, 1982	10.0	10.5	9.5
(Time)	(1100)	(1030)	(0830)

TABLE 3

pH VALUES*

Conway Gulch

	STATION #1	STATION #2	STATION #3
April 13, 1981	8.3	8.2	7.9
(Time)	(1115)	(1000)	(0930)
May 13, 1981	8.0	8.0	7.9
(Time)	(1115)	(1025)	(0815)
May 28, 1981	8.1	8.0	8.1
(Time)	(1100)	(1015)	(0815)
June 10, 1981	7.6	8.3	8.3
(Time)	(0915)	(1330)	(1430)
July 29, 1981	7.9	7.8	7.6
(Time)	(1515)	(1700)	(1830)
August 28, 1981	7.6	7.6	7.8
(Time)	(1245)	(1330)	(0830)
October 6, 1981	7.8	7.9	7.7
(Time)	(0930)	(0915)	(0830)
November 24, 1982	8.1	8.1	8.1
(Time)	(1100)	(1015)	(0915)
February 24, 1982	8.3	8.1	7.9
(Time)	(1130)	(1000)	(0830)
March 18, 1982	8.4	8.1	8.1
(Time)	(1100)	(1030)	(0830)

*NTU

TABLE 4

FLOW (CFS)

Conway Gulch

	STATION #1	STATION #2	STATION #3
April 13, 1981	16.0	4.8	2.3
May 13, 1981	48.0	29.0	5.6
May 28, 1981	59.0	43.0	4.5
June 10, 1981	59.0	49.0	5.0
July 29, 1981	52.0	23.0	4.0
August 28, 1981	55.0	25.0	3.0
October 6, 1981	60.0	30.0	3.0
November 24, 1981	19.0	24.0	2.8
February 24, 1982	30.0	25.0	2.8
March 18, 1982	16.0	14.0	1.9

TABLE 5a

CHEMICAL ANALYSES*

Conway Gulch
Station #1

PARAMETER	4-13-81	5-13-81	5-28-81	6-10-81	7-28-81
Chemical Oxygen Demand	4.5	9.45	12.7	11.7	12.5
Ammonia (as N)	0.132	0.0145	0.102	0.053	0.0565
Nitrite & Nitrate (as N)	6.04	2.205	2.612	1.805	2.32
Kjeldahl Nitrogen (as N)	0.6	1.06	0.85	0.9	0.81
Phosphorus (as P)	0.24	0.36	0.295	0.2	0.43
Ortho Phosphate (as P)	0.17	0.1205	0.1065	0.098	0.1405
Specific Conductance (umhos/cm)	1,044.0	389.0	446.5	442.0	574.0
Hardness (as $CaCO_3$)	236.0	-	-	133.0	-
Alkalinity (as $CaCO_3$)	280.0	-	-	141.5	-
Bicarbonate Alkalinity (as $CaCO_3$)	280.0	-	-	139.5	-
Carbonate Alkalinity (as $CaCO_3$)	<1.0	-	-	2.0	-
Calcium	59.2	-	-	33.5	-
Magnesium	18.0	-	-	10.1	-
Sodium	123.5	-	-	44.9	-
Potassium	3.7	-	-	3.1	-
Chloride	46.6	-	-	15.1	-
Fluoride	0.55	-	-	0.425	-
Sulphate (as SO_4)	84.0	-	-	66.0	-
Silica (as SiO_2)	19.2	-	-	27.65	-
Turbidity (NTU)	2.3	44.0	22.0	21.5	56.5
pH (SU)	8.25	7.9	7.7	7.7	7.9
Filterable Residue	610.0	334.0	312.5	288.5	349.5
Suspended Sediment	17.33	149.05	121.5	83.5	258.5
Arsenic Total (ug/l)	11.0	-	-	<10.0	-
Boron Total (ug/l)	390.0	-	-	195.0	-
Cadmium Total (ug/l)	<1.0	-	-	<1.0	-
Chromium Total (ug/l)	<50.0	-	-	<50.0	-
Copper Total (ug/l)	<10.0	-	-	10.0	-
Iron Total (ug/l)	280.0	-	-	930.0	-
Lead Total (ug/l)	<50.0	-	-	<50.0	-
Manganese Total (ug/l)	20.0	-	-	65.0	-
Mercury Total (ug/l)	<.5	-	-	<.5	-
Zinc Total (ug/l)	16.0	-	-	3.5	-

* In mg/l unless otherwise indicated.
\- Parameter not sampled.

