Water Quality Status Report No. 104

CONWAY GULCH

Canyon County, Idaho
1988 – 1989

State Agricultural Water Quality Program

Idaho Department of Health and Welfare

Division of Environmental Quality

November 1993

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Idaho Department of Health and Welfare
Division of Environmental Quality
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ACKNOWLEDGEMENT

Many different people were involved with the monitoring of Conway Gulch: Trish Klahr, Terry Meritt, Bill Clark, Don Martin, Steve Bauer and Craig Shepard. Also, a number of individuals were involved with guidance in the development of this report: Craig Shepard, Bill Clark, John Gleim, David Blew, Lee Tobison, Gi Gi Christensen, Steve Bauer and others that provided some form of assistance. A very appreciative thank you is extended to all of them.

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ABSTRACT

Conway Gulch enters from the north into the Boise River near river mile 13. The Boise River empties into the Snake River at the Idaho-Oregon stateline near the town of Nyssa, Oregon. The Conway Gulch project area encompasses approximately 180 farm units on 18,220 acres of land, of which 12,800 acres were determined to be critical erosion areas.

As demonstrated from past monitoring efforts, the Conway Gulch area is a major source of pollutants effecting water quality and beneficial uses in Conway Gulch and the Lower Boise River. A pollution source and transport monitoring technique was used in evaluating water quality. That is, this monitoring scheme analyzed pollutants in subreaches of the watershed to determine where pollutants originates and how they are transported, (ie. attached to sediments, ground water input, surface runoff events...etc.) The objective of the 1988-89 monitoring effort was to attempt to determine if the current implemented BMPs are improving, not effecting or degrading water quality in Conway Gulch.

Water quality in Conway Gulch remains poor. Nutrients, sediments, bacteria, and metals continue to effect water quality and beneficial uses in Conway Gulch and the Lower Boise River.

Nutrient (nitrite-nitrates as nitrogen and total phosphorus) levels exceed criteria for the prevention of eutrophic conditions. Higher concentrations of nitrates during non-irrigation season reflect ground water recharge that is affecting water quality and may reflect that a ground water quality problem exists in the Conway Gulch area. The three segments of Conway Gulch all contribute high concentrations of nutrients to Conway Gulch.

Suspended sediments concentrations and loads show no significant change since BMP implementation. Total sediment contribution from Conway Gulch is greater than 6,000 tons per year, which would indicate that erosion continues to be a significant problem in the Conway Gulch watershed. Correlation values for total phosphorus and suspended sediment indicate that to control phosphorus contribution sediment retention must also occur. High sediment concentrations and sediment loads appear to be uniform throughout the watershed.

Bacteria density continue to exceed State Water Quality Standards. The Standards for primary contact recreation were violated on 50% of the monitoring dates at the lower station located near Notus, Idaho. Secondary contact recreation standards were violated on 30% of the monitoring occasions.

Metals detected within the water column still pose a threat to aquatic biomass and agricultural water supply. Iron concentrations remain high and were above criteria established to protect freshwater aquatic biomass. Iron is abundant in the soils in the Conway Gulch project area, which would indicate that soil erosion remains the major source of pollutants.

INTRODUCTION

BACKGROUND

In June 1982, the Canyon Soil Conservation District (Canyon SCD) applied for financial assistance from the State of Idaho Water Pollution Control Fund for implementation of an Agricultural Water Quality Project in Conway Gulch. Conway Gulch was identified in the Lower Boise River 208 Project (Clark and Bauer 1982) as a significant source of agricultural pollution to the Boise River. The goal of the Conway Gulch Water Quality Project is to reduce or eliminate point and/or non-point source agricultural water quality impacts through the applications of Best Management Practices, BMPs, (Canyon Soil Conservation District 1982).

The Grant Agreement for the Conway Gulch Water Quality Project was signed by the State of Idaho Department of Health and Welfare and the Canyon SCD in October 1982. The agreement specified that water quality plans would be developed by the landowners and the Canyon SCD for critical erosion areas identified within the Conway Gulch drainage. The plan would incorporate a balanced program of erosion control and land treatment practices, and identify the BMPs and cost-share formula application for each area. The following water pollution reductions goals were established by the Canyon SCD:

70% sediment reduction;
60% phosphorus reduction;
65% pesticides reduction; and
70% fecal coliform level reduction.

In 1983, the Canyon SCD began the process of writing and implementing water quality contracts with landowners in the identified critical areas. These contracts are designed as a cost-share incentive; the Canyon SCD pays up to 75% (through State funds) of the cost to implement BMPs, and the cooperators are responsible for the balance. The participants are required to maintain operation of the designed BMPs for five years, or longer, as determined by the Canyon SCD.

ISSUES

Extensive studies conducted by the Bureau of Reclamation between 1973 and 1975 (U.S. Bureau of Reclamation 1977) and Idaho Department of Health and Welfare, Division of Environmental Quality (Clark and Bauer 1982, and Clark and Bauer 1983) had determined that surface irrigation waste water return flows carrying high concentrations of sediment, bacteria, nutrients, and pesticides were degrading water quality in Conway Gulch and the Lower Boise River. Bacteria densities exceeded State Water Quality Standards (Idaho Department of Health and Welfare 1990) on numerous occasions in both Conway Gulch and downstream of

Conway Gulch in the Boise River. Sediment loadings were determined to exceed 5,000 tons per year. Total phosphorus concentration averaged 0.25 mg/L with a yearly load estimated of 19,000 pounds per year (Clark and Bauer 1982).

The Bureau of Reclamation (U.S. Bureau of Reclamation 1977) study also identified similar magnitudes of phosphorus and sediment loads in Conway Gulch and the Boise River, and pointed out that surface irrigation practices were contributing high concentrations of nitrogen, salts, phosphates, bacteria, sediment and turbidity to Conway Gulch and the Lower Boise River. The Bureau of Reclamation concluded that Conway Gulch is one of the poorest water quality drains in the Boise Valley.

OBJECTIVE

The objective of the 1988-89 monitoring effort was to determine to what extent the Conway Gulch Water Quality Project has affected water quality within the Conway Gulch drainage (Klahr 1988). Clark and Bauer (1982) conducted a water quality survey of Conway Gulch from October 1981, through September 1982, which served to characterize the baseline water quality prior to implementing the Conway Gulch Water Quality Project. Since the 1981-82 study 35% of the critical area has been treated. We anticipate that current water quality condition, documented through this study, will substantiate if conditions are improving or if conditions are not improving in Conway Gulch. The main emphasis is to determine if sediment and phosphorus loads have been affected by the implementation of BMPs in the Conway Gulch Project Area.

DESCRIPTION OF PROJECT AREA

Conway Gulch enters from the north into the Boise River near river mile 13. The Boise River empties into the Snake River at the Idaho-Oregon stateline near the town of Nyssa, Oregon. The Conway Gulch Project Area (Figure 1) encompasses approximately 180 farm units on 18,220 acres of land, of which 12,800 acres were identified as critical erosion areas (Canyon Soil Conservation District 1982). Land uses within the Conway Gulch Project area are described in Table 1.

A majority of irrigation water in the Conway Gulch watershed originates from the Black Canyon Dam near Emmett, Idaho and is delivered to the watershed through the "D" Line and Notus Canals. Boise River irrigation water is provided to the lower elevation areas through the Farmer's Cooperative Sebree Canal. Some irrigation water is provided by deep irrigation wells for lands not serviceable by canals. Conway Gulch is siphoned under the service canals with no direct discharge noted. However, small amounts of agricultural waste water does discharge into the lower canals, mostly on a field by field basis. Table 2 shows acreage breakdown per segment drained and acreage that either directly or indirectly impacts Conway Gulch.

The soils, surface water drainage, surface water quality, and ground water quality within the Conway Gulch Project Area have been will documented; U.S. Bureau of Reclamation 1977, U.S. Bureau of Reclamation 1978, Canyon Soil Conservation District 1982, Clark and Bauer 1982, Dion 1972, Naylor et al. 1976; and Priest et al. 1972.

Table 1. Land Use Within the Conway Gulch Project Area, 1982.

LAND USE	ACRES
Surface Irrigated Croplands	12,880
Surface Irrigated Hay and Pasture Land	870
Sprinkler Irrigated Croplands	1,810
Misc., Roads, Homesteads	2,660

Table 2. Conway Gulch Segments: Total Acres, Indirect Impact Acres, Direct Impact Acres in the Conway Gulch Project area.

	STATION #1 (segment)	STATION #2 (segment)	STATION #3 (segment)	TOTAL
Total Acres	7287	8200	2733	18220
Acres Indirectly Impacting Conway	5142	5353	678	11173
Acres Directly Impacting Conway	2145	2847	2055	7047

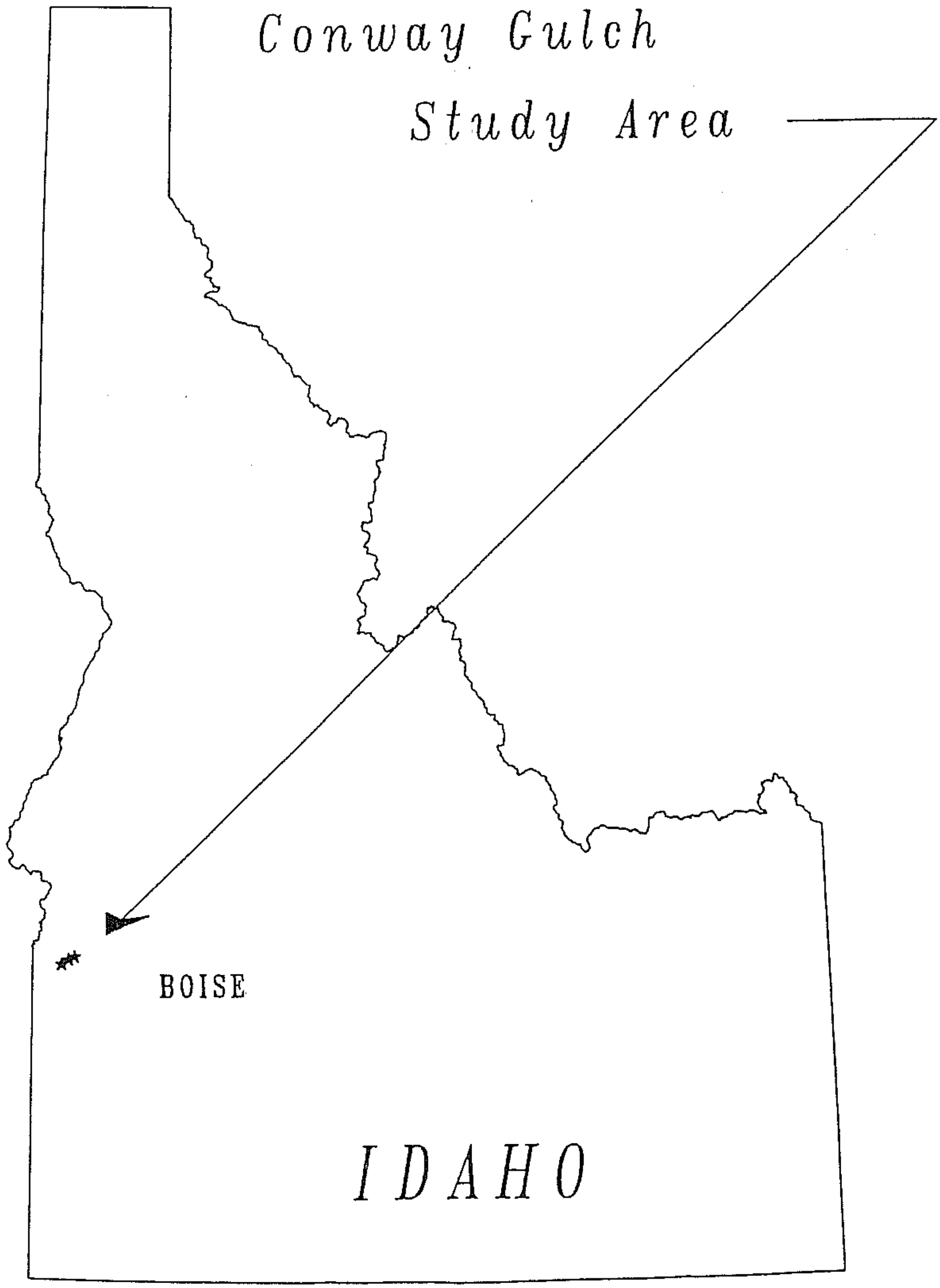

Figure 1. Conway Gulch Project Area.

MATERIALS AND METHODS

STUDY APPROACH / STUDY DESIGN

Monitoring in 1988-89 followed methods, stations and techniques utilized by Clark and Bauer (1982).

Stations

Three stations were chosen to segment land areas in the Conway Gulch project area. Station locations were selected to assist in the identification of critical areas and to help determine appropriate BMPs according to types of land use. Table 3 shows station number, station description and STORET Number; Figure 2 shows station locations and access roads. Table 2 describes acres that either directly or indirectly impact Conway Gulch.

Table 3. Conway Gulch Monitoring Stations.

STATION #	STATION DESCRIPTION	STORET #
Station #1	Conway Gulch @ Hwy 20/26	2040326
Station #2	Conway Gulch @ Stafford Rd.	2040327
Station #3	Conway Gulch @ Old Hwy. 30	2040328

Parameter Selection and Rationale

Parameter selection was based on parameters selected from the 1981-82 survey (Clark and Bauer 1982). Table 4 lists parameter, STORET Number and unit of measurement.

Suspended Sediment

Suspended sediment consists of solid material, either mineral or organic, that is suspended and is being transported by water. Suspended sediment has been selected as the prime indicator of BMP effectiveness for the Conway Gulch. It is of leading importance to land managing agencies (Soil Conservation Service and Soil Conservation District) in the Conway Gulch area. If sediment is kept from leaving irrigated croplands, then in turn it will provide cleaner water for the receiving waters (ie. Conway Gulch, Lower Boise River, and Snake River).

