THE EFFECTS OF SEDIMENTATION RESULTING FROM A PIPELINE CROSSING A MARGINAL TROUT STREAM

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ABSTRACT

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By

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Paint Creek is located near Lake Orion, Oakland County, Michigan. Three parameters were studied quantitatively. These included suspended solids, bedload movement and aquatic insect populations. Data on these parameters were collected in gravel and rubble bottom riffles. The sampling began in Fegruary, 1971 and was completed in November, 1971.

A correlation between suspended solids and changes in the insect populations was not evident. The bedload exhibited definite changes during the various stages of construction. Sand appears to have had the greatest influence on the insect populations, especially immediately below the crossing site. A correlation between silt and clay and its effect on the insect population was not clearly shown. It was also noted that rubble bottom riffle areas seem to provide better protection for insects against sand accumulations than gravel bottoms.

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Ralph L. Hay

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TABLE OF CONTENTS

LIST OF TABLES

Table | Page

LIST OF FIGURES

INTRODUCTION

This study was undertaken to observe the effects of sedimentation on the benthic fauna resulting from construction of a pipeline across a marginal trout stream. The pipeline is part of a sewer interceptor system being constructed to transport domestic sewage from the Village of Lake Orion to a waste water treatment plant.

With the current popular demand for protection of our environment, more information concerning pollution and its effect on our environment is needed to establish meaningful standards. Sedimentation is probably the least studied form of pollution since its effects are less noticeable than chemical or biological pollution. However its effects can produce drastic changes in the ecology of a stream. Sedimentation in streams is becoming more serious as a result of increased logging, road construction, pipeline crossings and other of mans' activities.

Three parameters were studied quantitatively. These included suspended solids, bedload movement and aquatic insect populations. Data on these parameters were collected before, during and immediately after completion of the pipeline crossing. The sampling began in February, 1971 and was completed in November, 1971. An attempt was made to observe if any changes occurred in the stream through the various stages of construction. Mining wastes discharged into a stream have been cited as causing reductions in benthic organisms (Smith, 1940; Herbert, Alabaster, Dart and Lloyd, 1961). Logging, road construction and resulting soil erosion entering the stream causes changes in the benthic population (Chapman, 1962; Burns, 1970 and 1972; King and Ball, 1964; Tebo, 1955). Floods also caused reductions in benthic organisms.

STUDY AREA

Paint Creek is a small marginal trout stream located near Lake Orion, Oakland County, Michigan. The stream is an outlet of Lake Orion and flows southeasterly through hilly, forested land with moderate residential development until it joins the Clinton River. The streamflow fluctuates rapidly, especially during spring floods.

The study was limited to a section of stream between two pipeline crossing sites located approximately 1.6 miles downstream from Lake Orion and within the Bald Mountain State Recreation Area (Figure 1). The distance between the two crossing sites is approximately 1500 ft with a series of riffles and pools. During non-flood periods the depth of the riffles was less than 18 inches and the pools averaged 3 ft deep. The average width was 25 ft.

The riffle areas were selected for study since it has been shown that this portion of a stream is the most productive and affords favorable habitats for a large variety of benthic invertebrates. The bottom is composed primarily of three types, rock rubble (~45%), gravel (~45%) and sand (~10%).

Figure 1.--Paint Creek, Lake Orion, Michigan, showing location of bottom fauna sampling stations. Scale approximately one inch to 0.9 miles.