TABLE 5b

CHEMICAL ANALYSES*

Conway Gulch
Station #1

PARAMETER	8-26-81	10-6-81	11-24-81	2-23-82	3-18-82
Chemical Oxygen Demand	14.5	12.35	10.8	5.6	7.1
Ammonia (as N)	0.0365	0.0225	.0495	0.063	0.0585
Nitrite & Nitrate (as N)	2.68	3.335	4.405	4.62	4.245
Kjeldahl Nitrogen (as N)	1.05	1.0	0.8	1.05	0.675
Phosphorus (as P)	0.32	0.245	0.24	0.26	0.22
Ortho Phosphate (as P)	0.161	0.126	0.181	0.195	0.1485
Specific Conductance (umhos/cm)	503.5	690.0	944.0	1,000.0	934.5
Hardness (as CaCO3)	-	180.0	-	224.0	-
Alkalinity (as CaCO3)	-	211.0	-	276.5	-
Bicarbonate Alkalinity (as CaCO3)	-	211.0	-	276.5	-
Carbonate Alkalinity (as CaCO3)	-	<1.0	-	<1.0	-
Calcium	-	46.0	-	62.4	-
Magnesium	-	14.1	-	19.6	-
Sodium	-	74.4	-	118.65	-
Potassium	-	3.9	-	4.1	-
Chloride	-	23.5	-	44.0	-
Fluoride	-	0.45	-	0.475	-
Sulfate (as SO4)	-	104.0	-	148.975	-
Silica (as SiO2)	-	39.5	-	45.85	-
Turbidity (NTU)	12.5	13.5	8.0	2.95	0.8
pH (SU)	7.725	8.2	7.9	8.05	8.3
Filterable Residue	387.0	433.5	623.0	628.0	628.0
Suspended Sediment	140.0	118.0	46.55	54.55	11.1
Arsenic Total (ug/l)	-	10.0	-	15.5	-
Boron Total (ug/l)	-	150.0	-	225.0	-
Cadmium Total (ug/l)	-	<1.0	-	<1.0	-
Chromium Total (ug/l)	-	<50.0	-	<50.0	-
Copper Total (ug/l)	-	<10.0	-	<10.0	-
Iron Total (ug/l)	-	670.0	-	540.0	-
Lead Total (ug/l)	-	<50.0	-	<50.0	-
Manganese Total (ug/l)	-	55.0	-	45.0	-
Mercury Total (ug/l)	-	<.5	-	<.5	-
Zinc Total (ug/l)	-	10.5	-	1.5	-

* In mg/l unless otherwise indicated.
\- Parameter not sampled.

TABLE 6

CHEMICAL ANALYSES *

Conway Gulch
Station #2

PARAMETERS	4-13-81	5-13-81	5-28-81	6-10-81	7-28-81
Chemical Oxygen Demand	9.9	12.0	11.0	10.6	10.0
Ammonia (as N)	0.029	0.033	0.083	0.047	0.061
Nitrite & Nitrate (as N)	3.59	1.09	1.79	1.34	1.65
Kjeldahl Nitrogen (as N)	0.4	0.87	0.9	0.7	0.81
Phosphorus (as P)	0.14	0.23	0.17	0.13	0.27
Ortho Phosphate (as P)	0.10	0.102	0.093	0.078	0.137
Specific Conductance (umhos/cm)	1,143.0	198.0	426.0	421.0	550.0
Turbidity (NTU)	1.0	18.0	15.0	13.0	38.0
pH (SU)	8.1	7.8	7.9	8.3	8.3
Filterable Residue	709.0	244.0	277.0	251.0	339.0
Suspended Sediment	3.33	86.0	72.0	36.0	150.0

PARAMETERS	8-26-81	10-6-81	11-24-81	2-23-82	3-18-82
Chemical Oxygen Demand	13.0	9.7	11.4	6.8	7.5
Ammonia (as N)	0.038	0.019	0.040	0.027	0.040
Nitrite & Nitrate (as N)	1.67	2.69	3.12	3.56	3.08
Kjeldahl Nitrogen (as N)	1.1	0.9	0.7	0.92	0.45
Phosphorus (as P)	0.27	0.20	0.25	0.28	0.23
Ortho Phosphate (as P)	0.127	0.119	0.164	0.191	0.147
Specific Conductance (umhos/cm)	488.0	641.0	948.0	989.0	983.0
Turbidity (NTU)	12.0	4.2	5.7	3.1	2.1
pH (SU)	7.75	8.25	7.9	7.8	8.2
Filterable Residue	321.0	401.0	607.0	596.0	610.0
Suspended Sediment	145.0	52.9	68.0	68.4	20.0

* In mg/l unless otherwise indicated.