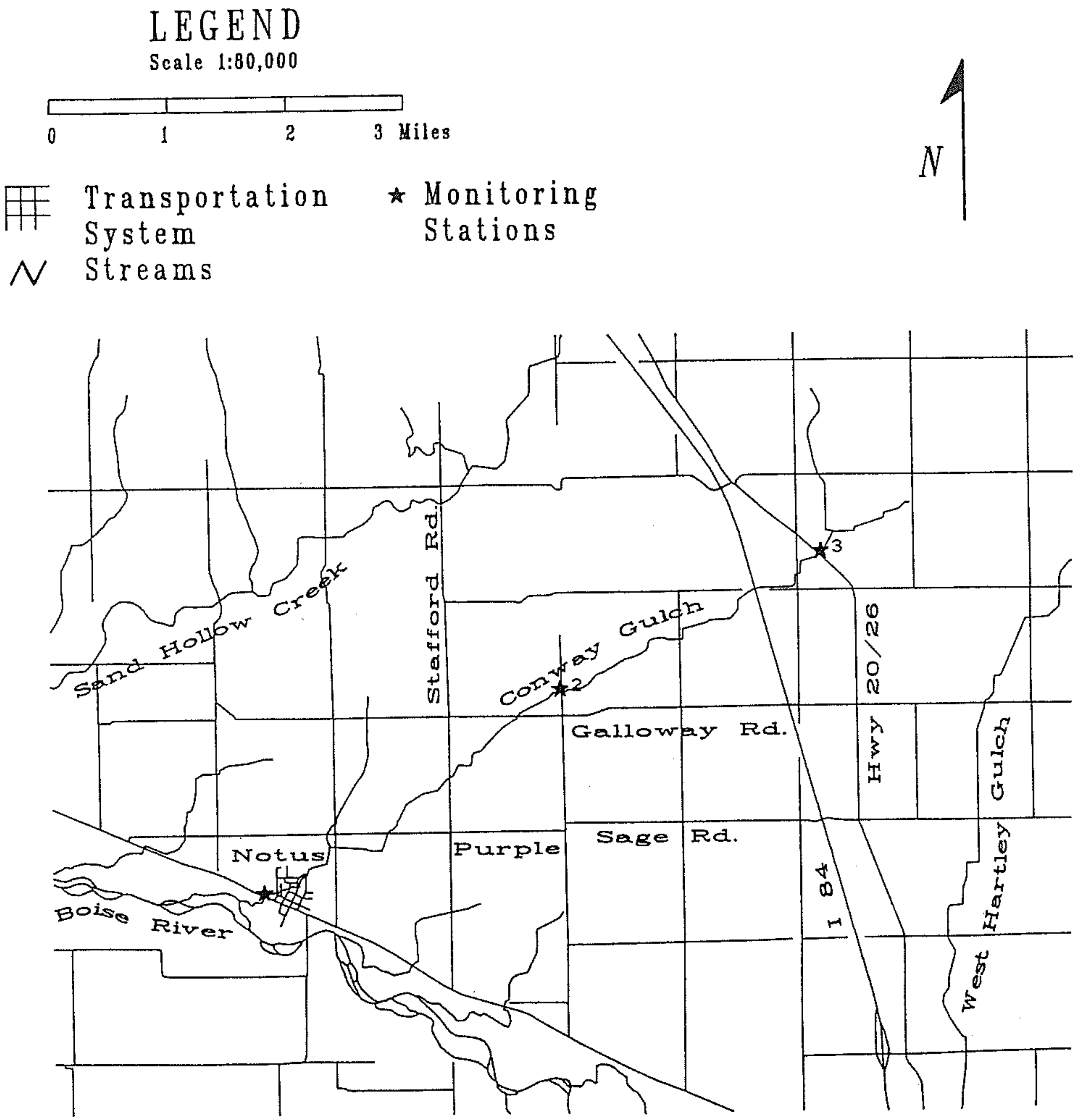

Figure 2. Conway Gulch Water Quality Project Monitoring Station Locations.

Bedload Sediment

Bedload sediment is the sediment that is found moving on or near the stream bed. In Conway Gulch the bedload is comprised mainly of medium to course sands. The abundance and number of aquatic life can be influenced by bedload sediment. Petran and Kothe (1978) demonstrated that most macroinvertebrate species are not able to colonize areas of moving substrate. Other studies, Bjornn et al. (1977), Megahan (1982), Megahan and Nowlin (1976), and Alexander and Hansen (1982) have researched the influences of moving substrate on fisheries and other aquatic life.

Dissolved Oxygen

Dissolved Oxygen (DO) concentrations are used to determine status of beneficial uses, mainly coldwater biota and salmonid spawning. The State Water Quality Standard states that Dissolved Oxygen concentration must exceed 6 mg/L at all times (Idaho Department of Health and Welfare 1990).

Temperature

Temperature is also used to determine the status of beneficial uses, mainly coldwater biota and salmonid spawning. The State Water Quality Standard (Idaho Department of Health and Welfare 1990) for coldwater biota, for one time measurement, requires a water temperature of 22°C or less with a maximum daily average of no more than 19°C. For salmonid spawning, temperature standards pertain to times when spawning activity is occurring and during incubation periods. The State temperature standards for salmonid spawning (Idaho Department of Health and Welfare 1990) requires that water temperature of 13°C or less with a maximum daily average no greater than 9°C.

pH

pH values are used to measure the hydrogen ion concentrations in water and soils. State Water Quality Standards (Idaho Department of Health and Welfare 1990) designate a pH range of 6.5su to 9.0su.

Turbidity

Turbidity is a measurement of the ability of light to pass through water. Turbidity and the light penetration through the water column are inversely related. Studies by Sigler et al. (1984) determined that turbidity levels as low as 25 NTUs can cause a reduction in fish growth and turbidity levels between 100-300 NTUs caused fish to either die or forced them to leave the channel. Lloyd et al. (1987) found that increased levels in turbidity caused reduction in light penetration resulting in decreased production of plant material (primary production), decreased abundance of food organisms (secondary production), and decreased production and abundance of fish. Lloyd also determined that even slight increases in turbidity (5-10 NTUs) caused decreases in plant abundance.

Narrative criteria established for aesthetic quality sets a maximum NTU level of 25 (Idaho Department of Health and Welfare 1980).

Nutrients

Nutrients are a major concern when examining agricultural return flows. Agricultural return flows may contain excessive nutrients that may impact water quality in receiving waters by creating over abundance of aquatic plants and animal biomass, especially undesirable species or communities.

Phosphorus

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 streams where it enters a lake or reservoir (U.S. Environmental Protection Agency 1988). Conway Gulch discharges into the Lower Boise River, then the Snake River and eventually reservoirs further downstream. This criteria should have a important role in future studies on the Lower Snake River. Other studies have indicated that a desired condition for instream criteria to prevent plant nuisance that do not discharge directly into a lake or reservoir is 0.10 mg/L total phosphorus (MacKenthun 1973). Since instream criteria is not easily obtained or may not apply to certain situations for surface waters, especially in a lotic situation, a range of 0.05 mg/L to 0.10 mg/L may be an appropriate indicator of excessive concentration of total phosphorus in Conway Gulch.

Nitrogen

Nitrogen is another important nutrient that can cause water quality problems when found in excess. Total inorganic nitrogen (nitrite, nitrate and ammonia) in concentrations of 0.3 mg/L is considered the limit for controlling biological nuisances and the acceleration of cultural eutrophication (Idaho Department of Health and Welfare 1980). In this study Nitrite-Nitrate as Nitrogen (NO_2+NO_3 as N) will be used to determine if this criteria exceeded. It should be noted that in oxygenated waters most nitrite is rapidly oxygenated to nitrate. Total ammonia concentrations appear low enough that they are not a factor for calculation of total inorganic nitrogen.

Metals

Clark and Bauer (1982) monitored for ten (10) trace metals at Station #1. Of the ten only five (5) had concentration in detectable amounts. The five detected trace metal monitored in 1981-82 and again in 1988-89 were arsenic, boron, iron, manganese, and zinc. Each metal parameter has different criteria that may effect either agriculture use, freshwater aquatic life or human health.

Bacteria

Fecal Coliform bacteria are found in the intestine of warm-blooded animals, and are indicators of contamination. Although not a pathogen itself, it may indicate the presence of other disease causing organism. Fecal Streptococci, Fecal Strep, are pathogens and are indicators of contamination from livestock. The Lower Boise River and to the same extent, Conway Gulch are protected for primary and secondary recreation contact (Idaho Department of Health and Welfare 1990), therefore data collected can be compared to State Water Quality Standards to determine if Conway Gulch exceeds state standards for these beneficial uses. The State standard for secondary contact recreation is (Idaho Department of Health and Welfare 1990):

a. 800/100 ml at any time; and

b. 400/100 ml in no more than ten percent (10%) of the total samples taken over a thirty (30) day period; and

c. A geometric mean of 200/100 ml based on a minimum of five samples taken over a thirty day period.

The State standard for primary contact recreation taken from May 1st to September 30th is (Idaho Department of Health and Welfare 1991):

a. 500/100 ml at any time; and

b. 200/100 ml in no more than ten percent (10%) of the total samples taken over a thirty (30) day period; and

c. A geometric mean of 50/100 ml based on a minimum of five samples taken over a thirty day period.

Using the fecal coliform/fecal strep ratio, a determination of possible source of contamination can be made (Clausen et al. 1977). Clausen et al. (1977) determined that a fecal coli/fecal strep ratio of less than 0.7 usually indicated the presence of a livestock contamination source.

Table 4. Conway Gulch Water Quality Status Report, Parameters, 1988-89.

PARAMETERS	STORET #	UNIT OF MEASUREMENT
NITRITE-NITRATE AS NITROGEN	00630	mg/L
AMMONIA	00610	mg/L
TOTAL KJELDAHL NITROGEN	00625	mg/L
TOTAL PHOSPHORUS	00665	mg/L
ORTHO PHOSPHATES	70507	mg/L
DISSOLVED o-PHOSPHATES	00671	mg/L
SPECIFIC CONDUCTIVITY	00095	umhos/cm
TURBIDITY	00076	NTUs
SUSPENDED SEDIMENT	80154	mg/L
BEDLOAD SEDIMENT	N/A	grams
ARSENIC	01002	ug/L
BORON	01022	ug/L
IRON	01045	ug/L
MANGANESE	01055	ug/L
ZINC	01092	ug/L
TEMPERATURE	00010	°C
DISSOLVED OXYGEN	00300	mg/L
pH	00400	su
FLOW	00060	cfs
FECAL STREPTOCOCCUS	31679	count/100 ml
FECAL COLIFORM	31616	count/100 ml

Sampling/Collection Methods

Suspended sediment, nutrients (phosphorus and nitrogen) and trace metals constituents were collected as cross composite depth integrated samples using a DH-48 and DH-59 Suspended Sediment Sampler. Samples were composites into a 8 Liter churn splitter. Composite subsamples were dispensed into one quart cubitainers. Samples collected for nutrient analysis were preserved with 2 ml H_2SO_4. Samples collected for trace metals were preserved with 10 ml HNO_3. Preservatives were added to the cubitainers one day before scheduled sample date.

Bedload sediment samples were collected with a three (3) inch Helly-Smith bedload sampler. Samples were collected by placing the bedload sampler on the stream bed for a thirty second period for three interval portions of the stream cross section. Bedload samples were placed in one gallon zip-lock storage bag. Samples were delivered to the Bureau of Laboratories where samples were air dried, oven dried and weighed. Ovendry weight (in grams) was recorded for each sample station.

Bacteria samples were collected by grab method. Samples were collected as close to main stream flow as possible into a sterile 250 ml Nalgene bottle leaving a one-half (1/2) inch air gap between water surface and neck of bottle.

Discharge (flow in cubic feet per second) was measured with a Marsh-McBirney Model 201D Portable Water Current Meter. Stream depth and velocity were measured at one foot intervals. Discharge was determined by multiplying velocity, depth, and interval width between measurements and adding all measurements over the total width of the stream.

Dissolved oxygen (mg/L) and temperature (°C) were determined with the use a Yellow Springs Instrument Model 50 Dissolved Oxygen Meter. pH was determined with the use of a Orion Model 231 pH/mv/temperature Meter. pH was reported in standard units (su).

Fish collection was attempted before the beginning of irrigation season in the spring of 1989, but no fish were collected. Data from fish collection would have been used to determine population and density and to collect fish tissue for pesticide analysis.

Frequency

The 1988-89 survey began in October 1988. Monthly samples were collected from October 1, 1988, through March 31, 1989 to characterize non-irrigation season water quality. Twice monthly sampling occurred during irrigation season, from April 1, 1989, to September 30, 1989. There are eighteen sample sets ($n=18$) for nutrients, sediment and bacteria, and thirteen sample sets ($n=13$) for total metals.

BASELINE SUSPENDED SEDIMENT AND BEDLOAD

Clark and Bauer (1982) stated that there are a variety of factors which can influence the sediment load calculations. The main variable is probably associated with sampling frequency. Other influences can be contributed to field and laboratory methods, time of day when sampling occurs, weather conditions which may alter irrigation scheduling, and individual farming and irrigation practices.

To determine baseline suspended sediment in the Conway Gulch drainage, six years of data were utilized using data obtained from the 1980 (Clark and Bauer 1983) and the 1981-82 (Clark and Bauer 1982) study; and data obtained from Bureau of Reclamation for years 1973, 1974, 1975 and 1976 (U.S. Bureau of Reclamation 1977). It was determined that the greatest factor influencing suspended sediment data was discharge. To decrease the effects of the variation from discharge calculations, the measured load was adjusted to a normalized flow. Yearly measured loads were divided by the mean flow for that year's irrigation season, then multiplied by the overall mean flow (50 cfs) for the six year period. This calculation was used to offset the extremes in flows between water years. The baseline irrigation season suspended sediment loading for the six years was determined to be **6,083 tons**. It was determined that this figure would be used as the comparison for all future studies, including the 1988-89 study.

Clark and Bauer (1982) calculated both suspended sediment and bedload sediment and were able to obtain total sediment loads. The 1981-82 data will be compared to the data collected in the 1988-89 study. Suspended sediment load is calculated by multiplying suspended sediment (mg/L) with flow (cfs) and a factor that converts the results into tons/day. Bedload sediment is calculated by multiplying grams of bedload per minute, stream width and a factor that converts the results into tons/day. Daily load for bedload and suspended sediment were added to determine total sediment loads in tons per day. Interval loadings were then determined by multiplying the total daily load and the number of days (interval) to the next sampling date.

With the addition of bedload sediment sampling, total sediment calculations could be made. Clark and Bauer (1982) determined that an additional 1,016 tons/year of sediment could be added onto the suspended sediment load and a reliable total sediment baseline figure could be achieved. For 1981-82 total sediment load was 5,427 tons/year. At station #2 total sediment yield was 3,066 tons for the year, Station #3 total sediment yield was 1063 tons for the year. Clark and Bauer (1982) further broke bedload loadings down into percent (%) total loading for each station, or segment. Bedload sediment contributed 19% of total sediment loading at Station #1, Conway Gulch at Notus; 35% of total sediment at Station #2, Conway Gulch at Stafford Road; and 33% of total sediment at station #3, Conway Gulch at Old Highway 30.

Comparison of suspended sediment 1981-82 data and results from 1988-89 are located in Tables 31, 32 and 33. Results from the 1981-82 monitoring effort are located in Tables 28, 29 and 30.

RESULTS

SEDIMENTS

Suspended Sediments

As stated earlier, baseline suspended sediment loads were determined from six years of data. Discharge (flows) appears to be the greatest variable effecting the measurable amount of suspended sediment in the Conway Gulch project area. For the six years of data used in the baseline evaluations a normalized discharge rate was utilized to compute suspended sediment loads. However, for this study, normalized flow as established by Clark and Bauer (1982) will not be used for suspended sediment load calculations. Station #1 flow rates for the study completed in 1989 averaged 55.8 cfs during irrigation season. Non-irrigation season flows averaged 22.0 cfs at Station #1.

Using data collected for the irrigation season, April 1, 1989 through September 30, 1989, interval suspended sediment load for Conway Gulch at Notus was 5,406 tons/year. Suspended sediment and total phosphorus loads and concentrations are shown on Tables 7, 8 and 9.

Table 5. Irrigation Season Suspended Sediment Loads. Baseline (Water Years 1973, 1974, 1975 1976, 1980, and 1982) Water Year 1982 and Water year 1989.