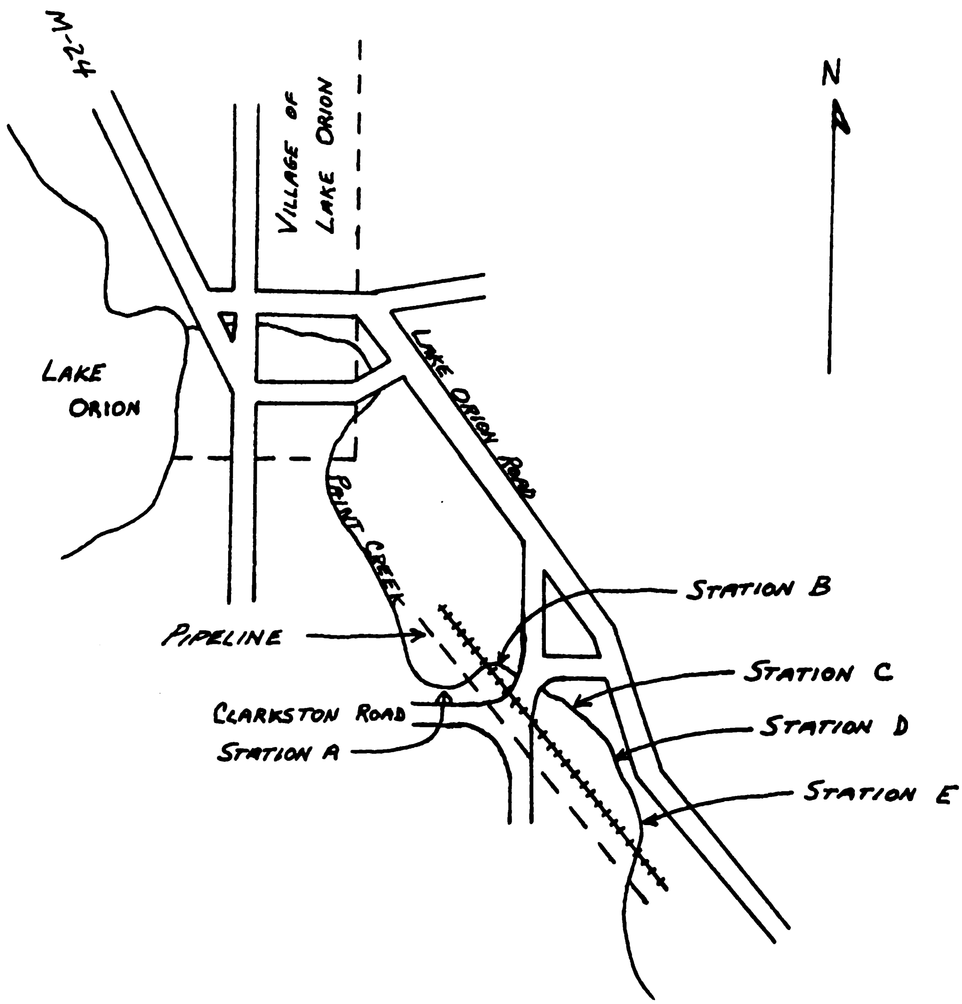
M-24
Village of Lake Orion
N
Lake Orion
Lake Orion Road
Paint Creek
Station B
Pipeline
Station C
Clarkston Road
Station D
Station A
Station E

Figure 1

SEDIMENT

Materials and Methods

Five riffle stations were chosen for study, one approximately 300 ft upstream from a pipeline crossing and four downstream, spaced at approximately 300-ft intervals. The stations were designated A through E with station A being the upstream (control) station.

Three suspended solids samples were collected at each station, one from the center of the stream and one from each margin. The samples were collected in 1-pint bottles at 4- or 8-week intervals. In the laboratory, 0.45-micron millipore filters were oven dried 1 hr at 85C and transferred to a desiccator for 2 hrs. Their weights were recorded and water filtered through them (usually 250 ml) by use of a vaccum pump. The filters were then oven dried at 85C for 1 hr and placed in a desiccator for 2 hrs. Based on the weight and volume of water filtered the suspended solids concentrations expressed as mg/l were calculated.

At each station a series of grid lines were superimposed upon the stream in a manner to establish 25 equal sized squares (approximately 5 ft x 5 ft). The bottom type within each square was classified as rubble or gravel. Three sampling sites for each bottom type were randomly selected.

To sample the continuous movement of bedload in each substrate, tin cans were buried in the stream bottom. The cans were buried so that the top was approximately level with the stream bottom. This was accomplished by digging a hole slightly larger than the can. When the can was in the proper position the surrounding material was pushed in around it.