TABLE 7

CHEMICAL ANALYSES *

Conway Gulch
Station #3

PARAMETERS	4-13-81	5-13-81	5-28-81	6-10-81	7-28-81
Chemical Oxygen Demand	16.6	12.9	10.5	17.5	30.0
Ammonia (as N)	0.081	0.049	0.123	0.065	0.095
Nitrite & Nitrate (as N)	5.29	0.645	0.863	0.902	0.805
Kjeldahl Nitrogen (as N)	0.7	1.07	0.9	0.9	1.47
Phosphorus (as P)	0.21	0.28	0.14	0.24	0.72
Ortho Phosphate (as P)	0.16	0.138	0.068	0.162	0.135
Specific Conductance (umhos/cm)	1,000.0	251.0	386.0	437.0	346.0
Turbidity (NTU)	2.0	60.0	15.0	58.0	170.0
pH (SU)	8.35	7.3	7.8	8.0	8.1
Filterable Residue	598.0	230.0	261.0	262.0	221.0
Suspended Sediment	16.11	468.0	44.0	240.0	780.0

PARAMETERS	8-26-81	10-6-81	11-24-81	2-23-82	3-18-82
Chemical Oxygen Demand	15.0	11.9	9.7	4.8	6.5
Ammonia (as N)	0.066	0.019	0.039	0.057	0.062
Nitrite & Nitrate (as N)	1.19	1.87	3.05	3.63	3.41
Kjeldahl Nitrogen (as N)	1.1	0.7	0.6	0.7	0.6
Phosphorus (as P)	0.26	0.19	0.21	0.23	0.18
Ortho Phosphate (as P)	0.088	0.128	0.164	0.170	0.126
Specific Conductance (umhos/cm)	366.0	242.0	1,094.0	1,043.0	1,177.0
Turbidity (NTU)	18.0	33.0	4.8	4.4	1.8
pH (SU)	7.55	7.77	7.9	7.75	8.1
Filterable Residue	252.0	437.0	708.0	701.0	713.0
Suspended Sediment	83.0	29.1	32.4	29.8	15.3

* In mg/l unless otherwise indicated.

TABLE 8

BACTERIOLOGICAL DATA

Conway Gulch
(colonies/100 ml.)

	STATION #1*		STATION #2		STATION #3	
	Fecal	Fecal Strep	Fecal	Fecal Strep	Fecal	Fecal Strep
April 13, 1981	100 / 10	130 / 150	480	2,000	---	---
May 13, 1981	620 / 10	3,400 / 10	990	3,600	1,300	6,700
May 28, 1981	780 / 710	1,500 / 1,500	1,700	2,300	830	2,200
June 10, 1981	660 / 720	2,600 / 2,400	260	1,300	600	3,500
July 28, 1981	250 / 400	13,000 / 13,000	600	4,500	1,200	7,500
August 26, 1981	10,000 / 800	12,000 / 10,500	1,200	13,000	1,800	10,000
October 6, 1981	70 / 120	750 / 650	170	1,600	240	2,700
November 24, 1981	70 / 1,000	15,000 / 14,000	30	4,000	40	2,000
February 23, 1982	10 / 10	700 / 480	20	320	10	400
March 18, 1982	60 / 60	270 / 250	20	170	30	700

--- No sample taken.
* Duplicate samples taken

TABLE 9

SUSPENDED SEDIMENT (TONS)

Conway Gulch At Notus (Hwy. 20/26)
Irrigation Season, Water Years 1973-1975

WATER YEAR	MONTH	DAY	FLOW (cfs)	SEDIMENT (mg/l)	DAILY LOAD (mg/l)	INTERVAL LOAD (tons)
WY 1973	4	1	0	0		
	4	5	18	56	2.72	10.88
	5	8	39	220	23.16	532.68
	6	12	30	518	41.96	1,468.6
	7	16	54	484	70.57	2,399.38
	8	21	63	280	47.63	1,714.68
	9	19	61	40	6.60	191.4
	10	16	33	198	17.64	476.28
TOTAL						6,793.9
WY 1974	4	1	0	0		
	4	9	22	6	0.36	12.96
	5	7	51	390	53.71	1,665.01
	6	5	72	326	63.37	1,837.73
	7	2	58	242*	37.90*	644.3 *
	7	30	58	158	24.74	692.72
	8	27	54	126	18.37	514.36
	9	24	51	70	9.64	202.44
	10	23	29	28	2.19	45.99
TOTAL						5,615.5
WY 1975	4	1	0	0		
	4	15	22	23	1.36	19.04
	5	12	42	156	17.69	477.63
	6	9	58	11	1.72	48.16
	7	9	52	566	79.47	2,384.10
	8	11	51	158	21.76	718.08
	9	8	61	49	8.07	225.96
	10	14	35	24	2.27	83.99
TOTAL						3,956.96

