S&A/TIB - 27

CLARK FORK RIVER STUDY
MONTANA
JULY - AUGUST, 1973

TECHNICAL INVESTIGATIONS BRANCH
SURVEILLANCE AND ANALYSIS DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY
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INTRODUCTION

This report on the quality of the waters of the Clark Fork River in the vicinity of Missoula, Montana is based on information obtained during the July 23 - August 3, 1973 field investigation conducted by personnel of Region VIII, Environmental Protection Agency.

The study was initiated in response to the request by the Montana Department of Health and Environmental Sciences for assistance in identifying existing water quality conditions in the river and any damage to aquatic life or degradation of water quality resulting from seepage or surface discharges from the Hoerner Waldorf Corporation paper mill located west of Missoula, Montana. The water quality and biological study was requested to cover specifically the reach of river extending from the City of Missoula to an area approximately 30 miles (48 km) downstream.

DESCRIPTION OF STUDY AREA

I. General

The Clark Fork of the Columbia River is located in the western portion of the State of Montana. The river originates in the hills near the City of Butte, and flows in a generally northwest direction for about 520 miles (832 km) where it terminates at Pend Oreille Lake in Northern Idaho. From its origin, to Warm Springs, Montana, the stream is known as Silver Bow Creek.

In the reach of the Clark Fork River from Warm Springs to Garrison, Montana, the river flows through Deer Lodge Valley, a north-south valley bordered on the east by the Continental Divide and on the west by the Flint Creek Range. The river then flows northwesterly through another valley bordered by the Garret Range and Sapphire Mountains, toward Missoula, Montana. The river continues on its northwesterly path from Missoula to the Montana-Idaho border through the valley bordered by the Bitterroot Range and Cabinet Mountains. The flood plain in this reach is underlain by alluvial silt, sand and gravel, with the river presently cutting into bedrock in numerous places. This latter reach contains the section of river covered by this investigation.

The area is characterized by long, cold winters and low precipitation. The precipitation, most of which usually occurs during the spring and summer months, was considerably below average this year. As a result the river was at a low flow condition during the study. During the course of the investigation, the river stage was observed to drop about 6 inches (0.15 m).

There is one major tributary to the Clark Fork River in the study area. This is the Bitterroot River which flows in a northerly direction entering the Clark Fork just downstream from Missoula.

Agriculture is Montana's leading consumptive water user and principle source of income. The tourist industry, petroleum production, lumbering, mining, and manufacturing are secondary to agriculture as income producers. The major industry in the study area is the paper mill operated by the Hoerner Waldorf Corporation, located just west of Missoula. The City of Missoula itself has grown to become western Montana's commerical, industrial, educational and transportation center.

II. Water Quality Standards

The Montana Department of Health and Environmental Sciences has adopted water quality standards for the Clark Fork River. These standards classified the reach from the Little Blackfoot River, which is located about 64 miles (103 km) upstream from

Missoula, to the Montana-Idaho border as $B\text{-}D_1$. This reach includes the study area.

These standards consist of specified water quality criteria designed to protect specified water uses. These criteria are summarized in Appendix A.

The standards applicable to the study area call for the quality of the water to be maintained suitable for drinking, cullinary, and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection, and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; growth and propagation of salmonid fish and associated aquatic life, waterfowl, and furbearers; agricultural and industrial water supply.

SURVEY METHODS

I. Water Quality Evaluation

To determine existing water quality and biological conditions in the Clark Fork River, a short-term, intensive field investigation was conducted during the period July 23 - August 3, 1973. Twelve sampling stations were established on the river within the study area (Figure 1), and sampling was conducted for two 5-day periods.

Samplers made field determinations at each station for dissolved oxygen, temperature, pH and conductivity, and collected additional water samples for laboratory determinations. All water quality samples collected were "grab" type samples, with sampling times staggered throughout the sampling day. The laboratory determinations included 5-day biochemical oxygen demand (BOD), total coliform, fecal coliform, and fecal streptococcous. Laboratory facilities for use by EPA personnel were provided by the University of Montana and the City of Missoula.

A detailed description of station locations and results of all analyses appear in Appendix B.

II. Biological Evaluation

Sampling was performed in riffle areas at approximately the same locations as the water quality sampling stations (Appendix Table B-1).

Several methods were used to collect qualitative samples of aquatic invertebrates. Organisms were handpicked with tweezers from selected rocks and debris. They were also captured by holding a dip net close to the bottom of the river and dislodging and stirring up the substrate immediately upstream from the net.

Quantitative samples were collected with a Surber square foot sampler and with multi-plate artificial substrates. Two or three square foot samples were collected from each sampling area where water depth didn't exceed 0.305 meters (one foot). Samples were sieved with a U.S. Standard No. 30 sieve and organisms remaining on the sieve were placed in pint jars with 10 percent formalin and transported to the EPA lab in Denver for processing.

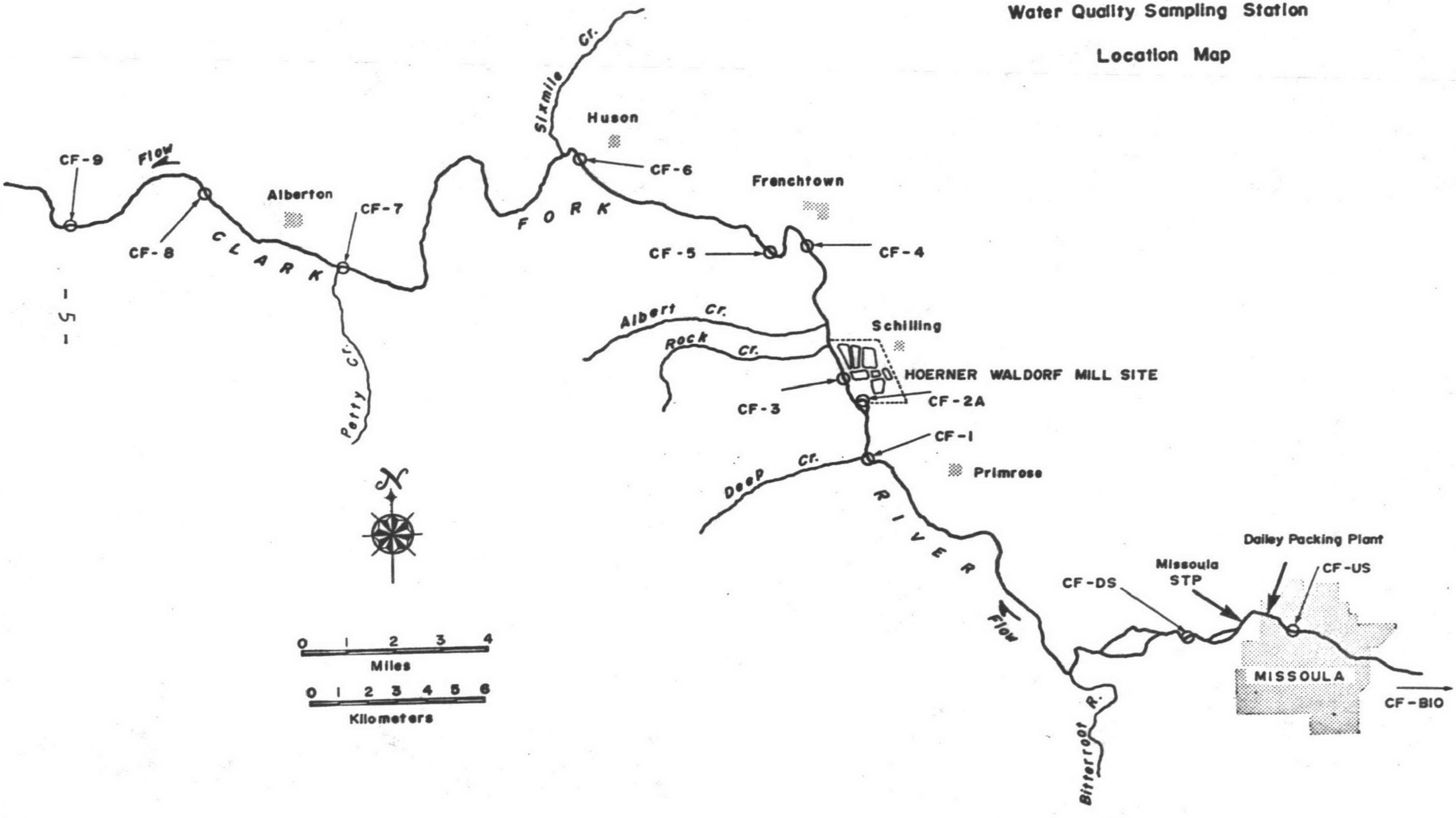
Multi-plate artificial substrates were placed at eight selected sampling sites and collected at the end of 12 days exposure. The substrates were constructed of 0.64 x 10.2 x 10.2 cm (¼ x 4 x 4 inch) masonite plates. Nine plates were mounted on a cadmium plated rod and were separated by 0.64 cm (¼ inch) layers of 1.9 cm (3/4 inch) diameter washers, thus exposing approximately 0.186 sq. meters (two square feet) of substrate for attachment by aquatic organisms.

Figure 1

CLARK FORK RIVER

Water Quality Sampling Station

Location Map



At the beginning of the survey all the substrates were submerged in riffle areas having approximately the same current. The depth of water over the top plate of each sampler was between 7.6 - 22.9 cm (3 and 9 inches). Macroinvertebrates collected on the substrates were removed and preserved in 10 percent formalin for later identification.

For periphyton (attached algae) studies, a 0.64 x 10.2 x 12.7 cm (¼ x 4 x 5 inch) plate was placed at the top of each substrate rod about 7.6 cm (3 inches) above the top 10.2 x 10.2 cm (4 x 4 inch) plate. Four clear glass, precleaned 2.54 x 10.2 cm (1 x 3 inch) microscope slides were attached to the longer plate with metal clips. Two slides from each substrate were selected for periphyton counts and were preserved in 10 percent formalin. The remaining two slides were collected for chlorophyll analysis. Samples for chlorophyll were preserved in 90 percent acetone buffered with sodium carbonate, and stored in the dark on wet ice until transported to Denver for analysis.

RESULTS & DISCUSSION

I. Water Quality

The organic matter contained in municipal and many industrial wastes, when introduced into the receiving waters, exerts, through the process of biochemical degradation, an oxygen demand, resulting in a reduction of the dissolved oxygen resources of the waters. If the concentrations of such oxygen-demanding wastes cause excessive dissolved oxygen depletion, the reduction of desirable aquatic life, including fish, and the creation of unpleasant odors can result.

The dissolved oxygen requirement applicable to the section of the Clark Fork River included in this investigation calls for a dissolved oxygen concentration of 7.0 mg/l to be maintained for the growth and propagation of salmonid fishes and associated aquatic life, water fowl and furbearers.

Results of the grab samples indicated that at no time during the study did the dissolved oxygen concentrations in the Clark Fork River fall below the 7.0 mg/l criteria. The plot of average dissolved oxygen concentrations at each sampling station (Figure 2) indicates a fairly uniform dissolved oxygen concentration throughout the study reach with a variation of only 1.3 mg/l from upstream of all sources of wastes (Station CF-US) to the downstream limit of the study (Station CF-8). A variation of only 0.4 mg/l occurred in the reach from upstream of the Hoerner-Waldorf ponds (Station CF-1) to the furthermost downstream station (Station CF-8).