The cans were filled with washed gravel similar in size to that of the natural streambed and small holes were drilled into the sides to allow for subterranean water movement. The rubble bottom was sampled by burying three large cans, $6\frac{1}{4}$ inches deep and 5 inches in diameter. The three cans placed in the gravel bottom were $4\frac{1}{4}$ inches deep, with a diameter of $2\frac{7}{8}$ inches. They were left in the stream bottom for 4 or 8 weeks.

The sediment which collected in the traps was separated into three size categories, sand, silt and clay, based upon settling rates. The sediment collected in the traps was washed into a 1-gal container, the contents thoroughly mixed and allowed to settle for 15 seconds, the supernatant decanted off into a second 1-gal container and the procedure repeated until the supernatant became clear. The combined supernatant in the second container was thoroughly mixed and allowed to settle for 15 minutes.

The supernatant was decanted off into a third 1-gal container and this final mixture was allowed to settle for 24 hours.

The material which settled out in 15 seconds was then oven dried and sifted for 15 minutes on an automatic shaker through a U.S. Standard sieve having an opening of 4.00 mm. The material passing through the sieve was sand. The material which settled out in less than 15 minutes but greater than 15 seconds was oven dried and weighed, and termed silt. The material settling out in less than 24 hours but greater than 15 minutes was considered clay and its dry weight recorded.

Discussion of Results

Suspended Solids

Table 1 shows the mean values for the suspended solids samples at the various stations and dates. These data were subjected to a one-way analysis of variance test for each date to see if there was a significant difference in suspended solids. If there was a significant difference at the .05 level, Duncan's new multiple range test was used to compare the mean values for each station.

Only the series of samples collected on November 1, 1971 (immediately after completion of construction) were found to differ statistically at the .05 level. Duncan's test revealed that the control was not significantly

TABLE 1.--Mean values for suspended solids (mg/l) with the standard error in parenthesis. All means based upon three samples.

Date	Station				
	A	B	C	D	E
February 7, 1971	9.86 (0.00)	6.68 (1.50)	9.52 (1.30)	10.68 (2.36)	7.46 (0.74)
April 3, 1971	1.57 (0.36)	5.67 (2.75)	10.85 (1.38)	9.28 (3.42)	3.90 (1.13)
May 28, 1971	13.26 (2.44)	13.28 (3.84)	9.93 (2.27)	7.82 (3.99)	11.30 (1.05)
June 25, 1971	5.52 (0.65)	5.34 (0.96)	4.48 (0.19)	7.23 (2.09)	3.81 (1.17)
July 25, 1971	12.52 (1.18)	12.55 (0.96)	12.63 (4.53)	13.21 (0.55)	14.04 (1.55)
August 20, 1971	7.18 (2.31)	7.44 (0.97)	8.29 (2.47)	5.74 (1.58)	7.01 (2.34)
September 17, 1971	10.31 (1.62)	12.14 (3.39)	12.71 (5.03)	22.16 (5.73)	7.82 (3.79)
November 1, 1971	17.05 (1.94)	18.00 (2.38)	16.47 (3.09)	24.12 (1.30)	28.15 (1.32)

different from stations B and C but was significantly lower than stations D and E. A correlation between suspended solids concentrations and construction activities was difficult to establish due to the infrequent sampling.

Tebo (1955) found that logging produced suspended solids concentrations from 261 to 390 ppm. The abundance of benthic organisms below the entrance of the turbid water was reduced by approximately 75%. Herbert, et al. (1961) found that the bottom fauna (expressed as wet weight per unit area) in clean Cornish streams was about nine times the density occurring in streams containing 1000 and 6000 ppm suspended solids, although in a stream with an average of 60 ppm the bottom fauna was about equal to that of clean rivers. In this study, most samples contained less than 20 mg/l, suggesting that suspended solids present no serious problem for the stream invertebrates.

Sediments

The sediment traps were first placed in the stream bottom on February 7 and were lifted eight weeks later (April 3). During this time no construction took place. Table 2 shows the results of Duncan's new multiple range test for mean values of various size sediments at the various stations. The table reveals that there was little change in sedimentation between stations.