	BASELINE* tons	**1982*** tons	**1989** tons
Conway Gulch at Notus Station #1	6,083	4,881	5,406

*Normalized loads were calculated to remove variations in flows from calculations of baseline suspended sediment loads. (Measured load is divided by the yearly mean flow then multiplied by overall mean flow (50 cfs) for the baseline data). Data for 1988-1989 uses flow data recorded at the time of sampling.

Bedload Sediment

Bedload sediment represented 5.8% of the total sediment load for the irrigation season in 1989. In 1981 bedload sediment made up 10.0% of the total sediment load during irrigation season. No bedload sediment data is available to determine six year baseline load. At Station #1, 68.3% of total bedload sediment is associated with the irrigation season. At Station #2, 59.1% of total bedload sediment is associated with the irrigation season. A conclusion at Station #3 cannot be achieved because of insignificant data. During the 1988-89 study, higher loads of bedload were observed at Station #2 than at Station #1, 616 tons/year and 516 tons/year respectively. This was also the case in 1981-82, where Station #1 had a bedload sediment load of 1016 tons/year. Station #2 had a bedload sediment of 1062 tons/year.

Overall, there is a reduction of measured bedload sediment in the Conway Gulch project area. The 1988-89 study showed a 50% decrease in bedload sediment from 1981-82. However, it should be noted that bedload sediment is not an accurate measurement of BMP effectiveness. Bedload sediment may be stored as instream storage in a fluvial system for several years on both the stream bottom and in side channel bars (Megahan 1982 and Megahan and Nowlin 1976).

Total Sediment

The total sediment load for Conway Gulch is calculated by adding the total bedload sediment loads and total suspended sediment loads. Station #1 measured a total sediment load of 6098 tons for both irrigation and non-irrigation season. At Station #2 the total sediment load was 3,457 tons, Station #3 had a total sediment load of 1,326 tons.

Area drained by Conway Gulch above Station #3 accounts for 22% of total sediment load to Conway Gulch. The area above Station #2, which is approximately half way up the watershed and below Station #3, accounts for 33% of total sediment load. The area drained between Station #1 and Station #2 accounts for 46% of the total sediment load to Conway Gulch. Table 6 also shows loads for each station for the 1988-89 study.

Table 6. Conway Gulch Segments: Total Acres, Indirect Impact Acres, Direct Impact Acres, Total Sediment Loads, and % for Acreage Drained

	STATION #1 (segment)	STATION #2 (segment)	STATION #3 (segment)	TOTAL
Total Acres	7287	8200	2733	18220
Acres Indirectly Impacting Conway	5142	5353	678	11173
Acres Directly Impacting Conway	2145	2847	2055	7047
Total Sediment Loads (in tons)	6098	3457	1326*	
% of Total Load per Segment	45%	33%	22%	100%

*Estimated using limited-measured bedload sediment data.

PHYSICAL PARAMETERS

Dissolved Oxygen

All stations in the Conway Gulch study were within State Water Quality Standard for Dissolved Oxygen, DO, (Idaho Department of Health and Welfare 1990) for the 1988-89 study. However, DO concentration in all likely hoods, drops below State standards during the night. Since continuous DO measurements were not made during twenty-four hour periods it is difficult to determine if state standards were violated. Clark and Bauer (1982) also felt there may be a severe DO problem at night during irrigation season. Instantaneous measurements were also made during the 1981-82 study, therefore no data is available to substantiate that theory.

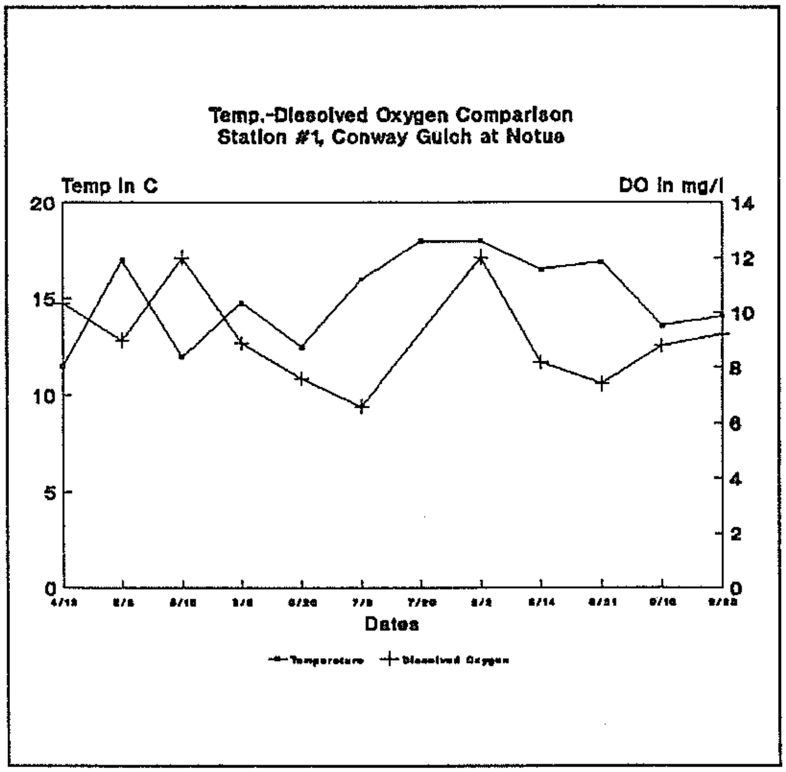

Figure 3. Dissolved Oxygen-Temperature Comparison. Conway Gulch at Notus. 1988-89

At Station #1, DO ranged from 6.60 mg/L to 12.00 mg/L during irrigation season. Average DO for irrigation season was 8.97 mg/L. DO ranged from 12.50 mg/L to 9.20 mg/L and averaged 10.70 mg/L during non-irrigation season. Station #2, DO ranged from 6.90 mg/L to 11.70 mg/L and averaged 8.41 mg/L during irrigation season. Non-irrigation season DO ranged from 8.90 mg/L to 12.60 mg/L and averaged 10.24 mg/L. Station #3, DO ranged from 6.90 mg/L to 13.70 mg/L during irrigation season and averaged 8.85 mg/L. During non-irrigation season DO ranged from 9.10 mg/L to 11.50 mg/L and averaged 10.28 mg/L. Dissolved Oxygen-Temperature relationships are shown in Figures 3, 4 and 5. DO results are located on Tables 19, 20 and 21.

Temperature

Even though the lower Boise River is protected by State Water Quality Standards (Idaho Department of Health and Welfare 1991) for salmonid spawning and cold water biota. Further temperature studies are needed to determine if temperature standards are violated. Studies have determined warmer waters usually occur in early evening. Continuous 24 hour temperature recordings will need to be made to determine if this is also true for Conway Gulch. Possible studies to determine periods of spawning activity would be useful.

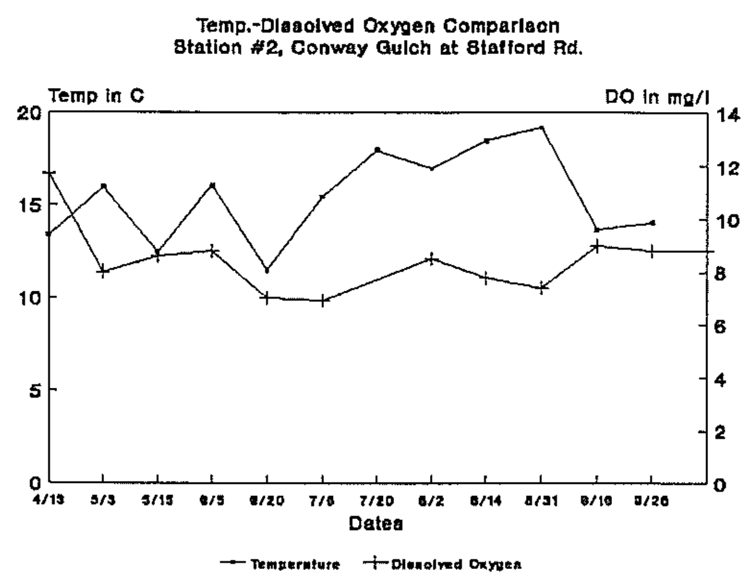

Figure 4. Dissolved Oxygen-Temperature Comparison. Conway Gulch at Stafford Road. 1988-89.

Station #1 water temperature ranged from 11.5°C to 18.0°C during irrigation season. Average water temperature for the irrigation season was 15.0°C. It should be noted that measured water temperature did not exceed 13.0°C until late in July, except for one measurement of 17.0°C in early June. During non-irrigation season temperature ranged from 7.0°C to 13.2°C and averaged 10.4°C. At Station #2 irrigation season temperature ranged from 11.5°C to 19.2°C and averaged 15.4°C. Non-irrigation season temperature ranged from 9.1°C to 11.3°C, and averaged 15.5°C. During non-irrigation season, temperatures ranged from 8.4°C to 13.2°C and averaged 10.7°C. Station #3 temperatures ranged from 7.9° C to 19.7° C and averaged 15.5°C during irrigation season. During non-irrigation season temperatures ranged from 12.4°C to 13.9°C and averaged 10.7°C. Dissolved Oxygen-Temperature- relationships are shown in Figures 3, 4 and 5. Temperature results are located on Tables 19, 20 and 21.

pH

pH measurements at the three stations on Conway Gulch were within this range. All stations had higher pH measurements during non-irrigation season. Average irrigation season measurements at Station #1 was 7.85su, while non-irrigation season averaged 8.08su. At Station #2 average irrigation season measurement was 7.95su, non-irrigation season averaged 8.12su. Station #3 averaged 7.83su during irrigation season and 8.13su during non-irrigation season. The somewhat higher pH measurements during non-irrigation season are probably associated with groundwater inflow. pH results are located on Tables 19, 20 and 21.

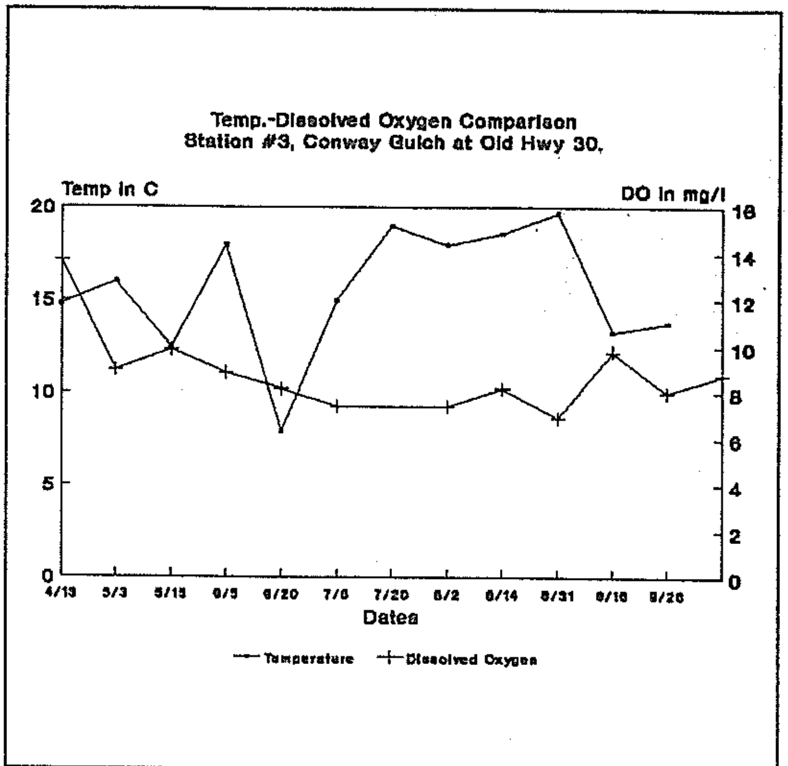

Figure 5. Dissolved Oxygen-Temperature Comparison. Conway Gulch at Highway 30. 1988-89.

Turbidity

The lower portions of Conway Gulch averaged 40 NTUs during irrigation season, while the upper station averaged 69.5 NTUs. It is probable that turbidity levels are impacting coldwater biota and salmonid spawning activity. Increased turbidity is affecting aesthetic quality and recreation potential. Further evaluation of turbidity will be examined in the statistical analysis section. Turbidity results are located on Tables 19, 20 and 21.

CHEMICAL PARAMETERS

Nutrients

The nutrients examined during this study are ammonia, nitrites, nitrates, kjeldahl nitrogen, total phosphorus, dissolved ortho phosphates and ortho phosphates. Selected nutrient constituent will be discussed separately. Chemical parameters results are located on Tables 22, 23 and 24. Comparison of data from 1981-82 and 1988-89 for total phosphorus concentrations are located on Tables 31, 32 and 33.

Phosphorus

Clark and Bauer (1982) determined total phosphorus loads for the Conway Gulch watershed to be 19,610 lbs/year, with an average concentration of 0.25 mg/L. The 1981-82 average concentration for irrigation season at Station #1 was 0.30 mg/L. Average flow was 49.8 cfs. Using a 198 day irrigation season the total load for irrigation season was 15,986.5 lbs/year irrigation season, or 80.74 lbs/day. For non-irrigation season the concentration was 0.24 mg/L with an average loading of 26.04 lbs/day. Average flow rate was 20.25 cfs. Total loading for the 167 day non irrigation season is 4,348.37 lbs/year. Total phosphorus loading for the full year was determined to be 20,335.18 lbs/year. Suspended sediment and total phosphorus loads and concentrations for 1981-82 are shown on Tables 28, 29 and 30. Comparison of the 181-82 and 1988-89 data are located in Tables 34, 35 and 36.

The 1988-89 data showed an average flow rate of **55.8** cfs and an average concentration of 0.35 mg/L for the irrigation season at Station #1. Average loads of 108.6 lbs/day were calculated with an irrigation season load of 21502.8 lbs/year for a 198 day irrigation season. Non irrigation season average concentration was 0.19 mg/L with an average load of 22.3 lbs/day. For a 167 day non-irrigation season the loading were 3,724.1 lbs/year. Total phosphorus loads for the full year was 25,226.9 lbs/year.

Station #2 had an average total phosphorus concentration of 0.30 mg/L during irrigation season. Irrigation season loads would be 9,286.2 lbs/irrigation season. Non-irrigation season total phosphorus concentrations averaged 0.21 mg/L. Total phosphorus load was 2,571.8 lbs/non-irrigation season. Station #3 showed higher total phosphorus concentration during non-irrigation season. Average non-irrigation season concentrations was 0.47 mg/L, while irrigation season concentration averaged 0.46 mg/L. Non-irrigation season load was 985.3 lbs/non-irrigation season and irrigation season load was 2,395.8 lbs/irrigation season. Station #3 exhibited higher concentration averages due to storm events that caused discharge from confined animal feeding areas. The storm events occurred in February and March and concentrations were measured at 0.79 mg/L and 1.29 mg/L respectively. A concentration of 1.61 mg/L was noted in May.

For a breakdown of segment and possible loads from each area, Station #1 accounted for 53.0% of the total phosphorus loads in Conway Gulch, Station #2 accounted for 33.6% and Station #3 13.4%. This percentage of breakdowns is comparable to stream segment sediment loads.

The 1988-89 study did show a larger contrast of total phosphorus concentrations. Station #1 showed that 85.5% of the total yearly loads of total phosphorus is associated with irrigation season. Station #2 showed that 75% of total phosphorus load is associated with irrigation season. Irrigation season loads accounted for 70% of the yearly total phosphorus loads at Station #3.