The results of the biochemical oxygen demand test which measures the relative oxygen requirements of municipal and industrial wastes, indicated the concentrations in the Clark Fork River from Missoula to the station downstream of Alberton, a distance of 62.6 km (39.1 miles), to be within a relatively narrow range of 1.3 - 3.0 mg/l (Figure 3). Although the BOD concentrations in the side channel near the Hoerner-Waldorf ponds reached an average of 5.1 mg/l (maximum 16.2 mg/l), only a slight increase from 1.3 to 1.8 mg/l was evident in the river. The largest in-stream increase in BOD (from 1.3 to 3.0 mg/l) occurred at Station CF-DS, downstream from the wastewater effluents of the Dailey Meat Packing Plant and the Missoula Wastewater Treatment Plant.

The density of coliform organisms in a water environment has been established as a criteria of the degree of pollution and the sanitary quality of the water under test.

Coliform criteria applicable to the reach of the Clark Fork River included in this study require that the average density of total coliform organisms be less than 1000/100 ml. Results of the study indicated that the total coliform densities remained less

Figure 2

CLARK FORK RIVER

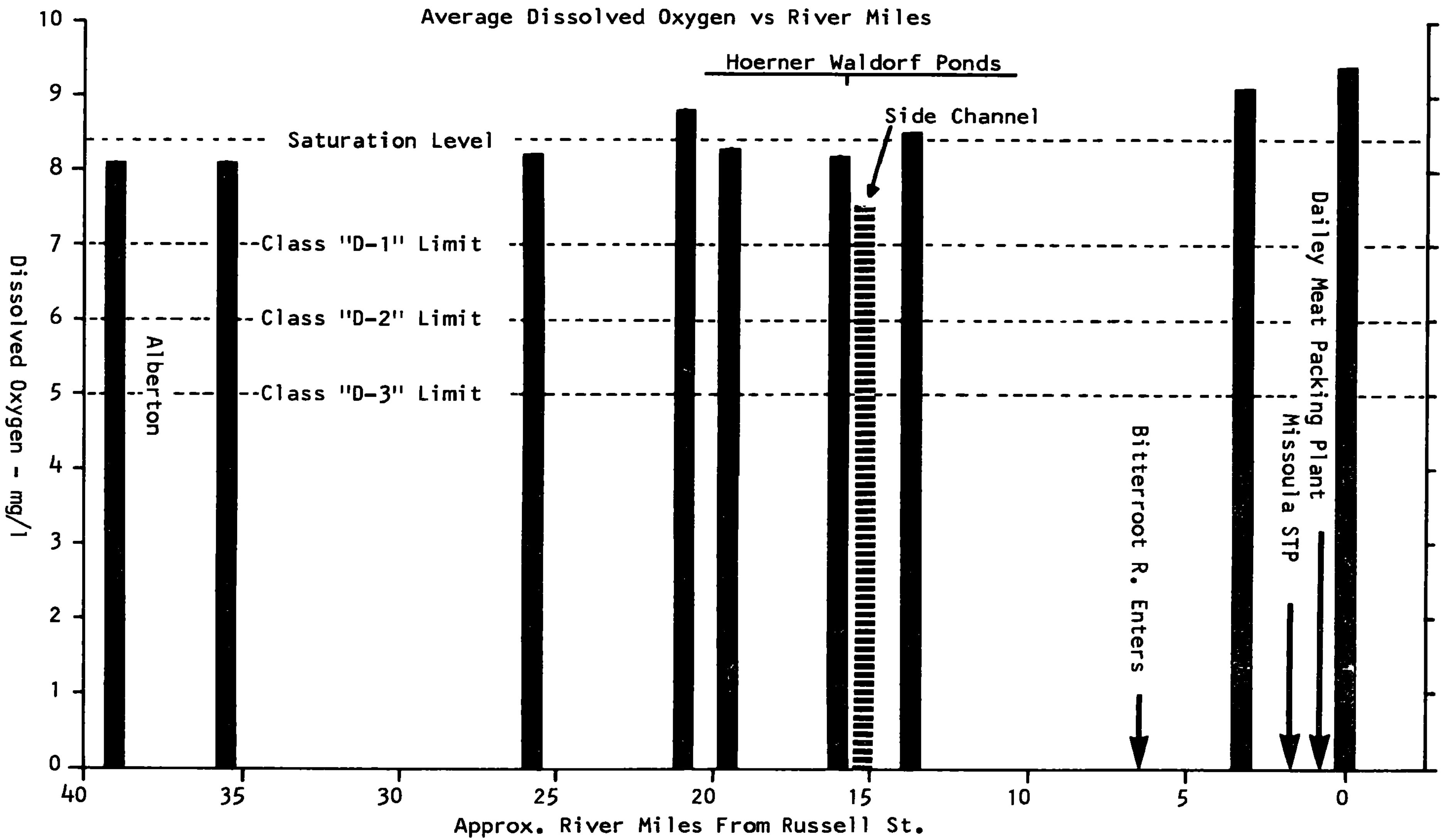
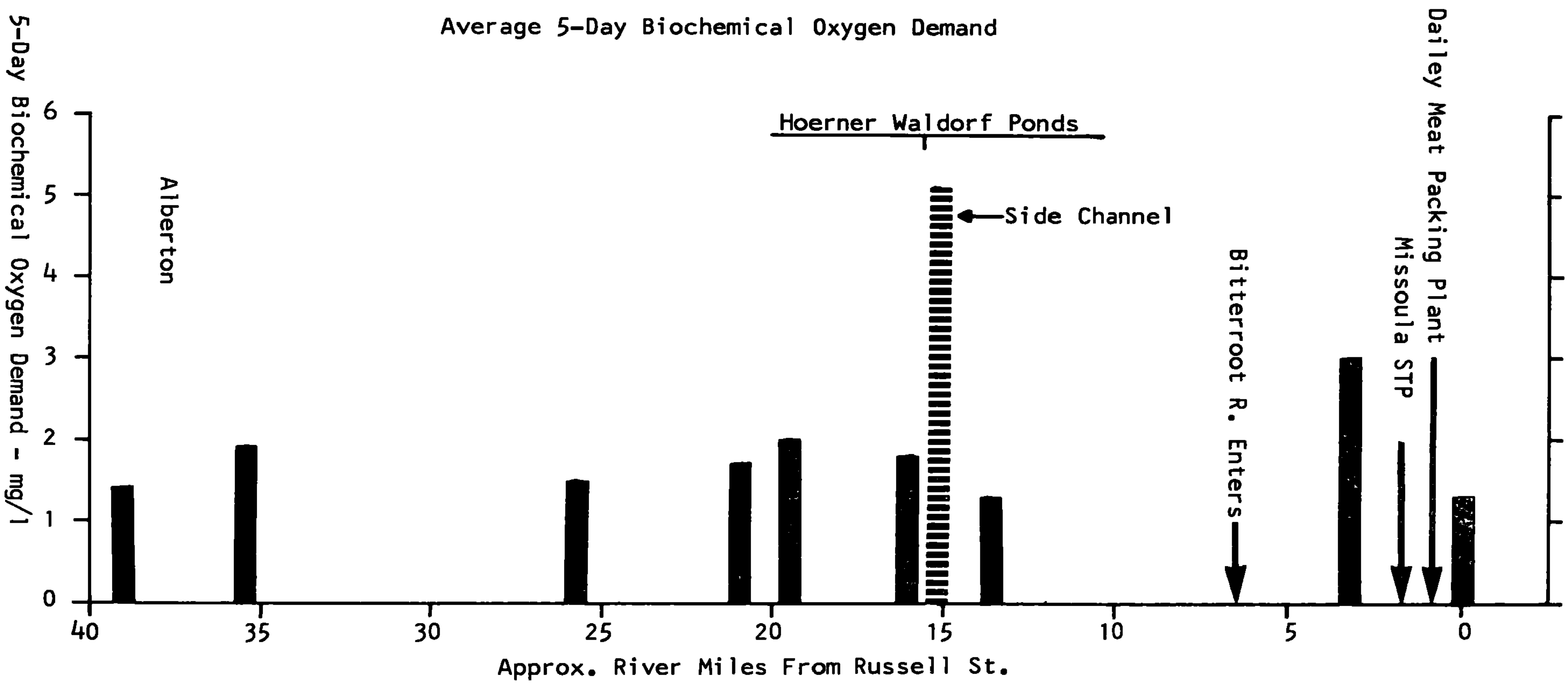


Figure 3

CLARK FORK RIVER

Average 5-Day Biochemical Oxygen Demand



than this limit throughout the study reach (Figure 4). Two peak densities did occur in the river which can be attributed to wastes from the Dailey Meat Packing Plant and Missoula Wastewater Treatment Plant (664/100 ml at Station CF-DS) and from the community of Alberton (115/100 ml at Station CF-8), however both peak concentrations were less than the 1000/100 ml criteria.

Fecal coliform organisms, indicators of recent pollution, were found at all sampling locations (Figure 5). Mean densities were less than 100/100 ml at all river locations with the exception of Station CF-DS, downstream of the discharges from the Missoula Wastewater Treatment Plant and the Dailey Packing Plant, where the mean density was 144/100 ml (maximum 7,300/100 ml). A high density of fecal organisms (mean 190/100 ml) was present in the side channel of the river containing seepage from the Hoerner Waldorf ponds, however no increase in coliform densities in the river could be attributed to the pond seepage.

These fecal coliform organisms were further identified to species. The IMViC classification, indole, methyl, red, Voges-Pasbauer, and citrate utilization, which are a combination of biochemical tests were used to differentiate the coliforms of fecal origin. Two species were identified, these were Eschericra coli and Klebsiella pneumoniae.

The species E. coli Variety II was found in water samples taken at all the sampling stations (Table 1). The K. pneumoniae organisms were detected at several locations, Stations CF-DS, CF-1, CF-2A, CF-6, CF-8 and CF-11 (Table 1).