TABLE 2.--Results of Duncan's new multiple range test for mean values of various size sediments at the different stations collected on April 3, 1971.*

Substrate Type	Sediment Size	Station				
Gravel:						
	Sand	D 103.33(3)	A 110.59(3)	E 111.79(2)	B 115.23(3)	C 118.90(2)
	Silt	D 1.17(3)	A 1.66(3)	E 1.86(2)	C 1.96(3)	B 2.04(2)
	Clay	B 0.29(3)	A 0.31(3)	C 0.32(2)	D 0.41(3)	E 0.58(2)
Rubble:						
	Sand	D 343.43(3)	C 392.08(3)	E 399.40(3)	A 459.16(3)	B 465.20(3)
	Silt	A 17.65(3)	C 17.65(3)	B 17.87(3)	D 24.02(3)	E 27.60(3)
	Clay	C 0.70(3)	D 0.87(3)	E 0.98(3)	B 0.99(3)	A 1.11(3)

*In this and subsequent tables involving Duncan's new multiple range test, any two means underscored by the same line are not statistically different at the .05 level. Weights are expressed in grams and the number in parentheses is the sample size.

During the first week of May the right-of-way was clear-cut of all trees and shrubs. Because the land is slightly susceptible to erosion, sediment accumulation from April 3 to May 28 should reflect changes resulting from the brushing operation. Table 3 shows accumulation of sediment during this time.

In looking at Table 3 it can be seen that the control station had the greatest accumulation of sediment. Perhaps this resulted from sediment upstream from station A being transported downstream during increased streamflow. The data indicate that the immediate effects of brushing caused no noticeable increase in sediment accumulation.

From May 28 to June 25 there was no noticeable activity on the right-of-way. The sediment collected in the June 25 sample reflects changes in sedimentation that may have occurred during this time. Table 4 shows that the sand and silt accumulations were significantly greater at station B than at the control in both the gravel and rubble bottoms. The clay accumulations were significantly greater at station E. This data shows that during the 4-week period the barren right-of-way probably contributed substantial amounts of sand and silt to the stream bottom immediately below the crossing site. The finer clay apparently moved farther downstream before it settled out.

TABLE 3.--Results of Duncan's new multiple range test for mean values of various size sediments at the different stations collected on May 28, 1971.

Substrate Type	Sediment Size	Station				
Gravel:						
	Sand	E 81.09(3)	D 100.72(2)	B 107.17(2)	C 113.34(2)	A 119.97(3)
	Silt	B 3.16(2)	C 3.17(2)	D 3.36(2)	E 3.45(3)	A 3.89(3)
	Clay	E 0.19(3)	B 0.22(2)	D 0.24(2)	C 0.36(2)	A 0.37(3)

TABLE 4.--Results of Duncan's new multiple range test for mean values of various size sediments at the different stations collected on June 25, 1971.

Substrate Type	Sediment Size	Station				
Gravel:						
	Sand	C 63.77(2)	E 78.69(3)	D 94.58(3)	A 99.74(3)	B 182.54(2)
	Silt	D 2.49(3)	A 2.93(3)	E 4.40(3)	C 7.32(2)	B 8.30(2)
	Clay	D 0.21(3)	C 0.33(2)	B 0.34(2)	A 0.35(3)	E 0.56(3)
Rubble:						
	Sand	D 77.11(3)	E 82.12(3)	C 92.48(2)	A 472.63(2)	B 715.24(3)
	Silt	A 45.36(2)	D 49.18(3)	C 57.52(2)	E 63.49(3)	B 301.25(3)
	Clay	D 0.52(3)	C 0.55(2)	B 0.63(3)	A 0.69(2)	E 0.86(3)

From June 25 to July 25 there was still no further construction on the right-of-way. Table 5 shows the results of sediment accumulation during this time. The rate of sand and silt accumulations in the gravel bottoms were only slightly greater at station B. The clay deposits are significantly greater at station B than at the control.

The sand and silt accumulation were slightly greater at station A than at station B in the rubble areas. On the other hand the deposition of clay at station B was slightly larger than at the control.