* Estimated value.

Loading calculations are based on the same number of days, from April 1 to October 15. Data From BOR 1977.

TABLE 10

SUSPENDED SEDIMENT (TONS)

Conway Gulch At Notus (Hwy. 20/26)
Irrigation Season, Water Years 1976-1980

WATER YEAR	MONTH	DAY	FLOW (cfs)	SEDIMENT (mg/l)	DAILY LOAD (mg/l)	INTERVAL LOAD (tons)
WY 1976	4	1				
	4	12	20	8	0.43	4.73
	5	4	36	296	28.77	632.94
	6	7	6	619	10.03	341.02
	7	13	48	488	63.24	2,276.64
	8	16	62	114	19.08	648.72
	9	8	43	111	12.88	296.24
	10	13	40	44	4.75	175.75
TOTAL						4,376.04
WY 1980	4	1				
	4	8	51	21	2.89	20.23
	5	6	80	276	59.61	1,669.08
	6	9	87	114	26.78	910.52
	7	2	90	701	170.34	3,917.82
	8	11	90	156	37.91	1,516.40
	9	10	100	118	31.86	955.80
	10	7	90	428	104.00	3,640.00
TOTAL						12,629.85

Loading calculations are based on the same number of days, from April 1 to October 15.

Data from BOR.

TABLE 11

SUSPENDED SEDIMENT (TONS)

Conway Gulch At Notus (Hwy. 20/26)
Irrigation Season, Water Year 1981

Station #1

WATER YEAR	MONTH	DAY	FLOW (cfs)	SEDIMENT (mg/l)	DAILY LOAD (mg/l)	INTERVAL LOAD (tons)
WY 1981	4	1	0	0	0	0
	4	13	16	17.33	.75	8.98
	5	12	48	149.1	19.32	560.38
	5	27	5.9	122	19.4	291.5
	6	10	59	84	13.38	187.34
	7	28	52	259	36.36	1,745.45
	8	26	55	140	20.79	602.91
	9 *	15	57.5	129	20.03	400.55
	10	6	50	118	19.12	401.44
TOTAL SEDIMENT						4,198.04

* Data estimated.

Loading calculations are based on the same number of days, from April 1 to October 6.

TABLE 12

SUSPENDED SEDIMENT (TONS)

Conway Gulch At Stafford Road
Irrigation Season, Water Year 1981

Station #2

WATER YEAR	MONTH	DAY	FLOW (cfs)	SEDIMENT (mg/l)	DAILY LOAD (mg/l)	INTERVAL LOAD (tons)
WY 1981	4	1	0	0	0	0
	4	13	4.8	3.33	.04	.52
	5	12	29	86	6.73	195.28
	5	27	43	72	8.36	125.39
	6	10	49	36	4.76	66.68
	7	28	23	150	9.32	447.12
	8	26	25	145	9.79	283.84
	9 *	15	27.5	99.4	7.38	147.61
	10	6	30	52.9	4.28	89.98
TOTAL SEDIMENT						1,356.41

* Data estimated.

Loading calculations are based on the same number of days, from April 1 to October 6.

TABLE 13

SUSPENDED SEDIMENT (TONS)

Conway Gulch At Highway 30
Irrigation Season, Water Year 1981

Station #3

WATER YEAR	MONTH	DAY	FLOW (cfs)	SEDIMENT (mg/l)	DAILY LOAD (mg/l)	INTERVAL LOAD (tons)
WY 1981	4	1	0	0	0	0
	4	13	2.3	16.11	.10	1.2
	5	12	5.6	468	7.08	205.21
	5	27	4.5	44	.53	8.02
	6	10	5	240	3.24	45.36
	7	28	4	780	8.42	404.35
	8	27	3	83	.67	20.17
	9 *	15	3	56	.45	8.62
	10	6	3	29.1	.24	4.95
TOTAL SEDIMENT						697.88

* Data estimated.