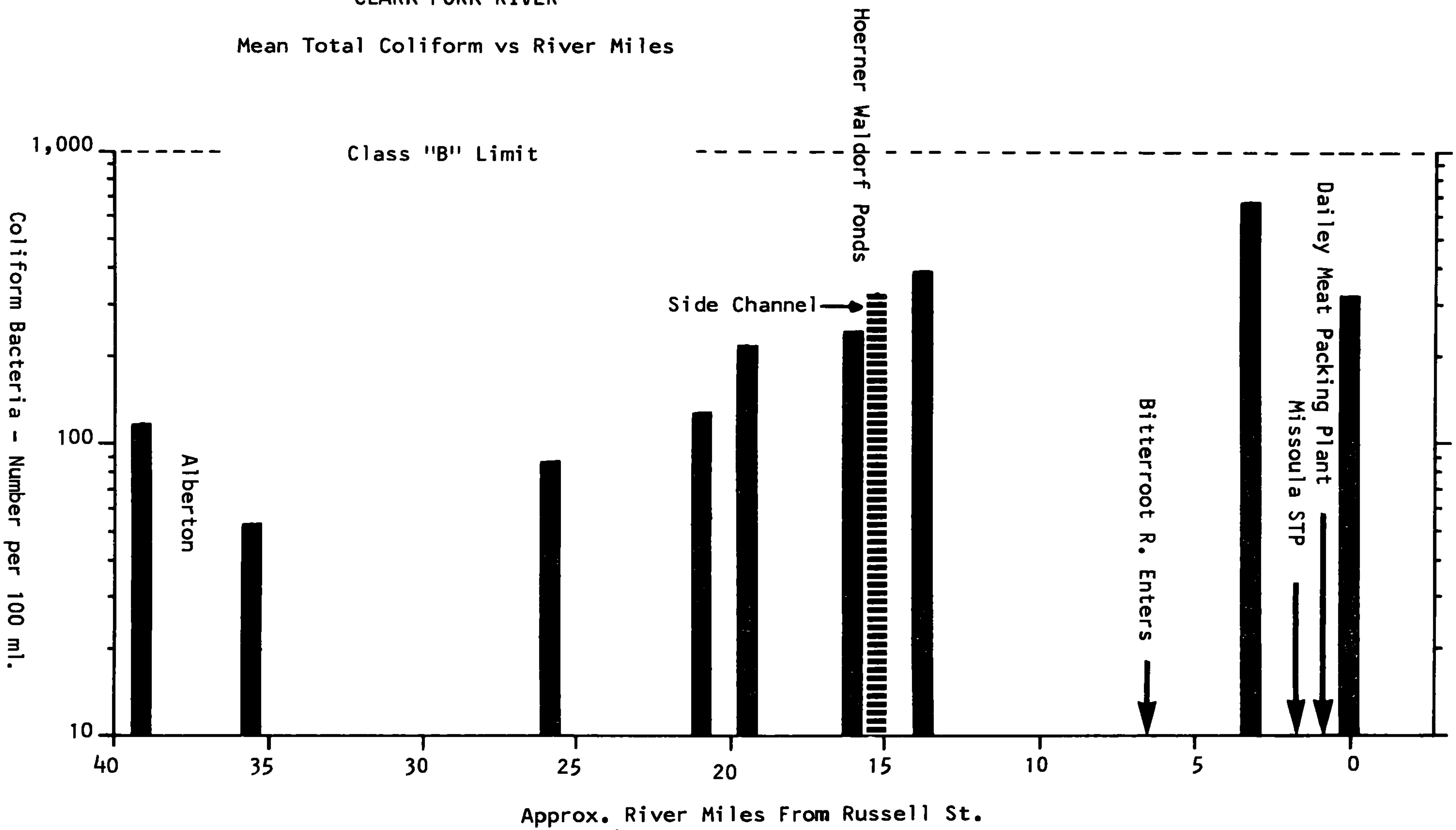
The Klebsiella pneumoniae organism is found in the intestinal tract of humans and animals at approximately 30 percent for humans and 40 percent for animals. It can be pathogenic and is a coliform by definition. Klebsiella pneumoniae is more often a cause of septicemia, pneumonia, and post-operative infections. It is the second most common, next to E. coli, as a causative organism in urinary tract infections, and has a propensity to become resistant to antibiotics and could be a serious source of antibiotic resistant pathogens that might reach downstream recreational areas.

Klebsiella pneumoniae organisms were not detected at the upstream Station CF-US, the Russell Street Bridge on the Clark Fork River, however K. pneumoniae were isolated and identified from water samples taken at Stations CF-DS and CF-1. These stations were located downstream of the Dailey Meat Packing Plant and the Missoula Wastewater Treatment Plant effluents. K. pneumoniae were also isolated in the side channel of the Clark Fork River containing strong pond waste seepage (Station CF-2A). This organism will survive in certain industrial wastes such as pulp and paper because of the high nutrient levels in these wastes. In addition, these nutrient-rich wastes can provide the capability for bacterial re-growth in the receiving stream.

Figure 4

CLARK FORK RIVER

Mean Total Coliform vs River Miles



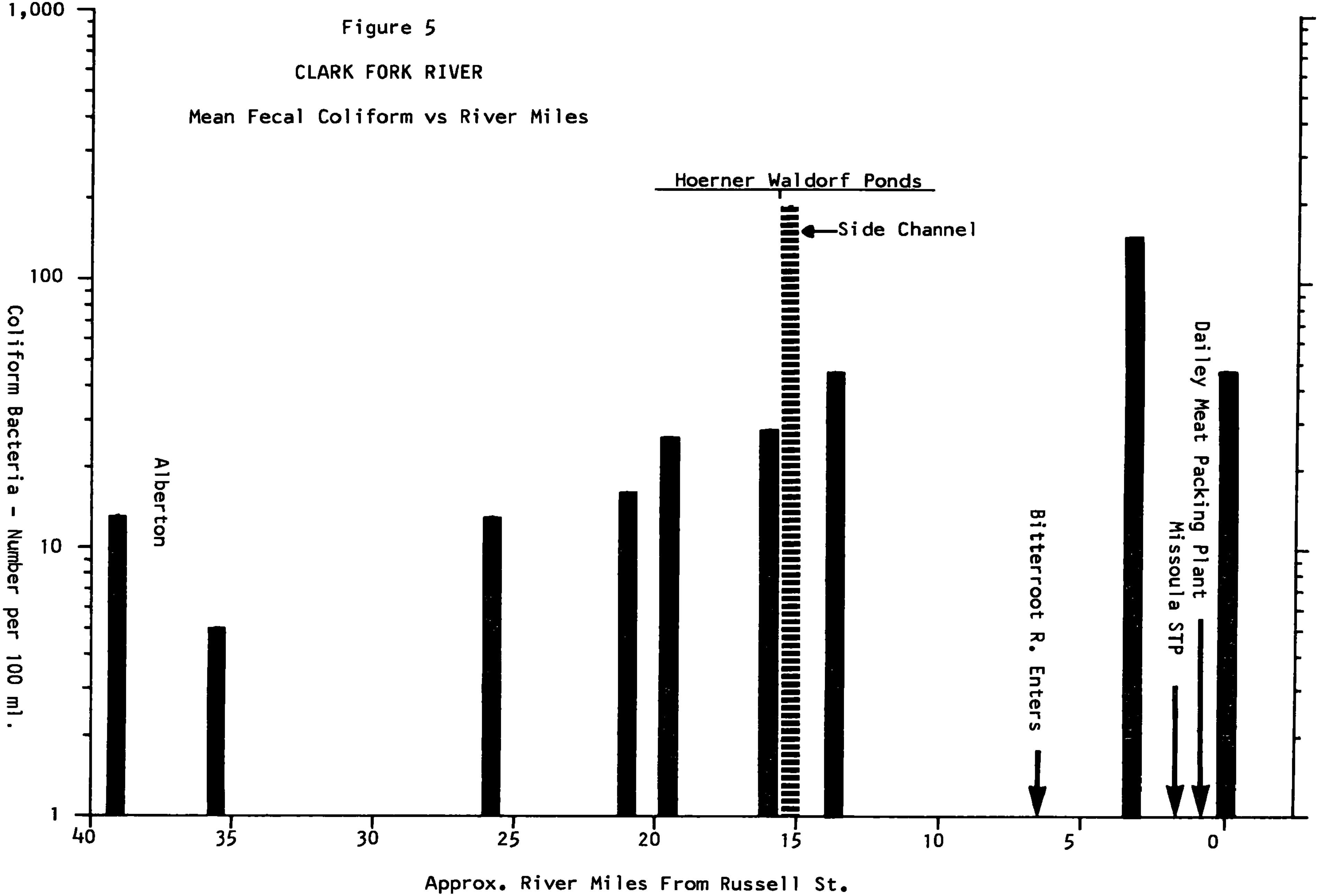


Figure 5

CLARK FORK RIVER

Mean Fecal Coliform vs River Miles

TABLE I

KLEBSIELLA PNEUMONIAE ISOLATIONS
CLARK FORK RIVER

Date	Station	Total Coliform per 100 ml.	Fecal Coliform per 100 ml.	Fecal Strept. per 100 ml.	Species Identified
7-26-73	CF-US	100	70	-	E. *coli* var. II
	CF-DS	490	84	-	E. *coli* var. II, K. *pneumoniae*
	CF-1	850	230	42	E. *coli* var. II, K. *pneumoniae*
	CF-2A	570	200	220	E. *coli* var.II, K. *pneumoniae*
	CF-3	270	44	32	E. *coli* var. II
	CF-4	320	16	300	E. *coli* var. II
	CF-5	52	6	-	E. *coli* var. II
	CF-6	120	12	-	E. *coli* var. II K. *pneumoniae*
	CF-7	160	6	-	E. *coli* var. II
	CF-8	180	10	-	E. *coli* var. II, K. *pneumoniae*
8-2-73	CF-8	3700	1000	1100	E. *coli* var. II, K. *pneumoniae*

At Stations CF-3, CF-4 and CF-5 K. pneumoniae organisms were not detected, however, downstream from Huson, Montana at Station CF-6, K. pneumoniae was again detected, the probable source of these organisms being municipal wastes from this community.

Upstream of Alberton, Montana (Station CF-7), K. pneumoniae organisms were not isolated, but downstream of this community these organisms were detected indicating municipal wastes were the probable source.

A grab sample taken from the Hoerner-Waldorf pond on 8-2-73, indicated total and fecal coliform counts of 3700/100 ml and 1000/100 ml respectively. Two species, Eschericia coli and Klebsiella pneumoniae, were isolated and identified from colonies from this sample.

Although color determinations in the reach of the Clark Fork River did not exceed 5 units above background (that found at the upstream control station), it can be seen that wastes entering the river in the vicinity of the Hoerner-Waldorf ponds produced an incremental increase of 5 units to a color intensity of about 10 units. This condition persisted downstream to the limit of the study reach (Figure 6).

Conductivity measurements showed a small increase in the average conductivity from 309 to 316 umhos (Station CF-1 to Station CF-3) within the reach of river which receives wastes from the Hoerner-Waldorf ponds. A conductivity cross-section made at Station CF-3, opposite the Hoerner-Waldorf ponds, showed that the conductivity progressively increased from the west bank of the river to the east bank where the ponds are located (Figure 7).

Another conductivity cross-section made approximately 1 mile (1.61 km) further downstream at about the most downstream limit of the Hoerner-Waldorf ponds, showed that the conductivity was uniform over most of the cross-section at the higher level (360 umhos) found at the upstream station opposite the ponds (Figure 8). At this station the conductivity also increased from the west bank to the east bank nearer the ponds. At the next regular water quality sampling station, Station CF-4 5.8 km (3.6 miles) downstream from Station CF-3, the conductivity averaged 319 umhos and remained at this level to the downstream limit of the study.