Ortho phosphorus as P. concentrations showed very little change between irrigation season and non-irrigation season at Station #1. Averages were 0.163 mg/L and 0.162 mg/L respectively. The 1981-82 data had concentration levels of 0.132 mg/L for irrigation season and 0.175 for non-irrigation season. Ortho phosphates made up 88% of the total phosphorus during non-irrigation season and 41% during irrigation season in 1988-89. This would indicate that a majority of irrigation phosphorus enrichment is tied (bound) up with the sediment in Conway Gulch. Table 22 shows breakdown of percentage ortho-phosphates to total phosphorus for each sample date.

Tables 22, 23 and 24 shows total phosphorus concentrations for 1988-89.

Groundwater that flows into Conway Gulch appears to be having an impact to phosphorus concentration found in surface waters. Dion (1972) found groundwater phosphorus concentrations averaged 0.24 mg/L for samples collected in 1970. Non-irrigation season concentration in 1989 showed that groundwater inflows were impacting surface waters. However, storm events that occurred in February and March of 1989 did affect measured concentration of total phosphorus in Conway Gulch for those months.

Nitrogen

Nitrogen is another important nutrient that can cause water quality problems when found in excess. Total inorganic nitrogen (nitrite, nitrate and ammonia) in concentrations of 0.3 mg/L is considered the limit for controlling biological nuisances and the acceleration of cultural eutrophication (Idaho Department of Health and Welfare 1980). In this study Nitrite-Nitrate (NO_2+NO_3) will be used to determine if this criteria exceeded. It should be noted that in oxygenated waters most nitrite is rapidly oxygenated to nitrate. Total ammonia concentrations appear low enough that they are not a factor for calculation of total inorganic nitrogen.

On all sampling dates and all sampling stations, nitrite-nitrate concentration exceeded the criteria of 0.30 mg/L. At Station #1 NO_2+NO_3 ranged from 2.77 mg/L to 5.63 mg/L. Irrigation season concentrations averaged 3.35 mg/L while non-irrigation season averaged 5.30 mg/L. Station #2 NO_2+NO_3 concentrations ranged from 1.46 mg/L to 4.47 mg/L. Average irrigation season concentration was 2.02 mg/L and non-irrigation season concentrations averaged 4.18 mg/L. Station #3 NO_2+NO_3 ranged from 0.64 mg/L to 4.65 mg/L. Irrigation season concentrations averaged 1.62 mg/L and non-irrigation season had an average concentration of 4.10 mg/L. Higher NO_2+NO_3 concentrations were noted during non-irrigation season which would suggest high groundwater concentrations. Dion (1972) reported a range of 0.00 mg/L to 58.00 mg/L and a median concentration of 12.00 mg/L (n=188) for groundwater in the Conway Gulch area. Lower concentrations during irrigation season are probably associated with higher flows and greater dilution.

Ammonia (NH_4 as N) concentrations ranged from 0.015 mg/ L to 0.170 mg/L at Station #1. Station #2 had an ammonia range from 0.019 mg/L to 0.317 mg/L. Station #3 had an ammonia range from 0.017 mg/L to 0.585 mg/L.

Tables 23, 23, and 24 show all chemical parameter results.

Metals

Arsenic

At Station #1 arsenic concentrations ranged from < 10.0 ug/L to 13.5 ug/L and are well below the criteria of 50 ug/L (Idaho Department of Health and Welfare 1980). Station #2 arsenic concentrations ranged from < 10.0 to 17.0 ug/L. Station #3 arsenic concentrations ranged from < 10.0 ug/L to 24.0 ug/L.

Boron

At Station #1 boron concentrations ranged from 62 ug/L to 304 ug/L. Long-term criteria for irrigation on sensitive plants is 750.0 ug/L (U. S. Environmental Protection Agency 1986). For aquatic life (minnows) concentrations for a lethal dose is 18,000 to 19,000 mg/L (U. S. Environmental Protection Agency 1988). All concentration for Station #1 were below this criteria. Station #2 concentrations ranged from 91 ug/L to 338 ug/L. Station #3 concentrations for boron ranged from 21 ug/L to 360 ug/L.

Iron

At Station #1 iron concentrations ranged from 160 ug/L to 10,280 ug/L. Environmental Protection Agency criteria for iron for freshwater aquatic life is 1.0 mg/L (1000 ug/L) (U. S. Environmental Protection Agency 1986). Iron is very abundant in many soils, especially clay soils. All samples exceeding the 1000 ug/L criteria were collected during irrigation season. Station #2 exhibited similar trends with higher concentrations during irrigation season. Concentrations ranged from 250 ug/L to 9200 ug/L. Station #3 iron concentrations ranged from 1 ug/L to 5650 ug/L. One non-irrigation season measurement, March 1989, had a concentration of 5420 ug/L. This sample was collected after a storm event and showed similar increases as nutrient and suspended sediment concentrations during the same period.

Manganese

The concentrations of manganese at Station #1 ranged from 20 ug/L to 250 ug/L. This range exceeds criteria for domestic drinking water. Manganese is not considered a problem to aquatic life (U. S. Environmental Protection Agency 1986). Station #2 had a concentration range from 20 ug/L to 200 ug/L. Station #3 concentrations ranged from 40 ug/L to 1530 ug/L. Station #3 did exceed recommended criteria for agricultural use on acidophilic crops cultivated and irrigated. The recommended criteria for these crops is 200 ug/L (U. S. Environmental Protection Agency 1986).

Zinc

The concentration of zinc ranged from 2 ug/L to 78 ug/L at Station #1. Criteria for zinc is dependent on water hardness. With a hardness of 50 mg/L $CaCO_3$, zinc concentration for one hour average is 65 ug/L. For a hardness of 100 mg/L $CaCO_3$, zinc concentration for one hour average is 110 ug/L. For a hardness of 200 mg/L $CaCO_3$, zinc concentration for one hour average is 190 ug/L (U. S. Environmental Protection Agency 1986). Without knowing hardness for Conway Gulch it is not possible to determine if this criteria is exceeded. Station #2 had a zinc concentration range from <2 ug/L to 72 ug/L. Station #3 concentrations ranged from <2 ug/L to 202 ug/L. Station #3 concentrations would indicate that U. S. Environmental Protection Agency's criteria are exceeded at this station.

Tables 13, 14 and 15 show total metal results for the three stations.

BIOLOGICAL

Bacteria

At Station #1, water quality standards for secondary contact recreation were violated 30% of the samples. Primary contact recreation standards were violated on 50% of the sample dates. During irrigation season the fecal coli/fecal strep ratio was less than 0.7 on six of the eight dates that results are available. During non-irrigation season all but one of the sampling dates had a ratio of less than 0.7.

Station #2 showed violation for primary contact recreation on 78% of the sample dates. Secondary contact recreation standards were violated on 55% of sample dates. Fecal coli/fecal strep ratio were less than 0.7 on twelve of the thirteen dates samples were collected.

Station #3 violated standards for primary contact recreation on 30% of the sample dates during irrigation season. Secondary contact recreation standards were also violated on 30% of the sample dates. Fecal coli/fecal strep ratios were less than 0.7 on twelve of the fourteen sampling dates.

Tables 16, 17 and 18 show bacteria monitoring results.

STATISTICAL ANALYSES

1981-82 AND 1988-89 SUSPENDED SEDIMENT

Further statistical analyses of the interval suspended sediment mean load shows no significant difference between data collected for baseline and data collected in the 1988-89 study. A F-Distribution calculation was used to calculate distribution at a 95% confidence interval for each years mean and standard deviation. Both the normalized monthly loads and the measured loads were examined. No significant difference was noted. Figure 3 and 4 illustrate the variation of suspended sediment loads and suspended sediment concentrations.

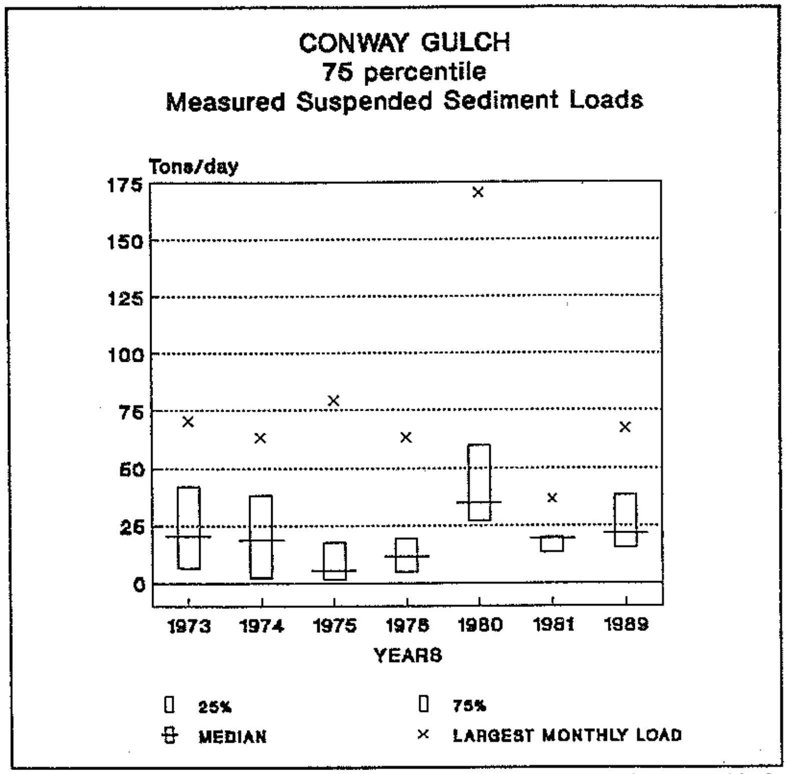

Figure 6. 75 Percentile Loads. Conway Gulch at Notus. 1973, 1974, 1975, 1976, 1980, 1981 and 1989.

PHOSPHORUS-SUSPENDED SEDIMENT CORRELATIONS

Irrigation season sediment-phosphorus correlations for Station #1 would indicate that a majority of phosphorus is associated with suspended sediment loads. Regression outputs showed a correlation value for $r^2=.91$. Non-irrigation season correlation values did not indicate that the same situation occurs during this season, correlation value for non-irrigation season is $r^2=.27$. The regression correlation values would confirm that a majority, approximately 88%, of non-irrigation season phosphorus is in the ortho phosphate form and is not associated with irrigation return flows. For Station #1 twelve (12) sample set (n=12) were available to determine correlation values for irrigation season. Six (6) sample sets (n=6) were available for non-irrigation season.

Station #2 did not exhibit the same characteristics as noted at Station #1. Correlation value for irrigation season is $r^2=.27$. For Station #2 twelve sample sets (n=12) were available to determine correlation values for irrigation season. Non-irrigation season correlation value is $r^2=.45$. Higher correlation values during non-irrigation season may be associated with the number of sample sets available for correlation calculations. For non-irrigation season only five (5) sample sets were available to determine correlation values.

Station #3 showed high correlation values for both irrigation season and non-irrigation season. Irrigation season correlation value is $r^2=.98$. Non-irrigation season correlation value is $r^2=.87$. For Station #3 twelve (12) sample set (n=12) were available to determine correlation values for irrigation season. Six (6) sample sets (n=6) were available for non-irrigation season. High correlation values are probably associated with storm events that introduced more suspended sediment into Conway Gulch during February and March, two of the five sampling dates.

Table 10, 11 and 12 shows monitoring and correlation results.

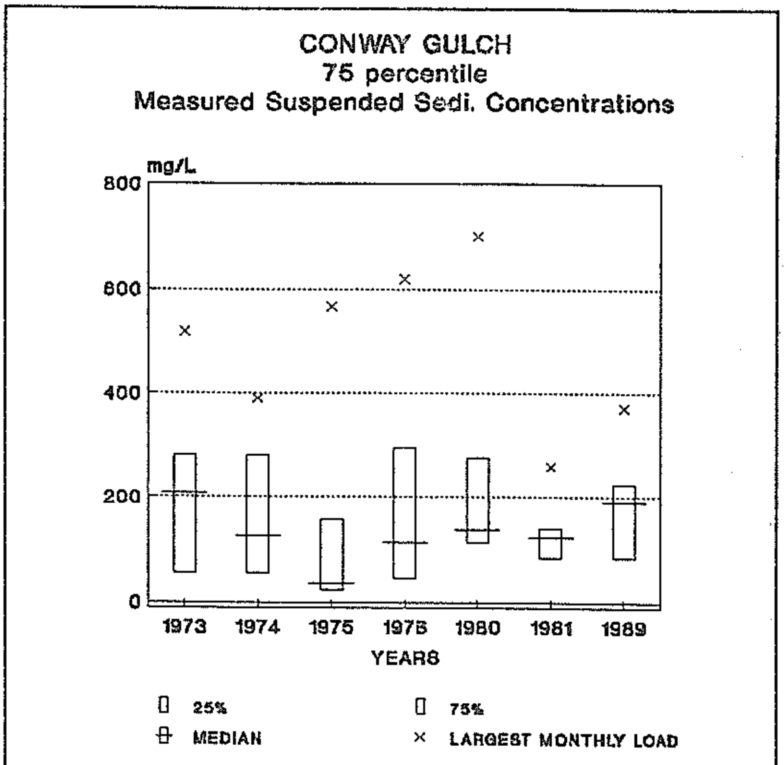

Figure 5. 75 Percentile Concentrations. Conway Gulch at Notus. 1973, 1974, 1975, 1976, 1980, 1981 and 1989.

TURBIDITY-SUSPENDED SEDIMENT CORRELATION

Although there are no current standards for turbidity in ambient surface water, there is usually a good correlation between turbidity and suspended sediment. For Conway Gulch at Station #1 turbidity measurements ranged from 7.9 NTUs to 63.0 NTUs during irrigation season, average turbidity was 37.3 NTUs. Correlation value for turbidity and suspended sediment is $r^2=.70$. Non-irrigation season turbidity ranged from 1.6 NTUs to 5.9 NTUs. Non-irrigation season correlation value is $r^2=.27$. Station #2 turbidity ranged from 6.6 NTUs to 58.0 NTUs. Correlation value is $r^2=.64$. Non-irrigation season turbidity measurements ranged from 2.5 NTUs to 29.0 NTUs and averaged 9.46 NTUs. Correlation value is $r=^2.34$. Station #3 had a turbidity range from 1.8 NTUs to 425.0 NTUs for irrigation season and averaged 69.5 NTUs. Correlation value is $r^2=.96$. Non-irrigation season turbidity measurements ranged from 2.2 NTUs to 340.0 NTUs and averaged 75.5 NTUs. Correlation value is $r^2=.99$. It appears that during irrigation season the correlation values are the greatest, which may indicate that water clarity is being impaired by colloidal material that has the capability of long term suspension, suspended sediment. Turbidity may be a useful tool for future monitoring in determining suspended sediment.

QUALITY ASSURANCE/QUALITY CONTROL

To assure that all physical parameters were recorded as accurately as the equipment allowed, all meters were calibrated daily before any measurements were obtained. Calibration followed methods recommended by the individual manufacture. To assure proper handling of data, field measurement results were recorded in a field notebook and were recorded at the time of measurement. A copy of the monitoring plan (Klahr 1988) accompanied monitoring staff into the field to assure that all monitoring procedures were followed as described in the plan.