During this time period it appears that the barren right-of-way did not contribute a substantial amount of sediment to the stream, perhaps because of a lack of rainfall.

Table 6 shows the accumulations of sediment in the two substrates from July 25 to August 20, 1971. During this time the right-of-way was leveled by bulldozers. A culvert was placed lengthwise in the stream channel and sand bags placed at both ends to divert the entire stream flow through it. This will allow the pipeline to be buried beneath the stream without blocking the flow. In addition ground water beneath the right-of-way was pumped onto the land surface which prevents the ditch from filling with water when excavated.

TABLE 5.--Results of Duncan's new multiple range test for mean values of various size sediments at the different stations collected on July 25, 1971.

Substrate Type	Sediment Size	Station				
Gravel:						
	Sand	E 16.35(3)	C 38.35(3)	D 41.75(3)	A 41.86(2)	B 48.46(2)
	Silt	E 5.43(3)	C 8.24(3)	D 8.91(3)	A 9.26(2)	B 11.88(2)
	Clay	A 0.20(2)	E 0.26(3)	D 0.34(3)	C 0.40(3)	B 0.42(2)
Rubble:						
	Sand	E 13.62(2)	D 23.49(3)	C 42.22(2)	B 76.28(2)	A 80.34(2)
	Silt	B 29.20(2)	A 29.62(2)	C 29.87(2)	E 30.28(2)	D 31.81(3)
	Clay	E 0.29(2)	D 0.29(3)	A 0.49(2)	C 0.58(2)	B 0.62(2)

TABLE 6.--Results of Duncan's new multiple range test for mean values of various size sediments at the different stations collected on August 20, 1971.

Substrate Type	Sediment Size	Station				
Gravel:						
	Sand	E 16.77(3)	C 47.00(2)	D 53.67(3)	A 64.40(3)	B 76.95(3)
	Silt	A 4.93(3)	B 9.21(3)	C 9.22(2)	E 14.02(3)	D 15.54(3)
	Clay	A 0.54(3)	E 0.83(3)	C 0.84(2)	B 0.86(3)	D 0.92(3)
Rubble:						
	Sand	E 16.59(3)	C 21.93(2)	D 23.81(3)	A 113.92(2)	B 194.81(3)
	Silt	A 19.67(2)	B 55.84(3)	C 56.69(2)	E 67.93(3)	D 74.07(3)
	Clay	A 1.16(2)	C 1.21(2)	D 1.34(3)	E 1.37(3)	B 1.49(3)

Sand accumulations in both the rubble and gravel bottom riffles were significantly greater at station B than at the control. Both silt and clay deposits were greatest at station D in the gravel riffles. Silt deposits at station D were significantly larger than the control in the rubble riffles.

Perhaps the leveling of the right-of-way coupled with pumping ground water onto the surface resulted in some soil erosion. Sand settled out first, with the silt and clay being carried downstream.

However, some of the ground water was discharged to the stream above station A. This increased flow may have moved additional amounts of sediment downstream. Therefore it is difficult to determine which factor(s) are responsible for the increased sediment deposits.

From August 20 to September 17, 1971 there was continued pumping of ground water. The sand deposits at station B were significantly greater than at the control in gravel and rubble riffles (Table 7). The large accumulation of sand at station E in the gravel riffle may be from earlier deposition upstream being carried to this station.

Silt deposits were greatest at station B in both types of riffles. Perhaps a change in streamflow resulted in the sand and silt being deposited at station B at different times. Again it appears that the pumping of

TABLE 7.--Results of Duncan's new multiple range test for mean values of various size sediments at the different stations collected on September 17, 1971.