Loading calculations are based on the same number of days, from April 1 to October 6.

TABLE 14

BASELINE DATA FOR SUSPENDED SEDIMENT LOADING

Conway Gulch At Notus
Irrigation Seasons, Water Years 1973-1981

WATER YEAR (April - October)	MEASURED LOAD (tons)	MEAN FLOW (cfs)	NORMALIZED LOAD (tons) *
WY 1973	6,793.9	43	7,899
WY 1974	5,615.5	49	5,730
WY 1975	3,956.9	45	4,397
WY 1976	4,376.0	36	6,078
WY 1980	12,629.0	84	7,517
WY 1981	4,198.0	43	4,881
MEAN		50	6,083
STANDARD ERROR			570
COEFFICIENT OF VARIATION			9.3%

* Normalized loadings were calculated to remove the yearly variation in flows from the calculation of baseline suspended sediment loadings. (Measured load is divided by the yearly mean flow then multiplied by the overall mean flow (50 (cfs) for the six years.)

TABLE 15. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH AND AN AMPHIBIAN FROM CONWAY GULCH, WATER YEAR 1982 (mg/kg, wet weight)*

SPECIES:	Rainbow Trout <u>Salmo gairdneri</u> Richardson	Rainbow Trout <u>Salmo gairdneri</u> Richardson	Chiselmouth Chub <u>Acrocheilus glutaceus</u> Agassiz & Pickering	Bull Frog <u>Rana Catesbeiana</u>
STATION:	#1	#2	#1	#1
DATE:	Nov. 25, 1982	March 22, 1982	Nov. 25, 1982	March 22, 1982
WEIGHT (g):	935	156	248	290
Lipid Content (%)	5.1	1.63	6.8	0.2
Total PCB's (1,254)	0	0	0	0
PCB (1,260)	0.018	-	0.039	-
Aldrin	0	0	0	0
Dieldrin	0.012	0.001	0.011	0
Total DDT & Analogs	1.031	0.039	0.568	0
o.p. DDE	0	0	0	0
p.p' DDE	0.497	0.025	0.568	0
o.p. DDD	0	0	0	0
p.p' DDD	0.152	0.004	0	0
o.p. DDT	0.120	0.003	0	0
p.p' DDT	0.262	0.005	0	0
Endrin	0	0	0	0
Methoxychlor	0	0	0	0
Hexachlorobenzene	0.014	0	0.015	0
Pentachlorophenol	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	0.001	0	0
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0
Toxaphene	4.679	-	2.499	-
Dacthal	0.002	-	0.050	-

* Detection limit 0.001 mg/kg.
0 Value less than detection limit.
\- Parameter not analysed.

TABLE 16. TRACE ORGANIC (PESTICIDE) RESIDUES FROM FISH (BRIDGELIP SUCKERS) COLLECTED IN CONWAY GULCH, WATER YEAR 1982 (mg/kg, wet weight) *

SPECIES:	Bridgelip Sucker, _Catostomous columbianus_ Eigenmann & Eigenmann			
STATION:	#1			
DATE:	March 22, 1982			
WEIGHT (g):	19	39.5	17.0	24.0
LIPID CONTENT (%):	3.0	2.25	2.99	1.59
Total PCB's (1,254)	0.073	0	0.029	0
Aldrin	0	0	0	0
Dieldrin	0.001	0.001	0	0
Total DDT & Analogs	0.017	0.014	-	0.011
o.p. DDE	0	0	0	0
p.p' DDE	0.012	0.014	0.014	0.011
o.p. DDD	0	0	0	0
p.p' DDD	0	0	0	0
o.p. DDT	0	0	0	0
p.p' DDT	0.005	0	0	0
Endrin	0	0	0	0
Methoxychlor	0	0	0	0
Hexachlorobenzene	0	0	0	<0.002
Total Chlordane	0	0	0	0
cis is. or chlordane	0	0	0	0
trans is. or chlordane	0	0	0	0
cis is. or nonachlor	0	0	0	0
trans is. or nonachlor	0	0	0	0.001
Hexachlorocyclohexane alpha BHC isomer	0	0	0	0
Hexachlorocyclohexane gamma isomer	0	0	0	0
Toxaphene	-	0.197	0.256	0.123

* Detection limit 0.001 mg/kg.
0 Value less than detection limit.
- Parameter not analyzed.