Sample cubitainers and Nalgene bottles were inscribed with waterproof ink and clearly marked with; STORET Number, station number, station description, date of collection, time of collection, and staff. Laboratory report forms were completed at the time of sampling with all information recorded to assure sample collection and reporting accuracy. All samples, chemical, suspended sediment and bacteria, were placed in an ice chest and cooled to 4°C. Samples were delivered to the Idaho Department of Health and Welfare Bureau of Laboratories in Boise, Idaho. Sample delivery was usually within a 24 hour time period. All sample analyses followed Standard Methods (American Public Health Association (APHA) 1985), at the Bureau of Laboratories.

Lab report sheets were completed at the time of collection to assure no mixup of sample containers would occur. Actual time of sampling was recorded on both sample containers and Lab report forms at the time of collection.

To assure proper handling and transportation of samples, all sample dates were augmented with trip "BLANK" samples. Blank samples were used to determine if any contamination occurred during handling, storage or transportation. All results from "BLANK" analyses indicated no such contamination occurred.

<u>Precision</u> is a measure of mutual agreement (or measure of the dispersion) among individual analyses of the same property and <u>accuracy</u> is a measure of the agreement of a measured value with an accepted reference or true value (Bauer 1986).

Percent recovery can be utilized to determine accuracy and uses a calculation as a ratio of the measured value of a spiked sample to the true value expressed as a percentage. Ideally, percent recovery would be 100%, with a narrow recovery range. Table 46 shows percent recovery and confidence intervals calculated from spiked samples and background samples collected for Conway Gulch. Recovery for suspended sediment, total phosphorus, dissolved o-phosphates, nitrite-nitrate, and total iron appear to be within a acceptable percent recovered. Total iron may be low, but with the high concentrations recorded, a 87.2% recovery may be expected. Total Kjeldahl nitrogen recovery was very poor with a confidence interval of $\pm$ 19.0%. Tables 47 through 52 shows calculations and percent recovered. Not all parameters that received spiked analysis received consideration for accuracy. All total metal parameters received spiked analysis, but only total iron was considered for accuracy analysis. Confidence intervals were determined with the use of a Student's t-distribution table (Zar 1984).

Precision for suspended sediment, total phosphorus, dissolved o-phosphates, nitrite-nitrate, total iron, and ortho phosphates for the Conway Gulch study was excellent to good. Table 37 shows parameters and average relative range (in %) results for Conway Gulch. Precision was poor for total Kjeldahl nitrogen and total ammonia. Tables 38 through 45 shows individual precision estimates for each parameter that received duplicate (replicate) analyses.

Laboratory QA/QC procedures were initiated at the Bureau of Laboratories in Boise, Idaho. Laboratory QA/QC is to assure that all analytical equipment is operating as designed and laboratory sample handling procedure were followed. Laboratory QA/QC procedures followed methods described in Bauer et al. (1986).

CONCLUSION

Conway Gulch remains a major source of sediment, nutrients, metals, and bacteria to the Lower Boise River, even with 35% of critical area under some form of treatment. Statistical analyses of suspended sediment data indicates that no significant changes have occurred with BMP implementation. Further analysis indicates if erosion and suspended sediments are controlled, there will be improvement in water quality by reducing turbidity and total phosphorus loadings. Primary and secondary contact recreation are not supported in Conway Gulch. Coldwater biota and salmonid spawning are greatly impaired by impacts from suspended sediments, bedload sediments, turbidity, metals, dissolved oxygen, and temperature.

Nutrient (nitrite-nitrates as nitrogen and total phosphorus) levels exceed criteria for the prevention of eutrophic conditions. Higher concentrations of nitrates during non-irrigation season reflect ground water recharge that is effecting water quality and may reflect that a ground water quality problem exists in the Conway Gulch area. The three segments of Conway Gulch all contribute high concentrations of nutrients to Conway Gulch.

Both Suspended sediments concentrations and bedload sediments show no significant change since BMP implementation. Total sediment contribution from Conway Gulch is greater than 6,000 tons per year, which would indicate that erosion continues to be a significant problem in the Conway Gulch watershed. Correlation values for total phosphorus and suspended sediment indicate that to control phosphorus contribution sediment retention must also occur.
High sediment concentrations appear to be uniform throughout the watershed.

Bacteria density continue to exceed State Water Quality Standards. The Standards for primary contact recreation were violated on 50% of the monitoring dates at the lower station located near Notus, Idaho. Secondary contact recreation standards were violated on 30% of the monitoring occasions.

Metals detected within the water column still pose a threat to aquatic biomass and agricultural water supply. Iron concentrations remain high and were above criteria established to protect freshwater aquatic biomass. Iron is abundant in the soils in the Conway Gulch project area, which would indicate that soil erosion remains the major source of pollutants.

RECOMMENDATIONS

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

1. In 1987 all applicable areas to receive treatment were under contract. Areas under the first contracts are currently in a maintenance condition and those contracts are due to expire in 1994-95. A third water quality survey should be initiated in Conway Gulch starting in Water Year 1994 and continue for a two year period, including a more extensive and intensive fish collection effort. If funding is not available for an intensive monitoring effort, a limited evaluation of water quality condition may be achieved by monitoring turbidity in Conway Gulch. Comments received from landowners in the Conway Gulch have stated that they feel that water quality is improving, at least through visual inspection.

2. Best Management Practices implementation and effectiveness reviews should continue and be an integral part of any future monitoring.

3. Irrigation Water Management (IWM) may be the answer for most of the sediment and nutrient loads associated with agricultural practices in Conway Gulch. Conservative use of irrigation water could reduce the amounts of sediments and nutrients leaving a field and assist in keeping soils in place for production agriculture. Possible extension of the implementation and maintenance of Best Management Practices could be extended so IWM can be incorporated into existing treatments.

4. Research possible construction of instream retention ponds (artificial wetlands) for Conway Gulch.

5. Ortho phosphorus is still a problem in the Conway Gulch area and BMPs may have to be adjusted to help reduce all phosphorus runoff. Further practices may have to focus on IWM and fertilizer application practices, or created wetlands.

6. As recommended by Clark and Bauer (1982), the establishment of a vegetation buffer (filter) strip along Conway Gulch may enhance the removal of sediments and associated nutrients.

7. Bacteria contamination remains a significant impact to beneficial uses in Conway Gulch. Further evaluation of Confined Animal Feeding Operations, CAFOs, is needed to determine if BMP are working or if other appropriate designs are needed.

8. An evaluation of the acres within the project area that are directly impacting Conway Gulch should be conducted. Future efforts should be directed at those areas.

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Table 7. Suspended Sediment-Total Phosphorus Loads, Conway Gulch at Notus, 1988-89.

DATE	Flows (cfs)	Total Phosphorus (mg/L)	Total Phosphorus (lbs/day)	Suspended Sediment (mg/L)	Daily Suspended Sediment (Tons/day)	Interval Suspended Sediment (Tons)
10/19/88	29.3	0.19	29.9	21.0	1.6	41.5
11/15/88	25.7	0.20	27.7	18.0	1.3	36.2
12/19/88	22.3	0.20	24.0	18.0	1.1	28.2
1/18/89	16.7	0.17	15.3	8.0	0.4	10.1
2/15/89	16.5	0.18	16.0	20.0	0.9	19.6
3/8/89	21.4	0.18	20.7	20.0	1.2	39.4
4/13/89	15.4	0.20	16.6	40.0	1.7	33.3
5/3/89	27.7	0.39	58.2	216.0	16.1	193.9
5/15/89	56.5	0.36	109.5	224.0	34.2	717.6
6/5/89	50.4	0.28	76.0	156.0	21.2	318.4
6/20/89	72.0	0.31	120.1	202.0	39.3	628.3
7/6/89	67.2	0.57	206.2	371.0	67.3	942.8
7/20/89	71.8	0.48	185.5	262.0	50.8	660.3
8/2/89	57.0	0.42	128.9	248.0	38.2	458.0
8/14/89	71.9	0.36	139.3	190.0	36.9	627.0
8/31/89	54.5	0.25	73.3	85.0	12.5	200.1
9/16/89	76.2	0.27	110.7	76.0	15.6	187.6
9/28/89	48.6	0.30	78.5	130.0	17.1	393.5
					TOTAL	5581.8
Oct.-March						
mean	22.0	0.20	17.5	17.5	1.18	Total 175.0
standard dev.	4.6	0.03	4.4	4.4	0.4	
Apr.-Sept.						
mean	55.8	0.35	183.3	183.3	29.2	Total 5406.8
standard dev.	17.9	0.10	86.9	86.9	17.8	

Table 8 . Suspended Sediment-Total Phosphorus Loads, Conway Gulch at Stafford Road, 1988-89.

DATE	Flows (cfs)	Total Phosphorus (mg/L)	Total Phosphorus (lbs/day)	Suspended Sediment (mg/L)	Daily Suspended Sediment (Tons/day)	Interval Suspended Sediment (Tons)
10/19/88	13.7	0.18	13.3	20.0	0.74	21.5
11/15/88	15.0	0.19	15.3	22.0	0.89	23.2
12/19/88	12.2	0.24	15.8	NA	NA	NA
1/18/89	13.7	0.19	14.0	16.0	5.9	13.0
2/15/89	11.4	0.29	17.8	170.0	5.2	177.9
3/8/89	15.8	0.19	16.2	50.0	2.1	42.7
4/13/89	10.5	0.44	24.9	44.0	1.2	15.0
5/3/89	20.2	0.39	42.4	650.0	35.5	744.5
5/15/89	32.6	0.69	121.1	336.0	35.4	530.8
6/5/89	29.6	0.19	30.3	72.0	5.8	93.7
6/20/89	37.6	0.19	38.4	132.0	13.4	187.6
7/6/89	35.0	0.31	58.4	132.0	12.5	162.2
7/20/89	32.1	0.26	44.9	88.0	7.6	91.5
8/2/89	31.7	0.24	53.0	158.0	13.3	225.9
8/14/89	35.6	0.23	41.7	122.0	11.7	186.8
8/31/89	27.7	0.24	35.8	110.0	8.2	98.0
9/16/89	36.5	0.23	45.2	58.0	5.7	129.6
9/28/89	24.1	0.21	27.2	68.0	4.4	97.0

					TOTAL	2840.9
Oct.-March						
mean	13.6	0.21	15.4	55.6	1.9	
standard dev.	1.5	0.04	1.5	58.5	1.7	
Apr.-Sept.						
mean	29.4	0.30	45.9	164.2	12.9	
standard dev.	7.5	0.14	24.3	163.7	10.7	

Table 9. Suspended Sediment-Total Phosphorus Loads, Conway Gulch at Highway 30, 1988-89.

DATE	Flows (cfs)	Total Phosphorus (mg/L)	Total Phosphorus (tons/day)	Suspended Sediment (mg/L)	Daily Suspended Sediment (Tons/day)	Interval Suspended Sediment (Tons)
10/19/88	2.2	0.17	2.0	22.0	0.1	3.8
11/15/88	2.0	0.17	1.8	22.0	0.1	3.1
12/19/88	1.8	0.19	1.8	12.0	0.1	1.6
1/18/89	1.7	0.18	1.7	10.0	0.1	1.0
2/15/89	1.3	0.79	5.5	170.0	0.6	20.3
3/8/89	3.3	1.29	22.9	914.0	8.1	162.9
4/13/89	3.9	0.16	3.4	18.0	0.2	2.3
5/3/89	5.1	1.61	44.2	2060.0	28.4	595.7
5/15/89	2.9	0.14	2.2	50.0	0.4	5.9
6/5/89	5.0	0.22	5.9	136.0	1.8	29.4
6/20/89	8.1	0.30	13.1	56.0	1.2	17.5
7/6/89	8.6	0.43	19.9	502.0	11.7	151.5
7/20/89	4.5	0.44	10.7	388.0	4.7	56.6
8/2/89	7.1	0.36	13.8	304.0	5.8	99.1
8/14/89	4.0	0.35	7.5	248.0	2.7	42.9
8/31/89	8.3	0.22	9.8	52.0	1.2	14.0
9/16/89	5.8	0.28	8.7	84.0	1.3	30.3
9/28/89	4.7	0.23	5.8	98.0	1.2	27.4
					TOTAL	1260.9
Oct.-March						
mean	2.0	0.52	6.7	225.6	1.8	
standard dev.	0.3	0.26	1.6	67.4	0.2	
Apr.-Sept.						
mean	5.5	0.46	12.9	377.7	5.3	
standard dev.	1.9	0.43	10.7	542.4	7.4	

Table 10. Suspended Sediment-Total Phosphorus Correlation Values. Conway Gulch at Notus 1988-89.

NON-IRRIGATION SEASON

DATES	Total Phosphorus (mg/L)	Suspended Sediment (mg/L)	Regression Value	Output:
10/19/88	0.19	21.0	Constant	-20.68
11/15/88	0.20	18.0	Std Err of Y Est	4.60
12/19/88	0.20	18.0	R Squared	0.27
1/18/89	0.17	8.0	No. of Observations	6.0
2/15/89	0.18	20.0	Degrees of Freedom	4.0
3/8/89	0.18	20.0	X Coefficients	204.55
			Std Err of Coef.	170.04

IRRIGATION SEASON

DATES	Total Phosphorus (mg/L)	Suspended Sediment (mg/L)	Regression Value	Output:
4/13/89	0.20	40.0	Constant	-106.75
5/3/89	0.39	216.0	Std Err of Y Est.	28.04
5/15/89	0.36	224.0	R Squared	0.91
6/5/89	0.28	156.0	No. of Observations	12.0
6/20/89	0.31	202.0	Degrees of Freedom	10.0
7/6/89	0.57	364.0	X Coefficient(s)	831.03
7/20/89	0.48	262.0	Std Err of Coef.	80.98
8/2/89	0.42	248.0		
8/14/89	0.36	190.0		
8/31/89	0.25	85.0		
9/16/89	0.27	76.0		
9/28/89	0.30	138.0		

Table 11. Suspended Sediment-Total Phosphorus Correlation Values. Conway Gulch at Stafford Road 1988-89.

NON-IRRIGATION SEASON				
DATES	Total Phosphorus (mg/L)	Suspended Sediment (mg/L)	Regression Value	Output:
10/19/88	0.18	20.0	Constant	-141.36
11/15/88	0.19	22.0	Std Err of Y Est	63.97
1/18/89	0.19	160.0	R Squared	0.45
2/15/89	0.29	170.0	No. of Observations	5.0
3/8/89	0.19	50.0	Degrees of Freedom	3.0
			X Coefficients	1085.4
			Std Err of Coef.	694.7

IRRIGATION SEASON				
DATES	Total Phosphorus (mg/L)	Suspended Sediment (mg/L)	Regression Value	Output:
4/13/89	0.44	44.0	Constant	-19.8
5/3/89	0.39	650.0	Std Err of Y Est.	155.8
5/15/89	0.69	360.0	R Squared	0.27
6/5/89	0.19	72.0	No. of Observations	12.0
6/20/89	0.19	132.0	Degrees of Freedom	10.0
7/6/89	0.31	132.0	X Coefficient(s)	616.6
7/20/89	0.26	88.0	Std Err of Coef.	324.3
8/2/89	0.24	158.0		
8/14/89	0.23	122.0		
8/31/89	0.24	110.0		
9/16/89	0.23	58.0		
9/28/89	0.21	68.0		

Table 12. Suspended Sediment-Total Phosphorus Correlation Values. Conway Gulch at Highway 30, 1988-89.