Substrate Type	Sediment Size	Station				
Gravel:						
	Sand	D 18.09(3)	A 19.09(3)	C 26.39(3)	B 32.31(3)	E 89.12(3)
	Silt	A 9.05(3)	E 12.28(3)	C 14.65(3)	D 15.76(3)	B 16.64(3)
	Clay	A 1.12(3)	B 1.19(3)	C 1.32(3)	D 1.44(3)	E 1.69(3)
Rubble:						
	Sand	A 46.73(3)	D 76.01(2)	C 107.38(2)	E 118.26(3)	B 157.44(3)
	Silt	A 56.61(3)	E 57.78(3)	D 76.07(2)	C 80.52(2)	B 101.55(3)
	Clay	A 1.68(3)	E 2.05(3)	C 2.39(2)	D 2.72(2)	B 3.06(3)

ground water and the barren right-of-way contributed to increased sedimentation.

During the last phase of the study (September 17 to November 1, 1971) the pipeline was buried beneath the streambed and the culvert removed. This resulted in considerable activity in and around the stream. It can be seen from Table 8 that sand accumulations at station B were significantly greater than the control. The silt and clay deposits were generally greater downstream. This activity undoubtedly caused an increase in sedimentation.

Sediment accumulation were greatest when the right-of-way lay barren and when construction was in and around the stream. Sand accumulations were largest immediately below the crossing site and gradually moved downstream. Silt and clay deposits were more irregular in their movement downstream. Due to their size they are more likely to be carried farther downstream and out of the study area.

Burns (1970) found that logging near a stream increased sedimentation. After logging the amount of sediment smaller than 0.8 mm was 30% greater than before logging. Sheridan and McNeil (1968) found that sedimentation increased immediately after logging but that five years later the amounts of sediment in spawning beds was not statistically different than before logging. King and Ball (1964) also found that highway construction caused

TABLE 8.--Results of Duncan's new multiple range test for mean values of various size sediments at the different stations collected on November 1, 1971.

Substrate Type	Sediment Size	Station				
Gravel:						
	Sand	A 22.06(3)	D 64.14(3)	C 69.91(3)	E 93.64(3)	B 118.51(3)
	Silt	E 3.45(3)	A 8.36(3)	D 19.02(3)	C 20.17(3)	B 24.36(3)
	Clay	E 0.44(3)	A 0.57(3)	B 0.95(3)	C 1.21(3)	D 1.60(3)
Rubble:						
	Sand	D 78.06(3)	A 151.89(3)	C 161.82(3)	E 163.73(3)	B 638.05(3)
	Silt	A 41.55(3)	B 65.16(3)	E 79.57(3)	C 128.32(3)	D 146.04(3)
	Clay	B 1.36(3)	A 1.49(3)	E 1.61(3)	C 1.70(3)	D 2.54(3)

extensive sedimentation with a drastic reduction in benthic fauna.

INSECT POPULATIONS

Materials and Methods

The procedure for selecting insect sample sites was the same as that used in selecting sites for the sediment traps except that five sample sites were selected in each substrate type. Samples were collected by means of a modified surber square-foot bottom sampler (Figure 2).

Samples were collected in early April before construction of the pipeline and in early November, immediately after completion of the construction. Ten samples were collected from each station, five from each of the bottom types. After analyzing the samples it was found that the insect fauna comprised the bulk of the sample and therefore only the insect populations were studied.

Samples collected in the field were sieved through a U.S. Standard sieve, no. 30 and preserved in 10% formalin. They were then identified to genera in the laboratory, except for the midges and black flies which were classified only to family. Numbers and dry weight were recorded for each taxa. A one-way analysis of variance was determined for each species (or relatively large numbers) during each sampling period.

Figure 2.--Diagram of the modified surber square-foot bottom sampler used in sampling insect populations. Height of sampler is about 20 inches.