II. Biological Quality

Benthic Organisms

Aquatic invertebrates have life spans of a few months to several years and reflect long-term as well as short-term changes in water quality. A non-polluted environment supports a large number of kinds of aquatic invertebrates with each kind represented

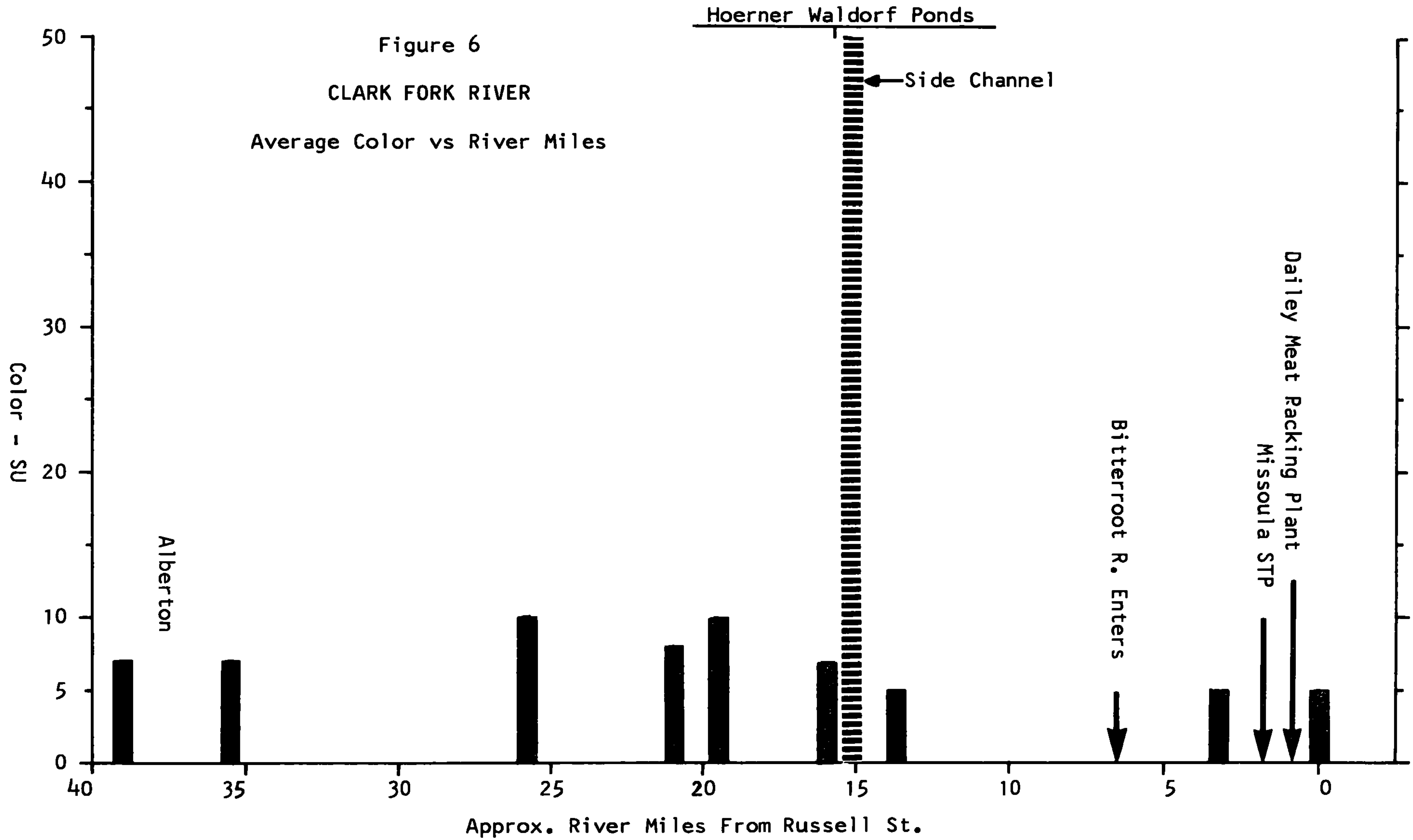


Figure 6

CLARK FORK RIVER

Average Color vs River Miles

Figure 7

CLARK FORK RIVER

Conductivity Cross Section - Station CF-3

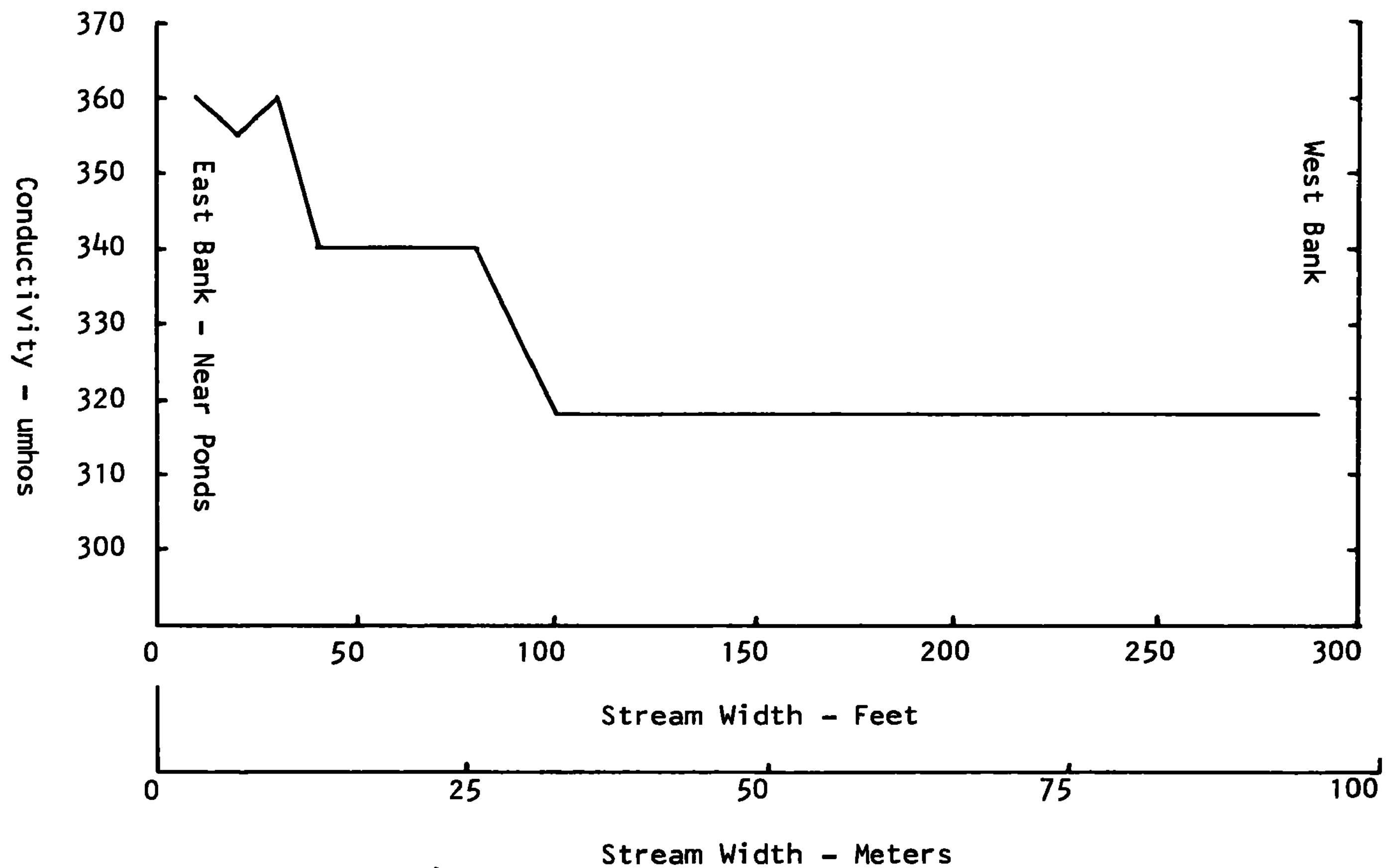
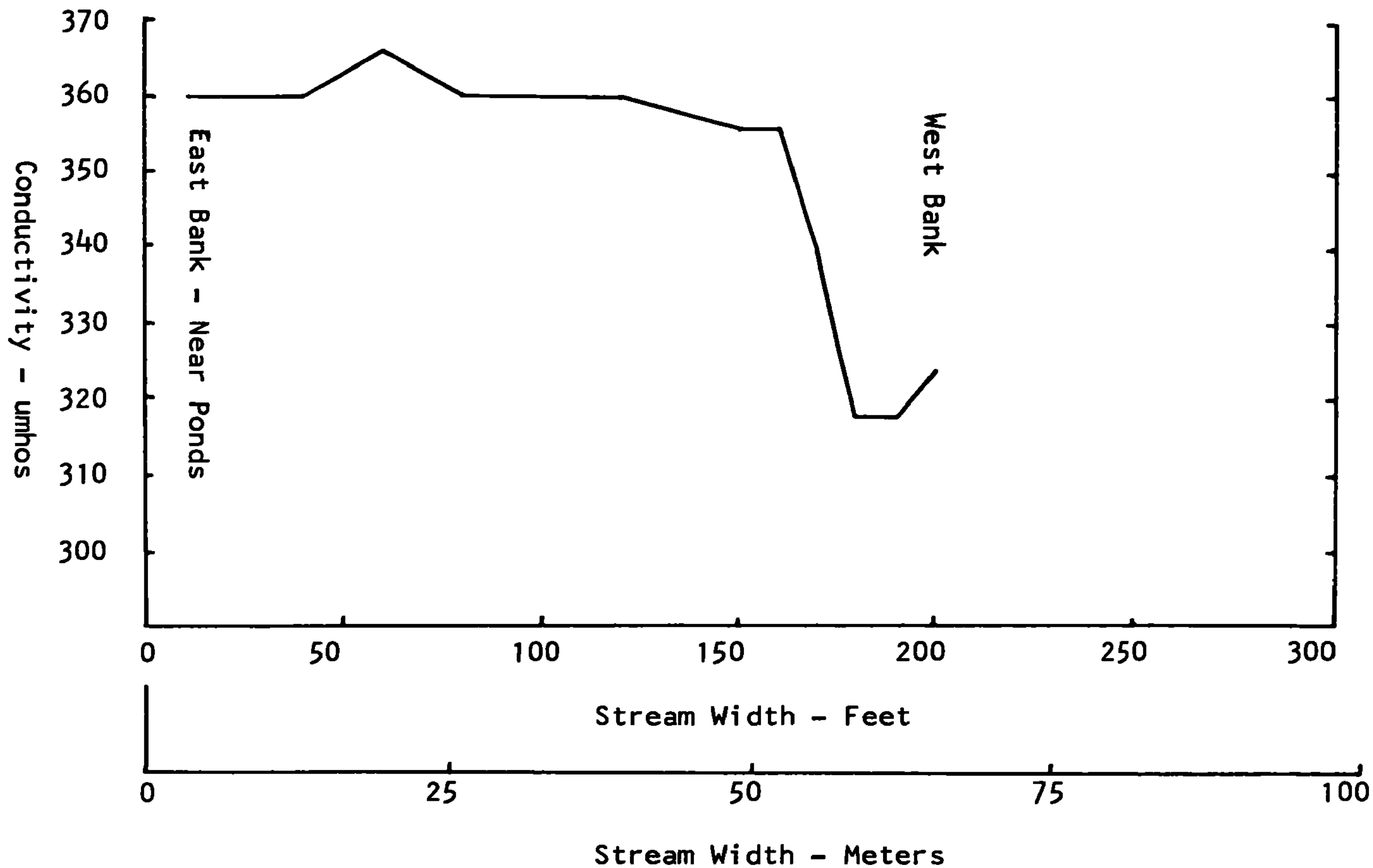


Figure 8

CLARK FORK RIVER

Conductivity Cross Section - Station CF-3.5



by a small number of individuals. When low concentrations of organic pollution occur invertebrates intolerant of such pollution decrease in number and in some cases disappear from the community. Organisms intermediate and tolerant in their sensitivities to organic pollution tend to increase in number; thus the total number of organisms may increase while numbers of kinds may decrease.

As organic pollution increases, both sensitive and intermediate organisms are reduced in number. When sensitive organisms, such as stonefly and mayfly larvae, are removed from the aquatic community predation and competition for food are lessened for the remaining intermediate and pollution tolerant organisms, such as some forms of caddis larvae, midges and blackflies, which respond with an increase in numbers.

Large discharges of organic materials usually result in excessive amounts of settleable solids which blanket stream bottoms, reduce dissolved oxygen concentrations and render a body of water uninhabitable to all but a few tolerant organisms such as blood worms and sludgeworms.