NON-IRRIGATION SEASON				
DATES	**Total Phosphorus (mg/L)**	**Suspended Sediment (mg/L)**	**Regression Value**	**Output:**
10/19/88	0.17	22.0	Constant	-137.23
11/15/88	0.17	22.0	Std Err of Y Est	146.80
12/19/88	0.19	12.0	R Squared	0.87
1/18/89	0.18	10.0	No. of Observations	6.00
2/15/89	0.79	170.0	Degrees of Freedom	4.00
3/8/89	1.29	914.0	X Coefficients	707.31
			Std Err of Coef.	138.89

IRRIGATION SEASON				
DATES	**Total Phosphorus (mg/L)**	**Suspended Sediment (mg/L)**	**Regression Value**	**Output:**
4/13/89	0.16	18.0	Constant	-228.28
5/3/89	1.61	2060.0	Std Err of Y Est.	72.83
5/15/89	0.14	50.0	R Squared	0.98
6/5/89	0.22	136.0	No. of Observations	12.0
6/20/89	0.30	56.0	Degrees of Freedom	10.0
7/6/89	0.43	502.0	X Coefficient(s)	1420.96
7/20/89	0.44	388.0	Std Err of Coef.	55.63
8/2/89	0.36	304.0		
8/14/89	0.35	248.0		
8/31/89	0.22	52.0		
9/16/89	0.28	84.0		
9/28/89	0.23	98.0		

Table 13. Total Metal Concentrations, Conway Gulch at Notus 1988-89.

DATE	Arsenic, Total (ug/L)	Boron, Total (ug/L)	Iron, Total (ug/L)	Manganese, Total (ug/L)	Zinc, Total (ug/L)
10/19/88	12	269	560	20	4
11/15/88	13	362	615	20	6
12/19/88	14	273	580	20	3
1/18/89	12	298	160	10	6
2/15/89	13.5	270	510	20	18
3/8/89	14	270	720	40	17
4/13/89	12	229	690	40	3
5/3/89	<10	195	6350	150	23
5/15/89	<10	136	5850	130	21
6/5/89	<10	121	4540	105	19
6/20/89	<10	148	5240	150	26
7/6/89	11	114	10280	250	74
7/20/89	<10	225	7860	190	32
8/2/89	11	175	7660	175	36
8/14/89	<10	142	5940	90	28
8/31/89	<10	144	2365	60	14
9/16/89	<10	211	2120	80	14
9/28/89	11	220	3140	65	22

Table 14. Total Metal Concentrations, Conway Gulch at Stafford Road 1988-89.

DATE	Arsenic, Total (ug/L)	Boron, Total (ug/L)	Iron, Total (ug/L)	Manganese, Total (ug/L)	Zinc, Total (ug/L)
10/19/88	15	251	460	30	<2
11/15/88	14	285	650	20	<2
12/19/88	17	NA	1780	60	2
1/18/89	12	338	280	30	5
2/15/89	17	NA	3090	90	13
3/8/89	14	250	1440	60	72
4/13/89	13	222	1000	40	4
5/3/89	<10	143	6300	150	17
5/15/89	<10	97	9200	200	29
6/5/89	<10	792	2420	50	22
6/20/89	<10	112	3780	70	41
7/6/89	<10	91	4800	120	17
7/20/89	<10	175	3630	90	27
8/2/89	<10	129	4890	120	11
8/14/89	<10	98	3020	150	14
8/31/89	<10	149	3310	80	15
9/16/89	<10	166	1560	50	12
9/28/89	11	167	2080	60	34

Table 15. Total Metal Concentrations, Conway Gulch at Highway 30, 1988-89.

DATE	Arsenic, Total (ug/L)	Boron, Total (ug/L)	Iron, Total (ug/L)	Manganese, Total (ug/L)	Zinc, Total (ug/L)
10/19/88	23	292	590	70	<2
11/15/88	19	360	1510	50	<2
12/19/88	23	NA	260	30	10
1/18/89	22	317	360	130	2
2/15/89	22	286	3620	210	14
3/8/89	21	230	54200	1330	188
4/13/89	24	259	200	50	<2
5/3/89	10	116	56500	1530	202
5/15/89	<10	119	1430	40	3
6/5/89	<10	72	5620	130	48
6/20/89	<10	73	6880	150	54
7/6/89	<10	90	12270	320	42
7/20/89	<10	192	9920	250	40
8/2/89	<10	136	7980	210	24
8/14/89	<10	21	8040	190	31
8/31/89	10	154	1780	60	16
9/16/89	10	177	2180	80	10
9/28/89	13	185	2500	80	38

Table 16. Bacteria Density, Conway Gulch at Notus 1988-89.

DATE	Fecal Coliform (#/100 ml)	Fecal Strep. (#/100 ml)	Fecal Coli.-Fecal Strep. Ratio
10/19/88	250	310	0.81
11/15/88	42	1750	0.02
12/19/88	24	725	0.03
1/18/89	18	305	0.06
2/15/89	66	115	0.57
3/8/89	24	245	0.1
4/13/89	NA	NA	NA
5/3/89	195	865	0.23
5/15/89	290	NA	NA
6/5/89	1650	2550	0.65
6/20/89	1300	4100	0.32
7/6/89	550	2200	0.25
7/20/89	900	600	1.50
8/2/89	380	NA	NA
8/14/89	NA	NA	NA
8/31/89	180	10	18.0
9/16/89	530	2500	0.21
9/28/89	415	21700	0.02

Table 17. Bacteria Density, Conway Gulch at Stafford Road 1988-89.

DATE	Fecal Coliform (#/100 ml)	Fecal Strep. (#/100 ml)	Fecal Coli.-Fecal Strep. Ratio
10/19/88	160	750	0.21
11/15/88	19	980	0.02
12/19/88	110	3700	0.03
1/18/89	1	300	0.00
2/15/89	7	130	0.05
3/8/89	5	410	0.01
4/13/89	NA	NA	NA
5/3/89	300	1160	0.26
5/15/89	1200	NA	NA
6/5/89	300	3500	0.09
6/20/89	1000	4200	0.24
7/6/89	1500	4000	0.38
7/20/89	800	1300	0.62
8/2/89	900	NA	NA
8/14/89	NA	NA	NA
8/31/89	600	10	60.0
9/16/89	560	5100	0.11
9/28/89	290	30400	0.01

Table 18. Bacteria Density, Conway Gulch at Highway 30 1988-89.

DATE	Fecal Coliform (#/100 ml)	Fecal Strep. (#/100 ml)	Fecal Coli.-Fecal Strep. Ratio
10/19/88	160	760	0.21
11/15/88	63	1540	0.04
12/19/88	25	6000	0.00
1/18/89	6	2000	0.00
2/15/89	6	240	0.03
3/8/89	63	1400	NA
4/13/89	NA	NA	0.05
5/3/89	100	1400	0.07
5/15/89	100	NA	NA
6/5/89	220.	1800	0.12
6/20/89	100	3900	0.03
7/6/89	400	1700	0.24
7/20/89	3300	3200	1.03
8/2/89	330	NA	NA
8/14/89	NA	NA	NA
8/31/89	420	10	42.0
9/16/89	1200	3000	0.40
9/28/89	2800	27900	0.10

Table 19. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch at Notus. Physical Parameters 1988-89.

DATES	Temp. in C	ph su	DO mg/L	Flow cfs	Turbidity NTU	Susp. Sed. mg/l	Bedload grams
10/19/88	13.2	8.00	NA	29.3	2.4	21.0	18.9
11/15/88	11.4	8.15	9.8	25.7	4.7	18.0	103.8
12/19/88	10.1	8.2	9.2	22.3	4.4	18.0	97.5
01/18/88	10.0	NA	11.1	16.7	1.6	8.0	11.24
02/15/89	7.1	8.1	11.3	16.5	3.0	20.0	28.7
03/8/89	10.8	8.0	12.5	21.4	5.9	20.0	28.7
04/13/89	11.5	8.2	10.3	15.4	7.9	40.0	39.1
05/3/89	17.0	8.1	9.0	27.7	62.0	216.0	30.0
05/15/89	12.0	7.9	12.0	56.5	NA	224.0	90.2
06/5/89	14.8	8.1	8.9	50.4	37.0	156.0	77.3
06/20/89	12.5	8.0	7.6	72.0	50.0	202.0	37.8
07/06/89	16.0	7.95	6.6	35.0	51.0	371	28.0
07/20/89	18.0	7.9	NA	71.8	53.0	262.0	93.7
08/2/89	18.0	7.85	12.0	57.0	63.0	248.0	70.9
08/14/89	16.5	NA	8.2	71.9	31.0	190.0	28.6
08/31/89	16.9	7.36	7.4	54.5	18.0	85.0	29.7
09/16/89	13.6	7.2	8.8	76.2	18.0	76.0	22.8
09/28/89	14.1	7.75	9.2	48.6	19.0	138.0	22.1

OCT-MAR							
mean	10.6	8.11	10.7	22.0	4.3	20.7	43.8
standard dev.	1.74	0.08	4.82	4.6	8.86	37.3	37.3
APR-SEPT							
mean	15.4	7.81	8.97	55.8	40.3	196.45	48.3
standard dev.	2.0	0.29	1.7	17.9	17.1	78.75	27.1

Table 20. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch at Stafford Road, Physical Parameters 1988-89.

DATES	Temp. in C	ph su	DO mg/L	Flow cfs	Turbidity NTU	Susp. Sed. mg/l	Bedload grams
10/19/88	13.8	8.0	NA	13.7	2.6	20.0	2.3
11/15/88	11.9	8.2	9.6	15.0	4.8	22.0	17.0
12/19/88	11.0	8.2	8.9	12.2	NA	NA	3.3
01/18/88	11.1	NA	10.6	13.7	2.5	160.0	6.3
02/15/89	9.1	8.2	9.5	11.4	29.0	170.0	150.8
03/8/89	10.8	8.0	12.6	15.7	8.4	50.0	55.5
04/13/89	13.4	8.4	11.7	10.5	6.6	44.0	18.8
05/3/89	16.0	7.9	8.0	20.2	58.0	650.0	39.5
05/15/89	12.5	8.2	8.6	32.6	NA	336.0	83.6
06/5/89	16.1	8.2	8.8	29.8	25.0	72.0	85.7
06/20/89	11.5	8.0	7.0	37.6	35.0	132.0	50.0
07/6/89	15.5	7.7	6.9	35.0	35.0	132.0	99.2
07/20/89	18.0	8.0	NA	32.1	30.0	88.0	63.1
08/2/89	17.0	7.8	8.5	31.7	41.0	158.0	16.2
08/14/89	18.0	NA	7.8	35.6	20.0	122.0	6.7
08/31/89	19.2	7.8	7.4	27.7	27.5	110.0	11.3
09/16/89	13.7	7.2	9.0	36.5	12.0	58.0	31.3
09/28/89	14.1	8.2	8.8	24.1	12.0	68.0	64.9

OCT-MAR							
mean	11.28	8.12	10.24	13.63	9.46	55.6	39.20
standard dev.	1.4	0.10	1.3	1.5	10.0	58.5	53.14
APR-SEPT							
mean	15.42	7.95	8.41	29.45	27.46	164.2	47.53
standard dev.	2.3	0.31	1.26	7.54	14.18	163.7	30.40

Table 21. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch @ Old Highway 30, Physical Parameters.

DATES	Temp. in C	ph su	DO mg/L	Flow cfs	Turbidity NTU	Susp. Sed. mg/l	Bedload grams
10/19/88	13.9	8.10	9.3	2.2	2.2	22.00	6.20
11/15/88	10.8	8.13	10.9	2.0	3.9	22.00	1.80
12/19/88	9.3	8.20	10.6	1.8	NA	12.00	4.60
01/18/88	10.2	NA	11.5	1.7	2.5	10.00	4.00
02/15/89	8.4	8.10	9.1	1.3	29.0	170.00	NA
03/8/89	12.2	NA	NA	3.3	340.0	914.0	NA
04/13/89	14.8	8.60	13.7	3.9	1.8	18.00	NA
05/3/89	16.0	8.10	9.0	5.1	425.0	2060.00	NA
05/15/89	12.5	8.20	9.9	2.9	NA	50.00	NA
06/5/89	18.0	8.00	8.9	5.0	51.0	136.00	NA
06/20/89	7.9	7.90	8.2	8.1	54.0	56.00	2.40
07/6/89	15.0	7.50	7.4	8.6	45.0	502.00	105.50
07/20/89	19.0	7.80	NA	4.5	60.0	388.00	4.00
08/2/89	18.0	7.70	7.4	7.1	48.0	304.00	15.10
08/14/89	18.6	NA	8.2	4.0	33.0	248.00	NA
08/31/89	19.7	7.30	6.9	8.3	18.0	52.00	NA
09/16/89	13.3	7.20	9.8	5.8	18.0	84.00	NA
09/28/89	13.8	7.80	8.0	4.7	11.0	98.00	NA
OCT-MAR							
mean	10.68	8.13	10.28	2.05	75.52	191.67	4.15
standard dev.	1.63	0.04	0.93	0.62	132.63	327.90	1.58
APR-SEPT							
mean	15.55	7.83	8.85	5.67	69.53	333.00	31.75
standard dev.	3.26	0.39	1.79	1.83	113.92	541.08	42.86

Table 22. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch at Notus, Chemical Parameters 1988-89.

DATES	Ammonia as N mg/L	Total NO_2+NO_3 mg/L	Total T.K Nit. mg/L	Total Phosphorus mg/L	Ortho Phos. as P. mg/L	Diss. o-Phos. mg/l	% Ortho in Total Phos. (x 100)
10/19/88	0.015	5.48	0.36	0.19	0.172	0.172	0.905
11/15/88	0.015	5.09	0.51	0.20	0.166	0.173	0.830
12/19/88	0.021	5.47	0.31	0.20	0.169	0.195	0.845
01/18/88	0.049	5.63	0.33	0.17	0.150	0.169	0.912
02/15/89	0.045	5.10	0.30	0.18	0.163	0.163	0.906
03/8/89	0.048	5.02	0.53	0.18	0.158	0.173	0.878
04/13/89	0.075	5.30	0.46	0.20	NA	0.166	0.000
05/3/89	0.100	2.87	0.84	0.39	0.199	0.154	0.510
05/15/89	0.170	3.51	0.94	0.36	0.177	0.153	0.492
06/5/89	0.041	2.95	0.61	0.28	0.128	0.122	0.439
06/20/89	0.100	2.77	0.73	0.31	0.156	0.130	0.503
07/6/89	0.140	2.83	1.00	0.57	0.170	NA	0.298
07/20/89	0.080	2.84	1.01	0.48	0.198	0.156	0.413
08/2/89	0.047	2.81	0.81	0.42	0.181	0.160	0.417
08/14/89	0.149	2.89	1.02	0.36	0.137	0.145	0.381
08/31/89	0.062	3.24	0.69	0.25	0.133	0.129	0.532
09/16/89	0.061	3.09	0.66	0.27	0.117	0.126	0.433
09/28/89	0.034	5.11	0.73	0.30	0.143	0.132	0.477
OCT.,-MARCH							
mean	0.032	5.30	0.39	0.19	0.163	0.173	0.88
standard dev.	0.015	0.24	0.09	0.01	0.007	0.01	
APRIL-SEPT.							
mean	0.088	3.35	0.79	0.35	0.158	0.143	0.45
standard dev.	0.043	0.86	0.17	0.10	0.026	0.015	

Table 23. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch @ Stafford Road, Chemical Parameters 1988-89.