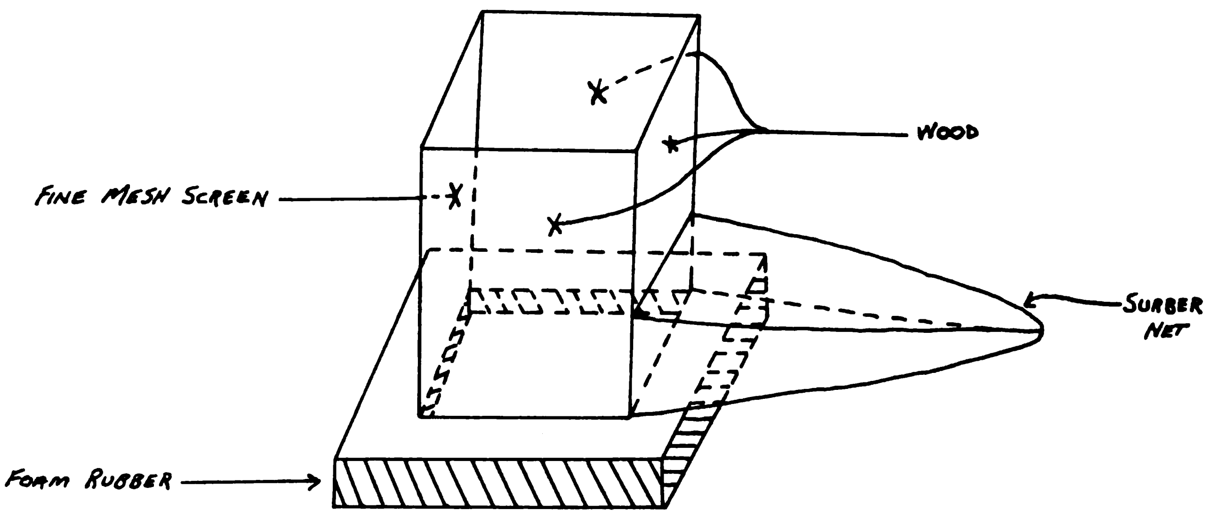

Figure 2

Discussion of Results

Tables 9 and 10 show the species of aquatic insects present in the gravel and riffle areas on April 3 and 4, 1971. Previous to this time there was no construction. Within the gravel riffles the largest standing crop of insects was at stations B and C (Table 9). Simuliidae, Hydropsychidae and Chironomidae were the most abundant.

Within the rubble riffles, stations B, D and E had the largest standing crop (Table 10). Again Simuliidae, Hydropsychidae and Chironomidae were the most abundant. Two additional forms were also found in the rubble riffles.

After completion of construction another series of insect samples were collected (November 1, 1971). Tables 11 and 12 show the species present in the gravel and riffle areas, respectively.

Between the two dates there was a slight increase in numbers of insects at station A whereas there was a substantial reduction at station B. The reduction is more pronounced in the gravel riffles.

Table 13 shows the total biomass of insects collected on April 3-4 and November 1, 1971. The November 1 collections show a definite reduction in biomass at station B in both gravel and rubble bottom riffles.

Sand accumulations the previous 4 weeks were significantly greater at station B and appears to be

TABLE 9.--Aquatic insects collected in Paint Creek on April 3-4, 1971. The quantities shown represent the number of insects collected in five square-foot samples from the gravel riffles.

Taxa	Station				
	A	B	C	D	E
Stenonema spp.	5	1	2		3
Helicopsyche sp.			1		
Hydropsyche spp.	5	43	117	20	30
Cheumatopsyche sp.	10	24	27	7	21
Ancyronyx sp.					4
Stenelmis sp.	1	3			3
Antocha sp.	3	13	28	4	6
Tipula sp.	6	3			
Simuliidae	180	179	211	179	207
Chironomidae	14	199	121	12	105
TOTAL number of insects	224	465	507	222	379
TOTAL number of taxa	8	8	7	5	8

TABLE 10.--Aquatic insects collected in Paint Creek on April 3-4, 1971. The quantities shown represent the number of insects collected in five square-foot samples from the rubble riffles.

Taxa	Station				
	A	B	C	D	E
Neophasgonophora sp.					1
Stenonema spp.	10	11	19	36	37
Corydalus cornutus					1
Hydropsyche spp.	70	74	157	138	142
Cheumatopsyche sp.	73	79	91	61	67
Ancyronyx sp.	2	2	5	1	2
Stenelmis sp.	2		5	1	2
Antocha sp.	6	32	20	44	6
Tipula sp.					2
Simuliidae	313	451	320	613	706
Chironomidae	119	251	146	72	140
TOTAL number of insects	595	900	763	966	1106
TOTAL number of taxa	8	7	8	8	11

TABLE 11.--Aquatic insects collected in Paint Creek on November 1, 1971. The quantities shown represent the number of insects collected in five square-foot samples from the gravel riffles.