Toxic materials reduce both numbers of kinds and total numbers of organisms immediately downstream from the point of discharge. As the toxic material proceeds downstream and is diluted or otherwise rendered harmless the benthic community increases in kinds and numbers.

Slight amounts of organic or toxic materials discharged to a stream may effect a chronic or insidious change on an invertebrate community that may be difficult to detect with conventional sampling methods used over a short time span.

Benthic organisms collected at a control station (CF-Bio) upstream from Missoula were predominantly pollution sensitive and intermediate organisms totaling 3767 organisms per meter^2 (350 organisms per ft.^{2}), (Appendix Table B-3). Proceeding downstream from the control station the effect of materials discharged to the Clark Fork River was not great enough to completely remove all pollution sensitive organisms from the sections of river sampled. Instead, the primary effect of either discharged or seeped wastes was to change the predominant group of organisms in the benthic community from intermediate organisms to pollution tolerant forms and to reduce in numbers the pollution sensitive organisms. Figure 9 depicts the percent of sensitive, intermediate and pollution tolerant organisms collected at each station. The Clark Fork River downstream from Missoula (CF-US) and upstream from the STP was also in good condition with only 17 percent of the benthic community composed of tolerant organisms (Table 2). Such an increase in tolerant organisms as compared to the control station probably resulted from the discharge of small amounts of nutrients from the metropolitan area. Downstream from the Missoula STP the percentage

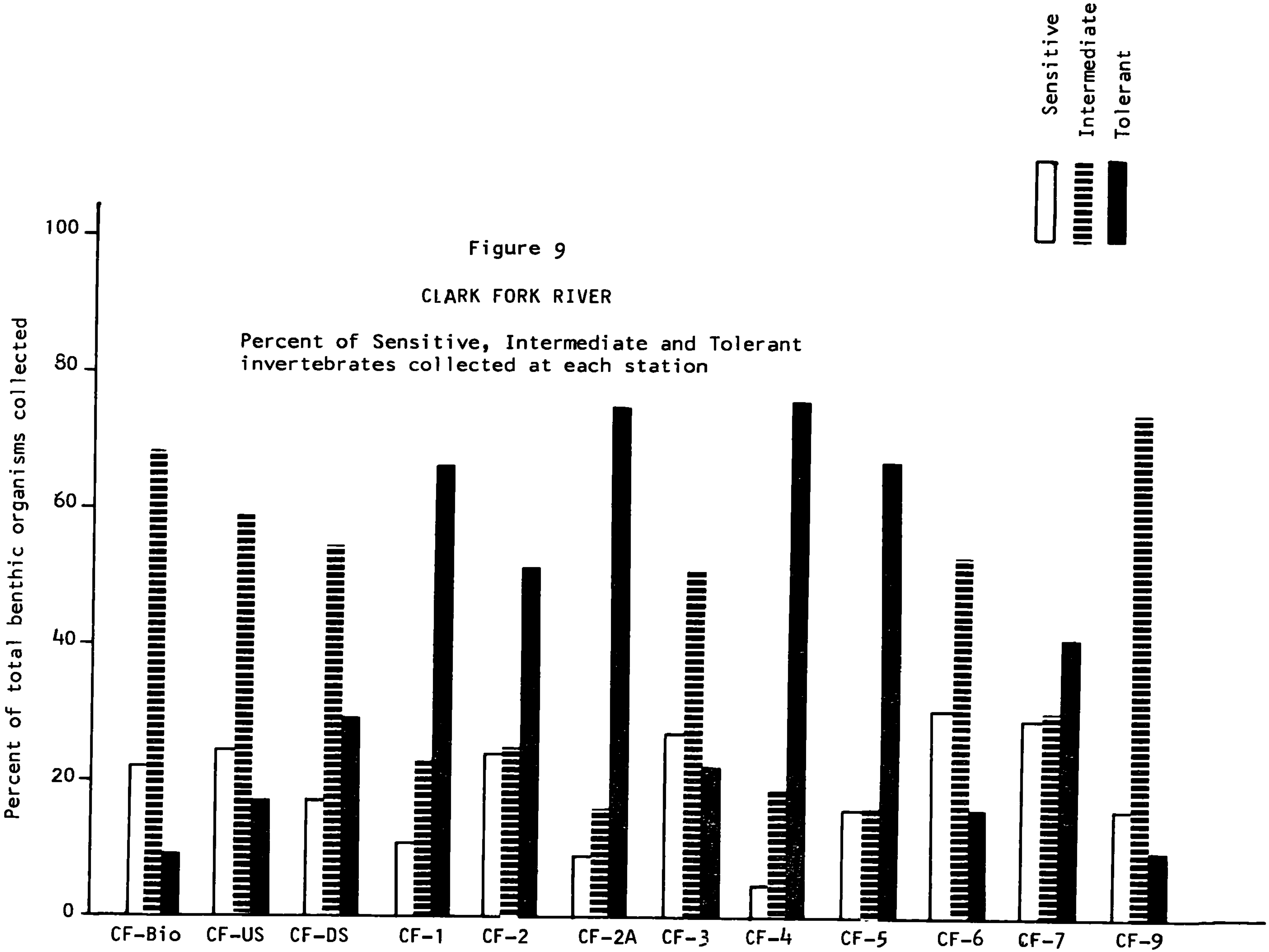


Figure 9

CLARK FORK RIVER

Percent of Sensitive, Intermediate and Tolerant invertebrates collected at each station

Table 2 Benthic Organisms Collected From The Clark Fork River, July 27 to August 2, 1973

Station	Avg. Avg Number/M^2	Avg. Avg Number/Ft^2
CF-Bio	3767	350
CF-US	7211	670
CF-DS	12173	1131
CF-1	5758	535
CF-2A	18480	1717
CF-2	4294	399
CF-3	3584	333
CF-4	13142	1221
CF-5	11021	1024
CF-6	4929	458
CF-7	11244	1045
CF-9	8277	769

of pollution tolerant organisms increased threefold over the control station (29 percent compared to 9 percent), indicating enrichment from the upstream area. Just upstream of the Harper Road Bridge (CF-1) pollution tolerant organisms comprised 70 percent of the 5758 organisms per meter^2 (535/ft^2) collected. The maximum effect of nutrients discharged upstream was evident in this reach.

Water quality in the Clark Fork, near the upstream end of the pulp mill waste lagoons (CF-2) had improved as indicated by a 20 percent reduction in pollution tolerant organisms and a threefold increase in pollution sensitive organisms as compared to the Harper Bridge reach (Figure 9).

A small side channel near the waste lagoons carried dark brown waste that had evidently seeped from the lagoons. Rocks on the bottom were covered with grey brown slime-like material. The benthic community in this area averaged 18,480 organisms per M^2 (1717/ft^2), 75 percent being pollution tolerant blackfly and midge larvae.

Downstream from the side channel (CF-3) the Clark Fork supported a benthic community that was predominantly intermediate organisms (Figure 9). Wastes seeping from the ponds had not completely mixed with the river water at this point and water quality appeared to be similar to that just upstream of the Missoula STP (CF-US).

In the reach of river downstream of the ponds, where river water and seepage was thoroughly mixed, the benthic community increased from 3584 per M^2 (333 per ft^2) at CF-3 to 13,142 per M^2 (1221 per ft^2) at CF-4. The invertebrate community shifted from 20 percent pollution tolerant organisms to 76 percent, indicating a degraded water quality compared to Station CF-3. Conditions favoring pollution tolerant organisms extended downstream for another 2.25 km (1.4 miles) with only a slight improvement near Frenchtown (CF-5). The benthic community was predominantly pollution tolerant organisms (Figure 9).

At Huson (CF-6), 7.7 km (4.8 miles) downstream from Station CF-5, the Clark Fork River recovered sufficiently to support a benthic community similar to that upstream from the influence of the waste ponds (Station CF-3). Sensitive and intermediate organisms comprised 31 and 53 percent of the aquatic invertebrates collected from the area. Tolerant species comprised only 16 percent of the total population.

Downstream near Alberton (CF-7) the river showed signs of slight enrichment. There was an increase in tolerant organisms and a decrease in intermediate. Also, the total number of organisms collected doubled from 4929 per M^2 (458 per ft^2) at CF-6 to 11,244 per M^2 (1045 per ft^2) at CF-7 (Appendix Table B-3). The source of nutrients that caused the increase in numbers of organisms was not located.

Approximately 5.6 km (3.5 miles) downstream of Alberton the Clark Fork had completely recovered. The benthic community was similar in composition to that upstream from the Missoula STP. Sensitive and intermediate organisms were the predominant invertebrates. Pollution tolerant midges and blackflies comprised only 9 percent of the organisms collected.

Periphyton

Samples of the periphyton community, growing on glass slides after 12 days exposure (7/20 - 8/1) were tested for chlorophyll a content and the results are shown in Figure 10. The amount of chlorophyll a present in a known amount of periphyton is used as an indicator of community size and well being, and is usually related to the amount of nutrients available to the community.

The amounts of chlorophyll a collected at each station indicate that except for Stations CF-1 and CF-2A at 22 and 24.5 km (river miles 13.7 and 15.2), there are no excessive periphyton growths in the surveyed reach of the Clark Fork River (Figure 10). At the Harper Road Bridge, Station CF-1, the greater amount of chlorophyll a (4.65 $\mu g/cm^2$) compared to downstream stations probably resulted from the upstream discharge of nutrients from Missoula's sewage treatment plant and the Dailey Packing Plant.

Periphyton growths in a small side channel containing dark colored waste water (CF-2A) supported 9.63 $\mu g/cm^2$ of chlorophyll a indicating a highly enriched environment. However, after the waste flow was diluted by the Clark Fork River main flow the periphyton community in the Clark Fork downstream from the waste ponds showed no apparent increase in growth attributable to pulp mill wastes.