DATE	Ammonia as N mg/l	Total NO_2 & NO_3 as N	Total T.K. Nit. as N	Total Phos. as P	Ortho Phos. as P	Diss. o-Phos as P
10/19/88	0.026	4.02	0.34	0.18	0.174	0.163
11/15/88	0.019	3.96	0.55	0.19	0.174	0.271
12/19/88	0.022	4.14	0.41	0.24	0.178	0.178
1/18/89	0.023	4.47	0.39	0.19	0.159	0.165
2/15/89	0.065	4.34	0.49	0.29	0.170	0.158
3/8/89	0.034	4.06	0.46	0.19	0.163	0.168
4/13/89	0.048	4.08	0.27	0.44	NA	0.161
5/3/89	0.116	1.63	0.95	0.39	0.153	0.144
5/15/89	0.317	1.71	1.15	0.69	0.399	0.358
6/5/89	0.039	1.46	0.53	0.19	0.115	0.097
6/20/89	0.049	1.48	0.54	0.19	0.135	0.125
7/6/89	0.052	2.87	0.56	0.31	0.197	NA
7/20/89	0.041	1.61	0.48	0.26	0.163	0.140
8/2/89	0.071	1.74	0.57	0.24	0.140	0.130
8/14/89	0.077	1.85	0.99	0.23	0.125	0.118
8/31/89	0.044	2.19	0.60	0.24	0.134	0.130
9/16/89	0.040	1.94	0.63	0.23	0.097	0.099
9/28/89	0.03	2.65	0.49	0.21	0.133	0.124

OCT-MAR						
mean	0.032	4.17	0.44	0.21	0.170	0.184
standard dev.	0.016	0.18	0.07	0.04	0.007	0.039
APR-SEPT						
mean	0.077	2.05	0.65	0.30	0.163	0.148
standard dev.	0.076	0.72	0.24	0.44	0.079	0.069

Table 24. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch at Highway 30, Chemical Parameters 1988-89.

DATES	Ammonia as N mg/L	Total NO_2+NO_3 mg/L	Total T.K Nit. mg/L	Total Phosphorus mg/L	Ortho Phos. as P. mg/L	Diss. o-Phos. mg/L
10/19/88	0.021	4.30	0.30	0.17	0.154	0.157
11/15/88	0.020	4.17	0.54	0.17	0.167	0.204
12/19/88	0.017	4.49	0.78	0.19	0.169	0.174
01/18/88	0.040	4.65	0.39	0.18	0.157	0.156
02/15/89	0.082	4.48	0.61	0.79	0.170	0.158
03/8/89	0.093	2.82	3.04	1.29	0.185	0.151
04/13/89	0.022	3.79	0.41	0.16	NA	0.133
05/3/89	0.585	0.69	3.86	1.61	0.415	0.261
05/15/89	0.089	1.59	0.50	0.14	0.131	0.117
06/5/89	0.068	1.08	0.68	0.22	0.139	0.094
06/20/89	0.081	0.74	0.88	0.30	0.107	0.096
07/6/89	0.060	0.64	0.85	0.43	0.169	0.084
07/20/89	0.066	2.39	0.87	0.44	0.190	0.147
08/2/89	0.080	1.15	0.72	0.36	0.122	0.098
08/14/89	0.096	1.57	1.38	0.35	0.129	0.139
08/31/89	0.092	1.56	0.69	0.22	0.127	0.130
09/16/89	0.037	1.97	0.65	0.28	0.134	0.133
09/28/89	0.033	2.35	0.54	0.23	0.133	0.140
OCT-MAR						
mean	0.046	4.10	0.94	0.47	0.167	0.167
standard dev.	0.031	0.61	0.95	0.43	0.010	0.018
APR.-SEPT						
mean	0.109	1.63	1.00	0.40	0.163	0.131
standard dev.	0.145	0.87	0.89	0.38	0.087	0.044

Table 25. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch at Notus, Bedload Sediment Loads 1988-89.

DATES	Bedload Sediment (grams)	Sampling Time (in seconds)	Stream Width (ft.)	Bedload Sediment (tons/day)	Interval Bedload (tons)
10/19/88	19.0	90	6.0	0.48	10.56
11/15/88	103.8	90	5.0	2.20	54.93
12/19/88	97.5	90	6.0	2.48	71.82
01/18/88	11.2	90	5.5	0.26	6.80
02/15/89	6.0	90	5.5	0.17	4.73
03/8/89	28.7	90	5.5	0.67	14.70
04/13/89	39.1	90	8.5	1.41	47.84
05/3/89	30.0	90	6.0	0.76	15.24
05/15/89	90.2	90	6.0	2.29	27.49
06/5/89	77.3	90	6.5	2.13	44.67
06/20/89	37.8	90	10.0	1.60	24.00
07/6/89	28.0	90	11.0	1.30	20.86
07/20/89	93.7	90	12.0	4.76	66.64
08/2/89	70.9	90	9.0	2.70	35.12
08/14/89	28.6	90	10.5	1.27	15.26
08/31/89	29.7	90	11.5	1.45	24.58
09/16/89	22.8	90	11.5	1.11	17.76
09/28/89	22.1	90	11.5	1.08	12.91
TOTAL					515.90
OCT.-MARCH					
mean	44.4		5.6	1.04	163.5
standard dev.	40.4		.3	0.93	
APRIL-SEPT.					
mean	47.5		9.5	1.82	352.4
standard dev.	26.1		2.2	1.03	

Table 26. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch at Stafford Road, Bedload Sediment Loads 1988-89.

DATES	Bedload Sediment (grams)	Sampling Time (in seconds)	Stream Width (ft.)	Bedload Sediment (tons/day)	Interval Bedload (tons)
10/19/88	2.3	90	7.0	0.07	1.50
11/15/88	17.0	90	10.0	0.72	17.99
12/19/88	3.3	90	9.0	0.13	3.65
01/18/88	6.3	90	8.5	0.23	5.89
02/15/89	150.8	90	10.0	6.38	178.75
03/8/89	55.5	90	8.5	2.00	43.94
04/13/89	18.8	90	8.5	0.68	23.00
05/3/89	39.5	90	8.5	1.42	28.43
05/15/89	83.6	90	9.0	3.19	38.22
06/5/89	85.7	90	9.5	3.45	72.38
06/20/89	50.5	90	8.0	1.69	25.40
07/6/89	99.2	90	10.0	4.20	67.19
07/20/89	63.1	90	9.5	2.54	35.53
08/2/89	16.2	90	9.0	0.62	8.02
08/14/89	6.7	90	9.5	0.27	3.23
08/31/89	11.3	90	9.5	0.45	7.73
09/16/89	31.3	90	9.5	1.26	20.14
09/28/89	64.9	90	10.5	2.88	34.62
TOTAL					615.60
OCT.-MARCH					
mean	39.2		9.2	1.9	
standard dev.	53.1		0.6	2.3	
APRIL-SEPT.					
mean	46.4		9.1	1.8	
standard dev.	40.2		0.8	1.7	

Table 27. Conway Gulch (Drain) Agriculture Water Quality Project, Station: Conway Gulch at Highway 30 Bedload Sediment Loads 1988-89.

DATES	Bedload Sediment (grams)	Sampling Time (in seconds)	Stream Width (ft.)	Bedload Sediment (tons/day)	Interval Bedload (tons)
10/19/88	6.2	90	4.0	0.10	2.31
11/15/88	1.8	90	3.5	0.03	0.67
12/19/88	4.6	90	4.5	0.09	2.54
01/18/88	4.0	90	4.5	0.08	1.98
02/15/89	NA	NA	NA	NA	NA
03/8/89	NA	NA	NA	NA	NA
04/13/89	NA	NA	NA	NA	NA
05/3/89	NA	NA	NA	NA	NA
05/15/89	NA	NA	NA	NA	NA
06/5/89	NA	NA	NA	NA	NA
06/20/89	2.4	90	6.0	0.06	0.91
07/6/89	105.5	90	7.0	3.13	50.02
07/20/89	4.0	90	7.5	0.13	1.78
08/2/89	15.1	90	7.0	0.45	5.82
08/14/89	NA	NA	NA	NA	NA
08/31/89	NA	NA	NA	NA	NA
09/16/89	NA	NA	NA	NA	NA
09/28/89	NA	NA	NA	NA	NA
TOTAL					66.03
OCT.-MARCH					
mean	6.4		8.0	0.1	
standard dev.	41.5		7.2		
APRIL-SEPT.					
mean	26.4		6.3	0.77	
standard dev.	39.7		1.2		

Table 28. Conway Gulch 1981-82 Study. Conway Gulch at Notus. Total Phosphorus and Suspended Sediment Loads.

DATE	Flows (cfs)	T. Phos. (mg/L)	T. Phos. (lb/day)	Susp. Sed. (mg/L)	Susp Sed. (Tons/day)
4/13/81	16	0.24	20.67	17.3	0.75
5/13/81	48	0.36	93.01	149.1	19.3
5/28/81	59	0.30	95.27	121.5	19.3
6/10/81	59	0.20	63.51	83.5	13.3
7/28/81	52	0.43	120.35	258.5	36.3
8/26/81	55	0.32	94.73	140.0	20.8
10/6/81	60	0.25	80.74	46.5	19.1
11/24/81	19	0.24	24.54	54.5	2.4
2/23/82	30	0.26	41.98	54.5	4.4
3/18/82	16	0.22	18.95	11.1	0.48

OCT.-MARCH					
mean	21.7	0.24	28.5	37.4	2.4
standard dev.	6.0	0.02	9.8	118.9	1.6
APR.-SEPT.					
mean	49.9	0.30	81.2	126.8	18.4
standard dev.	14.4	0.07	29.4	67.6	9.7

Table 29. Conway Gulch 1981-82 Study. Conway Gulch at Stafford Road. Total Phosphorus and Suspended Sediment Loads.

DATE	Flows (cfs)	T. Phos. (mg/L)	T. Phos. (lb/day)	Susp. Sed. (mg/L)	Susp. Sed. (Tons/day)
4/13/81	4.8	0.14	3.62	3.3	0.04
5/13/81	29	0.23	35.9	86.0	6.73
5/28/81	43	0.17	39.4	72.0	8.36
6/10/81	49	0.13	34.3	36.0	4.76
7/28/81	23	0.27	33.4	150.0	9.32
8/26/81	25	0.27	36.3	145.0	9.79
10/6/81	30	0.20	32.3	52.9	4.28
11/24/81	2.8	0.25	3.8	68.0	0.51
2/23/82	2.8	0.28	4.2	68.4	0.52
3/18/82	1.9	0.23	2.4	20.0	0.10

OCT.-MARCH					
mean	2.50	0.25	3.45	52.13	0.38
standard dev.	0.42	0.02	0.80	22.72	0.19
APR.-SEPT.					
mean	29.10	0.20	30.74	77.90	6.18
standard dev.	13.30	0.05	11.27	50.35	3.18

Table 30. Conway Gulch 1981-82 Study. Conway Gulch at Highway 30. Total Phosphorus and Suspended Sediment Loads.

DATE	Flows (cfs)	T. Phos. (mg/L)	T. Phos. (lb/day)	Susp. Sed. (mg/L)	Susp. Sed. (Tons/day)
4/13/81	2.3	0.21	2.6	16.1	0.10
5/13/81	5.6	0.28	8.4	468.0	7.07
5/28/81	4.5	0.14	3.4	44.0	0.54
6/10/81	5.0	0.24	6.5	240.0	3.24
7/28/81	4.0	0.72	15.5	780.0	8.42
8/26/81	3.0	0.26	4.2	83.0	0.67
10/6/81	3.0	0.19	3.1	29.1	0.20
11/24/81	2.8	0.21	3.2	32.4	0.25
2/23/82	2.8	0.23	3.5	29.8	0.22
3/18/82	1.9	0.18	1.8	15.3	0.07

OCT.-MARCH					
mean	2.5	0.21	2.8	25.8	0.18
standard dev.	0.42	0.02	0.7	7.5	0.07
APR.-SEPT.					
mean	3.9	0.29	6.2	237.2	2.90
standard dev.	1.1	0.18	4.2	267.6	3.24

Table 31. Conway Gulch Study, Average Suspended Sediment Concentration Comparison. Conway Gulch at Notus, 1988-89 and 1981-82.

MONTH	1988-89 Suspended Sediment (mg/L)	1981-82 Suspended Sediment (mg/L)
OCTOBER	21	118
NOVEMBER	18	47
DECEMBER	18	NA
JANUARY	8	NA
FEBRUARY	20	55
MARCH	20	11
APRIL	40	17
MAY	220	135
JUNE	179	84
JULY	316	259
AUGUST	174	140
SEPTEMBER	103	NA

Table 32. Conway Gulch Study, Average Suspended Sediment Concentration Comparison. Conway Gulch at at Stafford Road, 1988-89 and 1981-82.

MONTH	1988-89 Suspended Sediment (mg/L)	1981-82 Suspended Sediment (mg/L)
OCTOBER	20	52
NOVEMBER	22	68
DECEMBER	NA	NA
JANUARY	160	NA
FEBRUARY	170	68
MARCH	50	20
APRIL	44	3
MAY	505	79
JUNE	102	36
JULY	110	150
AUGUST	130	145
SEPTEMBER	63	NA

Table 33. Conway Gulch Study, Average Suspended Sediment Concentration Comparison. Conway Gulch at Highway 30. 1988-89 and 1981-82.

MONTH	1988-89 Suspended Sediment (mg/L)	1981-82 Suspended Sediment (mg/L)
OCTOBER	22	83
NOVEMBER	22	32
DECEMBER	12	NA
JANUARY	10	NA
FEBRUARY	170	30
MARCH	914	15
APRIL	18	16
MAY	1055	256
JUNE	96	240
JULY	445	780
AUGUST	201	83
SEPTEMBER	91	NA

Table 34. Conway Gulch Study, Average Total Phosphorus Concentration Comparison. Conway Gulch at Notus, 1988-89 and 1981-82.

MONTH	1988-89 Total Phosphorus (mg/L)	1981-82 Total Phosphorus (mg/L)
OCTOBER	0.19	0.25
NOVEMBER	0.20	0.24
DECEMBER	0.20	NA
JANUARY	0.17	NA
FEBRUARY	0.18	0.26
MARCH	0.18	0.22
APRIL	0.20	0.24
MAY	0.38	0.33
JUNE	0.30	0.30
JULY	0.53	0.20
AUGUST	0.34	0.32
SEPTEMBER	0.29	NA

Table 35. Conway Gulch Study, Average Total Phosphorus Concentration Comparison. Conway Gulch at Stafford Road, 1988-89 and 1981-82.