Taxa	Station				
	A	B	C	D	E
<u>Neophasgonophora</u> sp.	1		3	3	8
<u>Stenonema</u> spp.	34	12	103	46	30
<u>Basiaeschna</u> sp.		1			
<u>Hydropsyche</u> spp.	111	6	267	151	74
<u>Cheumatopsyche</u> sp.	58	3	165	113	76
<u>Ancyronyx</u> sp.	35		13	16	16
<u>Stenelmis</u> sp.	24	2	7	22	21
<u>Antocha</u> sp.	33	1	31	27	10
<u>Tipula</u> sp.	35	1	17	15	3
Simuliidae*	2			1	
TOTAL number of insects	331	25	606	393	238
TOTAL number of taxa	8	6	8	8	8

*Very small individuals and possibly many passed through the net so they are not included in the data.

TABLE 12.--Aquatic insects collected in Paint Creek on November 1, 1971. The quantities shown represent the number of insects collected in five square-foot samples from the rubble riffles.

Taxa	Station				
	A	B	C	D	E
Neophasgonophora sp.	4				
Stenonema spp.	158	45	77	50	49
Hydropsyche spp.	214	153	261	226	101
Cheumatopsyche sp.	192	84	195	197	74
Ancyronyx sp.	8	13	4		9
Stenelmis sp.	6		1		
Antocha sp.	41	40	44	34	19
Tipula sp.	27		11	7	2
Simuliidae*			2	9	6
Chironomidae	9		11	13	35
TOTAL number of insects	659	335	594	527	289
TOTAL number of taxa	9	5	8	6	7

*Very small individuals and possibly many passed through the net so they are not included in the data.

TABLE 13.--Total dry weight (grams) of all insects collected in five square-foot bottom samples from Paint Creek.

Date	Substrate	Station				
		A	B	C	D	E
April 3-4, 1971	Gravel	1.06	0.59	0.80	0.19	1.40
	Rubble	0.91	1.21	1.12	1.50	2.06
November 1, 1971	Gravel	2.45	0.27	1.87	1.92	0.55
	Rubble	2.59	0.68	1.67	1.68	0.58

responsible for the reduction in insect fauna. Sand accumulations at station E in the gravel riffles could account for the decline in insects while no explanation can be given for the reduction in the rubble riffles.

The species most affected were the net spinning caddisflies which are quite vulnerable to the molar action of sand. Also it appears that the insects within the rubble are able to withstand the effects of sedimentation better than those in gravel. This is probably because the rubble is less likely to be buried in sediment.

The question that now remains unanswered is whether or not the insect population is permanently damaged. Burns (1972) found that once the riffle areas are cleared of sediment that the insect population quickly re-establishes itself through reproduction of those individuals remaining and through insect drift.

SUMMARY

Sediment samples were collected before, during and immediately following construction of a pipeline across Paint Creek. The study was undertaken to observe any possible changes in the insect fauna as a result of the construction.

Suspended solids concentrations did not differ significantly during the various stages of construction. This may be due to two factors, the first being that this type of construction does not result in high turbities, perhaps related to the type of soil (sandy) present. The second is that of infrequent sampling periods. A correlation between suspended solids and changes in the insect populations was not evident.

The bedload on the other hand shows definite changes during the various stages of construction. Sand appears to have had the greatest influence on the insect populations, especially immediately below the crossing site. A correlation between silt and clay and its effect on the insect population was not clearly shown. This is probably due to the fact that silt and clay are easily transported by the stream and were carried beyond the study area. It was

also noted that rubble bottom riffle areas seem to provide better protection for insects against sand accumulations than gravel bottoms.

Before standards can be established to protect our environment more research has to be done on sedimentation on a quantitative basis, especially over a period of years. This problem is not easy to solve since streams vary widely in their characteristics and are in a constant state of change but if sufficient information is accumulated, some meaningful standards can be established.

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