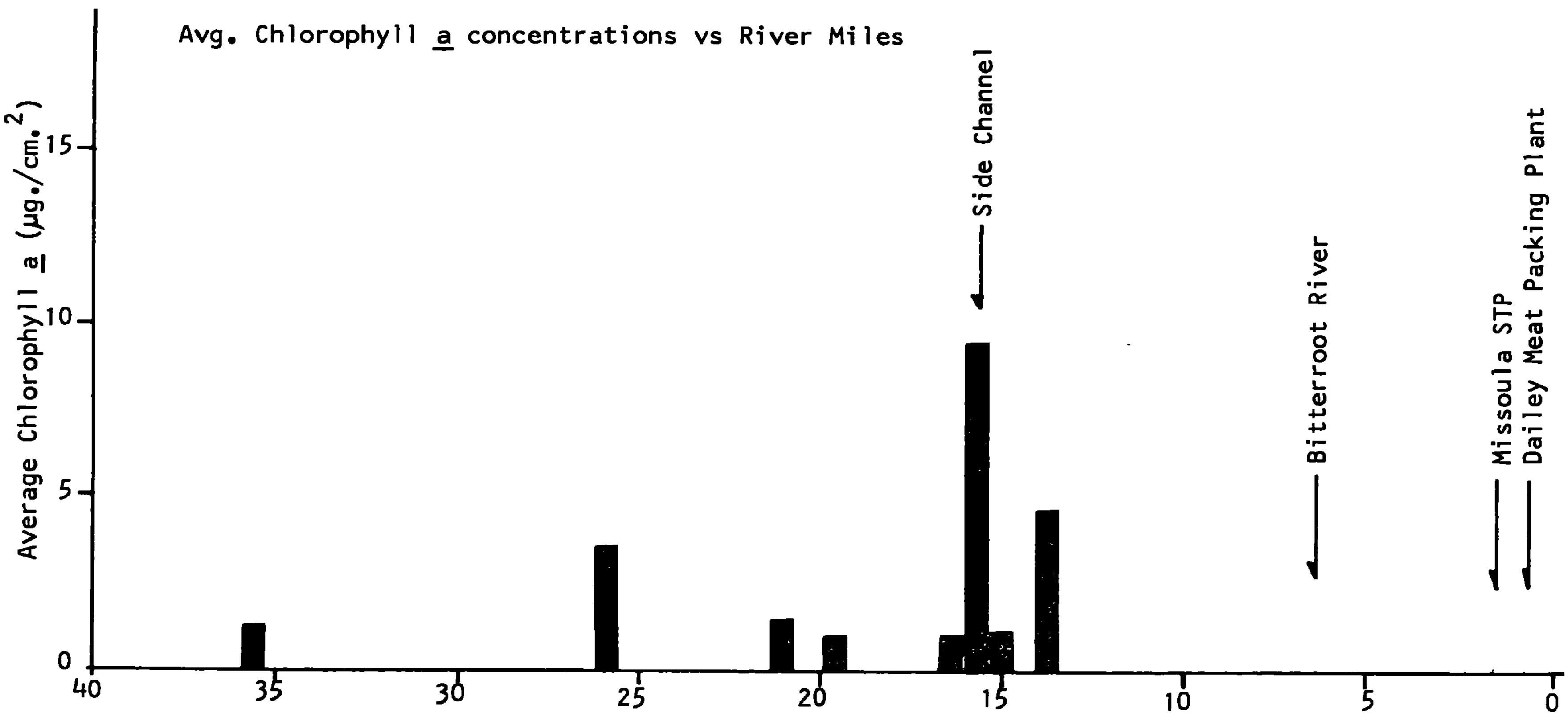
Actual counts of periphyton supported the results of the chlorophyll analysis. Pennate diatoms made up the majority of the periphyton community at all sampling sites with Stations CF-1 and CF-2A again showing the highest counts of cells per mm^2 of 3943 and 5622 respectively (Appendix Table B-4). These two stations were also the only ones to show any substantial filamentous bacteria counts (116/mm^2 and 768/mm).

In both cases however, natural variation and dilution offset any detrimental affects to the river.

Figure 10

CLARK FORK RIVER

Avg. Chlorophyll a concentrations vs River Miles



Approx. River Miles From Russell St.

SUMMARY AND CONCLUSIONS

The Montana Department of Health and Environmental Sciences requested that EPA provide assistance in identifying existing water quality conditions in the Clark Fork River and any damage to aquatic life or degradation of water quality resulting from seepage or surface discharges from the Hoerner Waldorf Corporation paper mill located west of Missoula, Montana.

A water quality and biological study was conducted by the EPA of the Clark Fork River from the City of Missoula to a point downstream from the City of Alberton, a distance of approximately 78.9 km (49 miles).

Detrimental effects of seepage and/or discharges from the Hoerner Waldorf ponds could not be evidenced by the dissolved oxygen and biochemical oxygen demand concentrations present in the Clark Fork River during the study period. Dissolved oxygen concentrations consistently remained at levels higher than the 7.0 mg/l established for this section of the river.

Total coliform densities throughout the study period did not exceed the 1000/100 ml level for this section of the Clark Fork River, with the highest coliform density occurring downstream (Station CF-DS) of the discharges from the Missoula Wastewater Treatment Plant and the Dailey Meat Packing Plant (664/100 ml). Mean fecal coliform densities were less than 100/100 ml at all river locations with the exception of the sample station (Station CF-DS) downstream of the Missoula STP and Dailey Packing Plant discharges (144/100 ml). Although no increase in coliform densities in the river could be attributed to seepage or discharges from the Hoerner Waldorf ponds, a high density of fecal coliform organisms (190/100 ml) were present in the side channel of the river containing pond seepage. *Klebsiella pneumonia*, an organism found in the intestional tract of humans and animals was isolated from samples at stations downstream from the Missoula Wastewater Treatment Plant, the Dailey Packing Plant, the side channel near the Hoerner Waldorf ponds, and the communities of Huson and Alberton.

As the river progressed downstream past the Hoerner Waldorf ponds, the color in the river increased by 5 units to a color intensity of about 10 units. This increased intensity however did not exceed 5 units above background. This higher color level, attributable to pond seepage, persisted to the downstream limit of the study, a distance of approximately 37 km (23 miles). Likewise, conductivity increased as the river progressed downstream past the ponds and maintained this higher level to the downstream limit of the study. Conductivity cross-sections made in the vicinity of the ponds indicated that the conductivity progressively increased from the west bank to the east bank of the river where the ponds were located.

The biological study indicated that the Clark Fork River in the area from upstream of Missoula to a point approximately 5.6 km (3.5 miles) downstream of Alberton was of good quality. The two main sources of organic enrichment in this reach of river were the Missoula STP and the seepage from holding ponds owned by the Hoerner Waldorf Corporation. Both operations did alter natural conditions slightly, but at the time of this survey the river evidenced signs of recovery downstream from both waste sources.

Pollution sensitive stoneflies and mayflies were present at all sampling stations. The main affect of the STP waste discharge and seepage from the Hoerner Waldorf ponds was to change the benthic community composition from a predominance of pollution sensitive organisms upstream of the wastes (only 9 percent pollution tolerant) to a predominance of pollution tolerant organisms downstream from waste sources (70 percent downstream of the STP, 76 percent downstream of the Hoerner Waldorf ponds). However the benthic community evidenced signs of recovery approximately 22.5 km (14 miles) downstream from the STP discharge and 9.7 km (6 miles) downstream from Hoerner Waldorf.

If additional biological studies are to be conducted on this river, efforts should be expanded to include main tributaries of the Clark Fork River such as the Big Blackfoot River and the Bitterroot River. Also there should be concentrated work on the river in the area around the Missoula STP and, downstream of the Hoerner Waldorf holding ponds at a time when they are discharging directly into the river.

Suggested benthic invertebrate sampling methods should include multiple plate samplers set with a minimum exposure time of twenty days to insure opportunity of habitation by a well balanced community.* These results should be supplemented by sampling of the natural substrate.

It is also suggested that acclimated fish be placed in live cages and exposed to the effluent from the Hoerner Waldorf plant, then subjected to a taste and odor test by an accredited council.

*Results of artificial substrates used in our study were inconclusive. As mentioned in the methods section, substrates were placed in riffles having approximately the same flow in the beginning of the survey. But due to a drought the area was experiencing, the level of the river dropped approximately six inches in less than two weeks forcing us to pull the artificial samplers prior to the desired exposure time.

APPENDIX A

STREAM CLASSIFICATIONS

MONTANA STATE WATER POLLUTION CONTROL COUNCIL

POLICY STATEMENTS

1. Quality of waters classified for multiple use shall be governed by the most stringent criteria listed for any use.

2. The Council has classified as "A-Closed" only those waters on which access and other activities are presently controlled by the utility owner. If other uses are permitted by the utility owner, these waters shall be reclassified "A-Open" or lower. Conversely, waters in the "A-Open" classification, if shown to meet the "A-Closed" criteria, may be so classified by the Council at the request of the utility owner.

   Where "A-Open" water is used for swimming and other water contact sports, a higher degree of treatment may be required for potable water use.

3. The water quality standards are subject to revision (following public hearings and, in the case of interstate streams, concurrence of the Federal Water Pollution Control Administration) as technical data, surveillance programs, and technological advances make such revisions desirable. There are waters in the state on which little water quality data are presently available. Water quality criteria for these waters were established to protect existing and future water uses on the basis of the most representative information available.

   In some cases, particularly in eastern Montana, waters have been classified "B" and "C" where the upper ends of the streams will probably be suitable for this use while the lower ends will not. However, not enough data is available to determine where the "B" and "C" designation should be dropped. Whenever a water supply or swimming area is developed, the regulations and the advice of the State Board of Health should be acquired. As time permits, data will be obtained and the classifications reviewed.

4. As used in the Water Quality Criteria, the phrases "natural," "naturally present," and "naturally occurring" are defined as conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied. Waters below existing dams will be considered natural.

5. It is the intent of the criteria that the increase allowed (temperature for example) above natural conditions is the total allowable from all waste sources along the classified stream.

6. Although the water quality criteria specify minimum dissolved oxygen concentrations, it shall be the policy of the Council to require the best practicable treatment or control of all oxygen-consuming wastes in order to maintain dissolved oxygen in the receiving waters at the highest possible level above the specified minimums.

7. For treatment plant design purposes, stream flow dilution requirements shall be based on the minimum consecutive 7-day average flow which may be expected to occur on the average once in 10 years.

8. Where sampling stations and points of mixing of discharges with receiving waters as mentioned in the water quality criteria are to be established on interstate waters, the concurrence of the Federal Water Pollution Control Administration will be solicited.

9. It is not the intent of these criteria to provide for a swimming water immediately below an existing treated domestic sewage outfall.

10. Where common treatment is practicable, it is the policy of the Council to restrict the number of sewer outfalls to a minimum.

11. Tests or analytical procedures to determine compliance with standards will, insofar as practicable and applicable, be made in accordance with the methods given in the twelfth edition of "Standard Methods for the Examination of Water and Waste Water" published by the American Public Health Association, et al, or in accordance with tests or analytical procedures that have been found to be equal or more applicable.

12. Because of conflicting testimony, it is the intent of the Water Pollution Control Council to obtain additional information on temperatures and fisheries on waters below existing steam generating stations at Billings and Sidney on the Yellowstone River. This can probably be best accomplished by a cooperative study between the utility, State Fish and Game Department, Federal Water Pollution Control Administration, and the Montana State Department of Health.

13. Insufficient information is available for establishing fixed sediment criteria at this time. Until standards can be set, reasonable measures, as defined by the Water Pollution Control Council, must be taken to minimize sedimentation from man's activities.

14. Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at that high quality unless it has been

affirmatively demonstrated to the state that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of such waters. Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required to provide the necessary degree of waste treatment to maintain high water quality. In implementing this policy, the Secretary of the Interior will be kept advised in order to discharge his responsibilities under the Federal Water Pollution Control Act, as amended. Note: A statement with similar meaning is included in the revised Water Pollution Control Act (H. B. No. 85, Chapter 25, Montana Session Laws, 1971.)

MINIMUM TREATMENT REQUIREMENTS

1. Domestic sewage -- the minimum treatment required for domestic sewage shall be secondary treatment or its equivalent with the understanding that properly designed and operated sewage lagoons will meet this requirement.

2. Industrial wastes -- the minimum treatment required for industrial wastes shall be secondary treatment or its equivalent.

WATER USE DESCRIPTIONS AND APPLICATION

Water use classifications assigned to the Columbia and Missouri Basin and the Hudson Bay drainage in Montana are described as follows:

"A-Closed"--Water supply for drinking, culinary, and food processing purposes, suitable for use after simple disinfection. Public access and activities such as livestock grazing and timber harvest should be strictly controlled under conditions prescribed by the State Board of Health.

The Council has classified as "A-Closed" only those waters on which access is presently controlled by the utility owner. If other uses are permitted by the utility owner, these waters shall be reclassified "A-Open-D_1" or lower.