MONTH	1988-89 Total Phosphorus (mg/L)	1981-82 Total Phosphorus (mg/L)
OCTOBER	0.18	0.20
NOVEMBER	0.19	0.25
DECEMBER	0.24	NA
JANUARY	0.19	NA
FEBRUARY	0.29	0.28
MARCH	0.19	0.23
APRIL	0.44	0.14
MAY	0.54	0.20
JUNE	0.19	0.13
JULY	0.29	0.17
AUGUST	0.24	0.27
SEPTEMBER	0.22	NA

Table 36. Conway Gulch Study, Average Total Phosphorus Concentrations Comparison. Conway Gulch at Highway 30, 1988-89 and 1981-82.

MONTH	1988-89 Total Phosphorus (mg/L)	1981-82 Total Phosphorus (mg/L)
OCTOBER	0.17	0.19
NOVEMBER	0.17	0.21
DECEMBER	0.19	NA
JANUARY	0.18	NA
FEBRUARY	0.79	0.23
MARCH	1.29	0.18
APRIL	0.16	0.21
MAY	0.88	0.21
JUNE	0.26	0.24
JULY	0.44	0.72
AUGUST	0.31	0.26
SEPTEMBER	0.26	NA

Table 37. Precision Estimates From Duplicate Samples, Conway Gulch State Agriculture Water Quality Project. Station #1, Conway Gulch at Notus 1988-89.

PARAMETERS	NUMBER OF SAMPLES	AVERAGE RELATIVE RANGE IN %
Suspended Sediment	11	8.3%
Total Phosphorus	10	8.6%
Dissolved Ortho-phosphate	9	4.6%
Total Kjeldahl Nitrogen	10	20.0%
Nitrite-Nitrate as N.	10	6.4%
Total Iron	10	3.6%
Ortho Phosphates	9	9.1%
Total Ammonia	10	16.4%

Table 38. Average Relative Range for Suspended Sediment Concentrations. Conway Gulch at Notus, Station #1, 1988-89.

DATE OF SAMPLE	X1	X2	MEAN	RANGE	R. RANGE %
10/19/88	22	20	21	2	9.524
11/15/88	18	18	18	0	0.000
12/19/88	18	18	18	0	0.000
02/16/89	16	24	20	8	40.000
04/13/89	38	42	40	4	10.000
05/03/89	216	216	216	0	0.000
06/05/89	160	152	156	8	5.128
07/06/89	364	378	371	14	3.774
08/02/89	242	254	248	12	4.839
09/01/89	80	90	85	10	11.765
09/28/89	134	126	130	8	6.154

SUM	91.183
NUMBER OF SAMPLES	11
AVERAGE RELATIVE RANGE	8.3%

Table 39. Average Relative Range for Total Phosphorus Concentrations. Conway Gulch at Notus, Station #1, 1988-89.

DATE OF SAMPLE	X1	X2	MEAN	RANGE	R. RANGE %
10/19/88	0.19	0.19	0.19	0	0.000
11/15/88	0.21	0.18	0.195	0.03	15.385
12/19/88	0.19	0.2	0.195	0.01	5.128
03/09/89	0.19	0.17	0.181	0.022	12.155
05/03/89	0.36	0.41	0.385	0.05	12.987
06/05/89	0.27	0.29	0.28	0.02	7.143
07/06/89	0.59	0.55	0.57	0.04	7.018
08/02/89	0.41	0.42	0.415	0.01	2.410
09/01/89	0.25	0.24	0.245	0.01	4.082
09/28/89	0.27	0.33	0.3	0.06	20.000

SUM	86.306
NUMBER OF SAMPLES	10
AVERAGE RELATIVE RANGE	8.6%

Table 40. Average Relative Range for Nitrite-Nitrate Concentrations. Conway Gulch at Notus, Station #1, 1988-89.

DATE OF SAMPLE	X1	X2	MEAN	RANGE	R. RANGE %
10/19/88	5.44	5.52	5.48	0.08	1.460
11/15/88	5.14	5.03	5.085	0.11	2.163
12/19/88	5.54	5.39	5.465	0.15	2.745
03/09/89	5.13	4.91	5.02	0.22	4.382
05/03/89	2.87	2.87	2.87	0	0.000
06/05/89	3.01	2.88	2.945	0.13	4.414
07/06/89	2.85	2.8	2.825	0.05	1.770
08/02/89	2.84	2.78	2.81	0.06	2.135
09/01/89	3.18	3.29	3.235	0.11	3.400
09/28/89	4.06	6.17	5.115	2.11	41.251

SUM	63.721
NUMBER OF SAMPLES	10
AVERAGE RELATIVE RANGE	6.4%

Table 41. Average Relative Range for Total Iron Concentrations. Conway Gulch at Notus, Station #1, 1988-89.

DATE OF SAMPLE	X1	X2	MEAN	RANGE	R. RANGE %
11/15/88	600	600	600.0	0.0	0.000
12/19/88	590	510	550.0	80.0	14.545
02/16/89	510	510	510.0	0.0	0.000
04/13/89	690	690	690.0	0.0	0.000
05/03/89	6500	6200	6350.0	300.0	4.724
06/05/89	4460	4620	4540.0	160.0	3.524
07/06/89	10000	10560	10280.0	560.0	5.447
08/02/89	7460	7860	7660.0	400.0	5.222
09/01/89	2360	2370	2365.0	10.0	0.423
09/28/89	3070	3140	3105.0	70.0	2.254

SUM	36.141
NUMBER OF SAMPLES	10
AVERAGE RELATIVE RANGE	3.6%

Table 42. Average Relative Range for Dissolved 0-Phosphates Concentration Conway Gulch at Notus, Station #1, 1988-89.

DATE OF SAMPLE	X1	X2	MEAN	RANGE	R. RANGE %
10/19/88	0.168	0.164	0.166	0.004	2.410
11/15/88	0.173	0.173	0.173	0	0.000
12/19/88	0.194	0.195	0.194	0.001	0.514
04/13/89	0.166	0.165	0.165	0.001	0.604
05/03/89	0.149	0.155	0.152	0.006	3.947
06/05/89	0.118	0.125	0.121	0.007	5.761
08/02/89	0.151	0.168	0.159	0.017	10.658
09/01/89	0.120	0.138	0.129	0.018	13.953
09/28/89	0.134	0.129	0.131	0.005	3.802

SUM	41.651
NUMBER OF SAMPLES	9
AVERAGE RELATIVE RANGE	4.6%

Table 43. Average Relative Range for T. Kjeldahl Nitrogen Concentrations. Conway Gulch at Notus, Station #1, 1988-89.

DATE OF SAMPLE	X1	X2	MEAN	RANGE	R. RANGE %
10/19/88	0.380	0.340	0.360	0.040	11.111
11/15/88	0.770	0.250	0.510	0.520	101.961
12/19/88	0.310	0.300	0.305	0.010	3.279
03/09/89	0.392	0.670	0.531	0.278	52.354
05/03/89	0.820	0.850	0.835	0.030	3.593
06/05/89	0.620	0.600	0.610	0.020	3.279
07/06/89	1.040	0.960	1.000	0.080	8.000
08/02/89	0.780	0.810	0.795	0.030	3.774
09/01/89	0.660	0.720	0.690	0.060	8.696
09/28/89	0.710	0.740	0.725	0.030	4.138

SUM	200.183
NUMBER OF SAMPLES	10
AVERAGE RELATIVE RANGE	20.0%

Table 44. Average Relative Range for Total Ammonia Concentrations. Conway Gulch at Notus, Station #1, 1988-89.

DATE OF SAMPLE	X1	X2	MEAN	RANGE	R.RANGE %
10/19/88	0.015	0.014	0.015	0.001	6.897
11/15/88	0.015	0.015	0.015	0.000	0.000
12/19/88	0.027	0.014	0.021	0.013	63.415
03/09/89	0.036	0.059	0.048	0.023	48.421
05/03/89	0.097	0.103	0.100	0.006	6.000
06/05/89	0.041	0.040	0.041	0.001	2.469
07/06/89	0.128	0.151	0.140	0.023	16.487
08/02/89	0.045	0.048	0.047	0.003	6.452
09/01/89	0.063	0.060	0.062	0.003	4.878
09/28/89	0.035	0.032	0.034	0.003	8.955

SUM	163.974
NUMBER OF SAMPLES	10
AVERAGE RELATIVE RANGE	16.4%

Table 45. Average Relative Range for Ortho Phosphates Concentrations. Conway Gulch at Notus, Station #1, 1988-89.

DATE OF SAMPLES	X1	X2	MEAN	RANGE	R. RANGE %
10/19/88	0.171	0.123	0.147	0.048	32.653
11/15/88	0.166	0.165	0.166	0.001	0.604
12/19/88	0.166	0.172	0.169	0.006	3.550
05/03/89	0.199	0.199	0.199	0.000	0.000
06/05/89	0.128	0.139	0.134	0.011	8.240
07/06/89	0.171	0.169	0.170	0.002	1.176
08/02/89	0.168	0.183	0.176	0.015	8.547
09/01/89	0.125	0.142	0.134	0.017	12.734
09/28/89	0.133	0.154	0.144	0.021	14.634

SUM	82.139
NUMBER OF SAMPLES	9
AVERAGE RELATIVE RANGE	9.1%

Table 46. Accuracy (% recovery) for Conway Gulch, State Agricultural Water Quality Project. October 1988 Through September 1989.

PARAMETER	NUMBER OF SAMPLES	AVERAGE % RECOVERY	95% CONFIDENCE INTERVAL
SUSPENDED SEDIMENT	11	91.8%	± 5.5%
TOTAL PHOSPHORUS	12	102.8%	± 4.0%
DISSOLVED 0-PHOSPHATE	12	101.9%	± 8.0%
T. KJELDAHL NITROGEN	12	113.0%	± 19.0%
NITRITE-NITRATE	12	100.8%	± 6.0%
TOTAL IRON	12	87.2%	± 4.7%

Table 47. Calculation of Percent Recovery (Accuracy) for Total Kjeldahl Nitrogen. Conway Gulch Water Quality Project 1998-89.

BACKGROUND "B"	RESULT "A"	RECOVERY "A"-"B"	PERCENT RECOVERY
0.30	1.82	1.52	76.0
0.49	1.78	1.29	65.5
0.61	2.12	1.51	75.5
0.46	2.45	1.99	99.5
0.27	3.62	3.35	167.5
0.41	2.96	2.55	127.5
0.88	2.96	2.08	103.0
0.54	2.65	2.11	105.5
0.73	2.91	2.18	109.0
0.66	3.51	2.85	142.5
0.63	3.47	2.84	142.0
0.65	3.51	2.86	143.0

NUMBER OF SAMPLES	12
TOTAL % RECOVERY	1355.5
AVERAGE % RECOVERY	112.96
STANDARD DEVIATION	30.65
CONFIDENCE INTERVAL	2.18

95% CONFIDENCE INTERVAL ± 19%

Table 48. Calculation of Percent Recovery (Accuracy) for Total Iron, Conway Gulch Water Quality Project, 1988-89

BACKGROUND "B"	RESULT "A"	RECOVERY "A"-"B"	PERCENT RECOVERY
160	5300	5140	93.6
280	5560	5280	96.2
360	5760	5400	98.4
54200	58200	4000	72.9
1440	6400	4960	90.3
720	5800	5080	92.5
5850	10650	4800	87.4
9200	13550	4350	79.2
1430	6300	4870	88.7
8040	12500	4460	81.2
3020	7700	4680	85.2
5940	10350	4410	80.3

NUMBER OF SAMPLES	12
TOTAL % RECOVERY	1045.9
AVERAGE % RECOVERY	87.16
STANDARD DEVIATION	7.32
CONFIDENCE INTERVAL	2.20

95% CONFIDENCE INTERVAL ± 5%

Table 49. Calculation of Percent Recovery (Accuracy) for Dissolved O-Phosphates, Conway Gulch Water Quality Project, 1988-89.

BACKGROUND "B"	RESULT "A"	RECOVERY "A"-"B"	PERCENT RECOVERY
0.163	0.653	0.490	94.4
0.158	0.665	0.507	98.6
0.178	0.635	0.083	112.0
0.166	0.663	0.497	99.4
0.161	0.684	0.523	103.8
0.133	0.644	0.511	102.9
0.096	0.596	0.500	100.0
0.125	0.597	0.472	94.4
0.130	0.830	0.700	140.0
0.126	0.578	0.452	90.4
0.099	0.579	0.480	96.0
0.133	0.582	0.449	91.2

NUMBER OF SAMPLES	12
TOTAL % RECOVERY	1223.1
AVERAGE % RECOVERY	101.93
STANDARD DEVIATION	12.82
CONFIDENCE INTERVAL	2.18

95% CONFIDENCE INTERVAL ± 8.0 %

Table 50. Calculation of Percent Recovery (Accuracy) for Total Phosphorus, Conway Gulch Water Quality Project, 1988-89.

BACKGROUND "B"	RESULT "A"	RECOVERY "A"-"B"	PERCENT RECOVERY
0.18	1.23	1.05	100.0
0.29	1.30	1.01	101.0
0.29	1.23	0.94	100.0
0.20	1.28	1.08	108.0
0.44	1.32	0.88	88.0
0.16	1.21	1.05	105.0
0.31	1.29	0.98	98.0
0.19	1.19	1.00	100.0
0.30	1.33	1.03	103.0
0.27	1.41	1.14	114.0
0.23	1.29	1.06	106.0
0.28	1.39	1.11	111.0

NUMBER OF SAMPLES	12
TOTAL % RECOVERY	1234.0
AVERAGE % RECOVERY	102.83
STANDARD DEVIATION	6.48
CONFIDENCE INTERVAL	2.18

95% CONFIDENCE INTERVAL ± 3%

Table 51. Calculation of Percent Recovery (Accuracy) for Nitrate-Nitrite as Nitrogen, Conway Gulch Water Quality Project, 1988-89.

BACKGROUND "B"	RESULT "A"	RECOVERY "A"-"B"	PERCENT RECOVERY
4.48	27.60	23.12	115.6
4.43	26.80	22.37	112.30
5.10	27.60	22.50	112.5
5.30	25.30	20.00	100.0
4.08	21.10	17.02	100.1
3.79	23.00	19.21	96.1
2.77	22.20	19.43	97.0
0.74	20.20	19.46	97.5
1.48	21.50	20.02	100.0
3.09	21.80	18.71	93.6
1.94	20.90	18.96	94.8
1.97	19.80	17.83	89.2

NUMBER OF SAMPLES	12
TOTAL % OF RECOVERY	1208.7
AVERAGE PERCENT OF RECOVERY	100.73
STANDARD DEVIATION	7.96
CONFIDENCE INTERVAL	2.18

95% CONFIDENCE INTERVAL ± 6%

Table 52. Calculation of Percent Recovery (Accuracy) for Suspended Sediment, Conway Gulch Water Quality Project, 1988-89.

BACKGROUND "B"	RESULT "A"	RECOVERY "A"-"B"	PERCENT RECOVERY
8	528	520	99.4
16	440	424	99.8
10	618	608	100.6
914	1388	474	89.5
50	390	340	100.6
20	560	540	100.6
224	528	304	86.9
336	686	350	86.0
50	368	318	92.4
248	556	308	88.5
122	370	248	78.5
190	785	595	78.5

NUMBER OF SAMPLES	11
TOTAL PERCENT RECOVERY	1101.3
AVERAGE % RECOVERY	91.78
STANDARD DEVIATION	8.07
CONFIDENCE INTERVAL	2.20

95% CONFIDENCE INTERVAL ± 5.5%