TABLE 17. TOTAL PHOSPHORUS LOADINGS FOR
CONWAY GULCH, WATER YEAR 1981

	Mean Flow (cfs)	Mean Concentrations (mg/l)	Phosphorus Load (lbs.)	% Phosphorus Load During Ag. Season	Actual Agricultural Loading Contribution (%)
#1 Conway Gulch @ Highway 20/26, Notus	38.8	0.25	19,610.8 8,895.3 kg	77%	50%
#2 Conway Gulch @ Stafford Road	26.4	0.23	11,470.3 5,202.8 kg	56%	10%
#3 Conway Gulch @ Highway 30	3.3	0.25	1,928.4 874.7 kg	70%	44%

TABLE 18. NITRATE - NITRITE NITROGEN LOADINGS FOR CONWAY GULCH
WATER YEAR 1981

	Mean Flow (cfs)	Mean Concentrations (mg/l)	Nitrate & Nitrite Load (lbs.)	% Nitrate & Nitrate Load During Ag. Season	Actual Agricultural Loading Contribution (%)
#1 Conway Gulch @ Highway 20/26, Notus	38.8	3.42	220,678 110,098 kg	60%	21%
#2 Conway Gulch @ Stafford Road	26.4	2.36	115,186 52,247 kg	47%	N/A
#3 Conway Gulch @ Highway 30	3.3	2.17	13,308 6,036 kg	43%	N/A

N/A = Non-irrigation season contribution larger than during agricultural season.

TABLE 19. BEDLOAD SEDIMENT (oven dry wgt., grams) SAMPLES
For Conway Gulch, Water Year 1981-1982

DATE	SAMPLE STATION #1 (Notus)	#2 (Stafford Road)	#3 (Hwy. 30
April 13, 1981	7.46 (2.5)	276.0 (2.0)	---------
May 13, 1981	206.6 (2.0)	19.75 (2.0)	54.3 (2.0)
May 28, 1981	135.4 (2.0)	46.0 (2.5)	37.15 (2.0)
June 10, 1981	473.9 (2.0)	271.3 (1.5)	9.55 (1.0)
July 28, 1981	256.8 (1.5)	13.45 (1.5)	694.9 (1.0)
August 27, 1981	35.8 (1.5)	174.8 (1.5)	153.5 (1.0)
October 6, 1981	134.15 (1.5)	----------	----------
November 24, 1981	117.35 (1.5)	393.1 (1.5)	29.35 (1.0)
February 24, 1982	186.25 (1.5)	114.05 (1.5)	----------
March 18, 1982	140.9 (1.5)	99.35 (1.5)	49.0 (1.0)

(Time of sample collection in minutes.)

TABLE 20. ESTIMATED BEDLOAD AND TOTAL SEDIMENT LOADINGS (TONS) FOR CONWAY GULCH, WATER YEAR 1981-1982

	BEDLOAD SEDIMENT				
	Irrigation Season	Non-Irrigation Season	Total	Suspended Sediment	Total Sediment*
STATION #1 (Notus)	544	472	1,016	4,411	5,427
STATION #2 (Stafford Road)	419	643	1,062	2,004	3,066
STATION #3 (Highway 30)	268	62	330	783	1,063

* Suspended and bedload sediment.

TABLE 21. Textural Analysis Of Bedload Sediment For Stations #1 And #2, Conway Gulch April, 1981

	WEIGHT IN GRAMS			
PARAMETERS	SAMPLE STATION #1 - Notus	% Of Total Weight	SAMPLE STATION #2 Stafford Road	% Of Total Weight
Dry Weight (g)	7.46		276.0	
Ash Weight (g)	0.216	3%	1.20	<1%
Sieve Size (wgt. in (g))				
#20 (very coarse sand)	1.08	14%	76.1	28%
#35 (coarse sand)	1.80	24%	88.4	32%
#60 (medium sand)	4.11	55%	103.0	37%
#140 (very fine sand)	0.220	3%	6.37	2%
#200 (silt)	0.010	<1%	0.108	<1%
Past #200 (clay)	0.029	<1%	0.164	<1%

ACKNOWLEDGEMENTS

We thank the following individuals for assistance in the field:

Don Anderson, Susan Lowman, Don Martin, Glen Nielson, Will Reid, Dorothy Reynolds, David Sanders, and Craig Shepard.

The following organizations aided with various aspects of this study:

Idaho Department of Health and Welfare, Bureau of Laboratories, Bureau of Water Quality and the 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.