"A-Open-D_1"-Water supply for drinking, culinary, and food processing purposes suitable for use after simple disinfection and removal of naturally present impurities. Water quality shall also be maintained suitable for the use of these waters for bathing, swimming and recreation (See "Note" below), (where these waters are used for swimming and other water contact sports, a higher degree of treatment may be required for potable water use); growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, these waters shall be held suitable for "A-Open", "C", "D", "E", and "F" uses but may not necessarily be used for all such purposes.

Waters in this class, if shown to meet the "A-Closed" criteria, may be so classified by the Council at the request of the utility owner.

All waters within the boundaries of national parks and nationally designated wilderness, wild, or primitive areas in Montana are classified "A-Open-D_1" except those adjacent to developed areas such as Snyder Creek through the community of Lake McDonald and Swiftcurrent Creek below the Many Glacier Chalet, both in Glacier National Park. Also, Georgetown, Flathead, and Whitefish Lakes and Lake Mary Ronan are classified as "A-Open-D_1" as are some streams presently used for domestic water supply.

"B-D_1" The quality of these waters shall be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection, and any additional treatment necessary to remove naturally present impurities; bathing, swimming, and recreation (see Note under "A-Open-D_1"); growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, "B-D_1" equals "B", "C", "D_1", "E", and "F".

"B-D_2" The quality of these waters shall be maintained suitable for the uses described for "B-D_1" waters except that the fisheries use shall be described as follows:

> "Growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers."

Therefore, "B-D_2" equals "B", "C", "D_2", "E", and "F".

"B-D_3" The quality of these waters shall be maintained suitable for the uses described for "B-D_1" waters except that the fisheries use shall be described as follows:

> "Growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers."

Therefore, "B-D_3" equals "B", "C", "D_3", "E", and "F".

Note: Common sense dictates that swimming and other water contact sports are inadvisable within a reasonable distance downstream from sewage treatment facility outfalls.

"C-D_2" The quality of these waters shall be maintained suitable for bathing, swimming, and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, "C-D_2" equals "C", "D_2", "E", and "F".

"D_2" The quality of these waters shall be maintained for growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply. Therefore, "D_2" equals "D_2", "E", and "F".

"E" The quality of these waters shall be maintained for agricultural and industrial water supply uses and "E" shall equal "E" and "F" uses.

"F" The quality of these waters shall be maintained suitable for industrial water supply uses, other than food processing.

WATER USE CLASSIFICATION

COLUMBIA BASIN

Clark Fork River Drainage

Clark Fork River:

Warm Springs Drainage to Myers Dam	A-Open-D_1
Remainder of Warm Springs Drainage	B-D_1
Silver Bow Creek (mainstem) from the confluence of Yankee Doodle and Blacktail Deer Creeks to Warm Springs Creek	For industrial waste use.
Yankee Doodle Creek Drainage to and including the Butte water supply reservoir	A-Closed
Remainder of Yankee Doodle Creek Drainage	B-D_1
Blacktail Deer Creek Drainage except portion of Basin Creek listed below:	B-D_1
Basin Creek Drainage to and including the Butte water supply reservoir	A-Closed
Remainder of Basin Creek Drainage	B-D_1
All other tributaries to Silver Bow Creek from the confluence of Yankee Doodle and Blacktail Deer Creeks to Warm Springs Creek	B-D_1
Clark Fork River (mainstem) from Warm Springs Creek to the Little Blàckfoot River	C-D_2
Tin Cup Joe Creek Drainage to the Deer Lodge water supply intake	A-Closed
Remainder of Tin Cup Joe Drainage	B-D_1
Clark Fork River Drainage from the Little Blackfoot River to the Idaho line except those portions of tributaries listed below:	B-D_1
Georgetown Lake and tributaries above Georgetown Dam	A-Open-D_1
Flint Creek Drainage from Georgetown Dam to the Farm-to-Market Highway No. 348 bridge about one mile west of Philipsburg except those portions of tributaries listed below:	B-D_1
Fred Burr Lake and headwaters from source to the outlet of the lake	A-Closed

Flint Creek (mainstem) from Farm-to-Market Highway No. 348 bridge about one mile west of Philipsburg to the Clark Fork River	$B\text{-}D_2$
South Boulder Creek Drainage to the Philipsburg water supply intake	$A\text{-}Open\text{-}D_1$
Remainder of South Boulder Drainage	$B\text{-}D_1$
All other tributaries to Flint Creek from F-to-M Highway 348 bridge to the Clark Fork River	$B\text{-}D_1$
Rattlesnake Drainage to the Missoula water supply intake	A-Closed
Remainder of Rattlesnake Drainage	$B\text{-}D_1$
Packer and Silver Creek Drainage (tributaries to the St. Regis River) to the Saltese water supply intakes	$A\text{-}Open\text{-}D_1$
Remainder of Packer and Silver Creek drainages	$B\text{-}D_1$
Ashley Creek Drainage to the Thompson Falls water supply intake	A-Closed
Remainder of Ashley Creek Drainage	$B\text{-}D_1$
Pilgrim Creek Drainage to the Noxon water supply intake	$A\text{-}Open\text{-}D_1$
Remainder of Pilgrim Creek Drainage	$B\text{-}D_1$
All tributaries of Clark Fork River not otherwise mentioned	$B\text{-}D_1$

PAGE NOT

AVAILABLE

DIGITALLY

APPENDIX B

SURVEY DATA

TABLE B-1

WATER QUALITY SAMPLING STATION LOCATIONS

CLARK FORK RIVER - MISSOULA, MONTANA

Station No.	Approx. Dist. from Russell St. miles	km	Description
CF-BIO	-6.4	-10.2	Clark Fork River upstream biological control station
CF-US	0	0	Clark Fork River upstream of STP at Russell St. Bridge (Upstream Control)
DPP-1	0.8	1.3	Dailey Meat Packing Plant EFF
STP-1	1.7	2.7	Missoula, Montana STP EFF
CF-DS	3.2	5.1	Clark Fork River downstream from STP about 1.5 miles - Schmidt Rd.
CF-1	13.7	21.9	Clark Fork River at Harper Rd. Bridge
CF-2A	15.2	24.3	Side Channel Clark Fork River containing strong pond waste seepage
HW-1			Hoerner Waldorf Pond
CF-3	15.9	25.4	Clark Fork River near pond seepage area about ½ mile downstream from CF-2A
CF-3.5	16.9	27.2	Clark Fork River near downstream limit of pond seepage area
CF-4	19.5	31.2	Clark Fork River downstream of ponds in complete mix area
CF-5	20.9	33.4	Clark Fork River at boat retrieval point off South Side Rd.
CF-6	25.8	41.3	Clark Fork River at RR Trestle at Huson
CF-7	35.5	56.8	Clark Fork River at bridge upstream from Alberton
CF-8	39.1	62.6	Clark Fork River at bridge downstream from Alberton
CF-9	42.6	68.2	Clark Fork River approximately 3.5 miles downstream from the Alberton bridge

TABLE B-2

RESULTS OF ANALYSIS

CLARK FORK RIVER -- MISSOULA, MONTANA

Station No.	Date Yr/Mo/Day	Time Mtly	Temp. Cent.	pH SU	DO mg/l	Cond. umho	Color SU	BOD_5 mg/l	T.Coli T/100ml	F.Coli T/100ml	F.Strep. T/100ml
CF-US	73/07/23	1625	19.5	8.6	10.1		5	1.3	30	6	
	73/07/24	1330	19	8.3	9.8	318	5	1.4	110	90	
	73/07/25	1350	20	8.5	9.6	313	<5	1.2	48	38	
	73/07/26	1420	20	8.5	9.5	318	5	1.1	100	70	
	73/07/27	1435	21	8.4	9.3	318	5	1.4	56	42	
	73/07/30	1330	20	8.5	9.35	329	5	1.1	100	<2	
	73/07/31	1330	21	8.3	9.4	339	5	1.4	190	160	
	73/08/1	1155	20	8.5	8.9	329	5	1.2	370	260	
	73/08/2	1400	21	8.2	9.4	339	5	1.4	100	88	
	73/08/3	1150	20	8.3	8.65	329	5	1.2	2,600	110	
CF-DS	73/07/24	1400	19.5	8.3	9.5	318	5	2.5	120	82	
	73/07/25	1430	20	8.4	9.6	318	5	3.2	140	24	
	73/07/26	1455	20	8.3	9.2	323	5	2.5	490	84	
	73/07/27	1505	21	8.4	9.1	329	5	3.1	850	300	
	73/07/30	1400	20	8.3	9.25	318	5	2.5	270	20	
	73/07/31	1400	20	8.2	9.3	339	5	2.5	830	190	
	73/08/1	1130	19	8.3	8.7	350	5	3.8	850	220	
	73/08/2	1500	22	8.3	9.0	350	5	2.6	30,000	7,300	
	73/08/3	1120	19	8.2	8.45	339	5	4.1	630	86	
CF-1	73/07/23	0945	15.5	8.1	9.0	295	5	1.8	180	20	22
	73/07/24	1025	15.5	8.0	8.4	297	5	0.3	70	32	360
	73/07/25	1040	17	8.1	8.5	302	5	1.6	560	68	45
	73/07/26	1045	18	8.1	8.5	313	5	1.0	850	230	42
	73/07/27	1045	17	8.1	7.9	313	5	1.4	760	74	400
	73/07/30	1050	18	8.1	8.5	318	5	1.3	130	2	220
	73/07/31	1050	17.5	8.3	8.5	307	<5	1.2	2,200	690	65
	73/08/1	1055	18	8.2	8.5	318	5	1.2	360	28	46
	73/08/2	1110	18	8.1	8.7	318	5	1.2	290	24	72
	73/08/3	1045	18	8.2	8.6	307	5	1.6	480	68	54

TABLE B-2 continued

Station No.	Date Yr/Mo/Day	Time Mtly	Temp. Cent.	pH SU	DO mg/l	Cond. umho	Color SU	BOD_5 mg/l	T.Coli T/100ml	F.Coli T/100ml	F.Strep. T/100ml
CF-2	73/07/23	1030		7.3	8.5	290	<5		100	20	88
	73/08/2	0935				300					
CF-2A	73/07/23	1045		7.2	7.0	515	90		240	230	230
	73/07/24	0845	14	7.65	6.7	435	65	16.2	340	230	360
	73/07/25	0940		7.8	6.9	445	80	14.0	300	210	350
	73/07/26	0930	16.5	7.8	7.3	392	35	3.2	570	200	220
	73/07/27	0945	17	7.8	7.8	360	35	2.0	360	210	44
	73/07/30	0925	16	7.8	7.9	382	40	3.0	310	180	110
	73/07/31	1025	16.5	7.9	8.35	382	45	1.2	270	160	230
	73/08/1	0950	17.5	7.9	8.3	398	35	0.6	300	250	320
	73/08/2	0905	17	7.5	7.2	390	40	3.0	260	120	260
	73/08/3	0920	17	7.6	7.8	403	40	3.0	390	150	110
CF-3	73/07/23	1130		7.8	9.2	280	<5		46	10	45
	73/07/24	0910	15	7.7	7.6	339	15	4.4	270	34	180
	73/07/25	1000		8.0	8.4	297	5	1.6	410	60	12
	73/07/26	1000	16.5	7.9	8.1	318	7	1.5	270	44	32
	73/07/27	1010	18	7.6	8.2	313	5	1.0	300	12	430
	73/07/30	1000	17.5	7.9	7.8	302	5	2.6	130	14	36
	73/07/31	1030	16.5	8.0	8.2	313	8		2,800	230	35
	73/08/1	1250	18	8.1	9.3	323	8	0.4	70	10	28
	73/08/2	0955	18	7.7	7.75	340	8	1.4	100	10	64
	73/08/3	0945	17.5	7.75	7.6	339	8	1.2	760	80	10
CF-4	73/07/23	1155		7.5	8.8	295	10		40	18	2
	73/07/24	0940	16	8.0	7.9	318	20	3.5	120	24	290
	73/07/25	1015		7.8	8.0	318	8	4.6	370	36	26
	73/07/26	1050	17.5	8.0	8.2	329	10	1.7	320	16	300
	73/07/27	1050	18	8.0	8.2	313	7	2.0	170	20	380
	73/07/30	1025	18	8	8.0	318	10	2.0	92	8	30
	73/07/31	1105	17.5	7.9	8.35	318	8	0.6	2,900	140	32
	73/08/1	1325	18.5	8.2	9.5	329	8	1.2	52	28	12
	73/08/2	1040	18	7.9	7.9	325	8	1.8	84	12	36
	73/08/3	1010	18	7.8	7.9	329	15	1.1	1,800	76	36

TABLE B-2 continued

Station No.	Date Yr/Mo/Day	Time Mtly	Temp. Cent.	pH SU	DO mg/l	Cond. umho	Color SU	BOD_5 mg/l	T.Coli T/100ml	F.Coli T/100ml	F.Strep. T/100ml
CF-5	73/07/23	1330	19	8.2	9.9	310	8		100	6	
	73/07/24	1025	17.5	8.1	8.6	309	10	2.8	78	26	
	73/07/25	1055		8.0	8.2	318	8	2.6	66	26	
	73/07/26	1130	18	7.9	8.65	313	7	1.9	52	6	
	73/07/27	1145	19	8.2	8.95	318	7	2.4	70	14	
	73/07/30	1100	18.5	8.1	8.2	329	8	1.1	110	15	
	73/07/31	1140	18.0	8.0	8.15	329	10	0.7	50	20	
	73/08/1	1420	20	8.2	9.8	329	7	0.9	1,500	14	
	73/08/2	1120	19	8.3	8.35	340	8	1.4	140	8	
	73/08/3	1050	18	7.9	9.3	329	12	1.4	540	100	
CF-6	73/07/23	1715	20	8.3	10.2	315	15		22	10	
	73/07/24	0950	17	7.7	8.8	318	10	2.0	230	18	
	73/07/25	0950	17	8.4	8.0	318	8	3.8	130	20	
	73/07/26	1000	18.5	8.4	7.7	323	7	1.1	120	12	
	73/07/27	1000	18.5	8.1	8.0	323	10	1.3	100	8	
	73/07/30	1010	19	8.3	8.0	329	8	1.2	65	2	
	73/07/31	1010	18	8.2	7.9	318	10	1.1	48	18	
	73/08/1	1015	19		7.95	334	8	0.5	68	12	
	73/08/2	1030	19	8.1	7.8	323	8	1.6	56	18	
	73/08/3	0945	19	8.2	7.5	318	12	1.3	260	60	
CF-7	73/07/23	1110	17.5	8.5	8.85	300	8	3.4	36	2	
	73/07/24	0900	16	8.1	8.6	318	8	2.5	90	6	
	73/07/25	0910	17	8.1	8.35	313	5	3.3	68	14	
	73/07/26	0910	18	8.4	8.0	318	5	1.6	160	6	
	73/07/27	0925	19	8.2	7.75	318	7	1.0	32	2	
	73/07/30	0935	19	8.3	7.85	334	8	1.1	20	<2	
	73/07/31	0940	18	8.3	8.0	318	7	1.2	56	4	
	73/08/1	0935	19	8.35	8.0	329	7	1.6	72	8	
	73/08/2	0945	19.5	8.1	8.0	329	8	1.6	26	6	
	73/08/3	0910	19	8.2	7.7	323	10	1.3	68	8	

TABLE B-2 continued

Station No.	Date Yr/Mo/Day	Time Mtly	Temp. Cent.	pH SU	DO mg/l	Cond. umho	Color SU	BOD_5 mg/l	T.Coli T/100ml	F.Coli T/100ml	F.Strep. T/100ml
CF-8	73/07/23	1150	17.5	8.3	9.2	310	7	1.4	46	4	
	73/07/24	0840	16	8.1	8.3	318	7	1.7	130	25	
	73/07/25	0845	17	8.1	8.3	313	5	1.5	120	16	
	73/07/26	0835	18	8.3	8.05	318	7	1.4	180	10	
	73/07/27	0900	18.5	8.2	8.05	318	7	1.3	120	34	
	73/07/30	0910	19	8.4	7.7	323	8	1.2	250	5	
	73/07/31	0920	19	8.4	7.8	329	7	0.9	120	10	
	73/08/1	0915	19	8.3	7.9	318	7	1.6	110	18	
	73/08/2	0930	19.5	8.15	8.1	329	7	1.3	88	16	
	73/08/3	0850	19	8.2	7.8	318	10	1.4	92	20	
DDP-1	73/08/2	1515	21	6.5				326	290,000	46,000	56,000
CF-3.5	73/08/2	1015	18								
HW-1	73/08/2	0930							3,700	1,000	1,100
STP-M	73/08/3	1210	18.5						1,800	120	420

TABLE B-3

Benthic Invertebrates Collected using Surber Sq. Ft. Sampler on the Clark Fork River 7/23/73 - 8/3/73.

	Upstream Missoula	Upstream S.T.P.	Downstream S.T.P.	Sta. #1	Sta. #2	Sta. #3
Plecoptera						
Pteronarcella sp.	9	4	3	Q	3	2
Pteronarcys sp.	19	13	1	6	1	Q
Claassenia sp.	Q	1	1	Q	1	2
Acroneuria sp.		1	1		1	
Alloperla sp.	Q	Q	1			
Isogenus sp.	Q	2		1	1	Q
Isoperla sp.		1	1			
Arcenopteryx sp.	1	1	1	1	2	1
Ephemeroptera						
Baetis sp.	25	64	133	14	25	16
Ephemerella sp.	10	60	12	10	27	13
Iron sp.	4	1	Q	1	1	
Rithrogena sp.	1	1		1	1	1
Tricorythodes sp.		1	14	1	1	
Centroptilum sp.		1				
Heptagenia sp.	1			1	1	8
Paraleptophlebia sp.					2	Q
Heptageniidae (Unknown)			6	8	8	
Baetidae (Unknown)			20		18	48
Tricoptera						
Hydropsyche sp.	184	279	27	87	50	148
Cheumatopsyche sp.	3	6	6	2	Q	10
Arctopsyche sp.	58	101	5	19	15	6
Hydropsychidae (Unknown)			558		31	
Glossosoma sp.		1			2	
Brachycentrus sp.	Q	Q	1	1	1	4
Ocecetis sp.			1		1	2
Hydroptila sp.			1	3		
Agapetus sp.				1		
Leucotrichia sp.						
Dolophilus sp.	1					
Coleoptera						
Elmidae	4	10	7	1	2	1
Dytiscidae						
Lepidoptera						
Elophila sp.						
Hemiptera						
Corixidae					1	
Diptera						
Atherix sp.	2	1		1	1	2
Simulium sp.	15	9	141	281	134	15
Tipulidae	Q	1	1	1	1	2
Chironomidae	14	100	188	95	64	51
Nematomorpha						
Gordius sp.					1	1
Annelida						
Hirudinea					1	
Oligochaeta			1		1	
Avg. No./Ft.^{2}	350	670	1131	535	399	333
Avg. No./M^2	3767	7211	12,173	5758	4294	3584
No. samples collected	2 Sq Ft	2 Sq Ft	3 Sq Ft	3 Sq Ft	5 Sq Ft	2 Sq Ft
No. of Kinds	20	25	22	22	28	21

NOTE: Q = Organism present in qualitive sample, counted as "1" in computing No. of kinds. Unknown not counted in No. of kinds.

TABLE B-3 (continued)

Benthic Invertebrates Collected using Surber Sq. Ft. Sampler on the Clark Fork River 7/23/73 - 8/3/73

	Sta.#2A	Sta. #4	Sta. #5	Sta. #6	Sta. #7	Sta. #9
Plecoptera						
Pteronarcella sp.	7	3	1	1	13	1
Pteronarcys sp.	1	1	2	1	3	Q
Claassenia sp.	1	1	1	2	2	1
Acroneuria sp.	1		1	1	4	1
Alloperla sp.					2	
Isogenus sp.		1		1	4	
Isoperla sp.					Q	
Arcenopteryx sp.	1	4	1	1	8	3
Ephemeroptera						
Baetis sp.	107	28	57	38	114	42
Ephemerella sp.	1	5	9	15	22	8
Iron sp.				1	1	Q
Rithrogena sp.		21	6	9	1	1
Tricorythodes sp.	11		1		5	
Centroptilum sp.						
Heptagenia sp.	9	1	6	5	5	5
Paraleptophlebia sp.		1	1	1		Q
Heptageniidae (Unknown)	11		7	18		
Baetidae (Unknown)		13	66	47	92	65
Tricoptera						
Hydropsyche sp.	213	Q	156	Q	Q	Q
Cheumatopsyche sp.	Q	Q	Q	Q	Q	Q
Arctopsyche sp.	53	Q	7	Q	Q	Q
Hydropsychidae (Unknown)		225		236	306	565
Glossosoma sp.				3	2	
Brachycentrus sp.	1		4		3	
Ocecetis sp.					1	
Hydroptila sp.		1			13	
Agapetus sp.			1			
Leucotrichia sp.				1	1	4
Dolophilus sp.						
Coleoptera						
Elmidae	1		2	3	7	2
Dytiscidae	1					
Lepidoptera						
Elophila sp.			1			1
Hemiptera						
Corixidae	5		1	1	1	
Diptera						
Atherix sp.		1	2	Q	1	10
Simulium sp.	575	834	602	13	127	8
Tipulidae	1	Q	1		2	Q
Chironomidae	717	82	87	59	305	56
Nematomorpha						
Gordius sp.		Q	1			Q
Annelida						
Hirudinea						
Oligochaeta				1		
Avg. No./Ft.^{2}	1717	1221	1024	458	1045	769
Avg. No./M^2	18,480	13,142	11,021	4929	11,244	8277
No. samples collected	2 Sq Ft	2 Sq Ft	3 Sq Ft	2 Sq Ft	2 Sq Ft	2 Sq Ft
No. of Kinds	19	19	24	23	28	22

Note: Q = Organism present in qualitive sample, counted as "1" in computing No. of kinds. Unknown not counted in No. of kinds.

TABLE B-4

CLARK FORK RIVER, MISSOULA, MONTANA. ORGANISMS COLONIZING PERIPHYTON SLIDES (NO/mm^2), EXPOSURE PERIOD 7-20 to 8-1-73.

Station Number	1	2	2A	3	4	5	6	7
Organisms								
Diatoms								
Centrics	27	8	109	4	3	4	0	0
Pennates	3413	1430	4820	1839	996	1485	2206	2393
Chlorophyta (green algae)								
Scenedesmus sp.	292	12	327	51	24	47	22	21
Cosmarium sp.	95	12	153	20		21	17	31
Closterium sp.	20		4	4	3			
Unknown Cocceid green	27	2	153	10				4
Ulothrix sp.			14					
Zygnema sp.	7							
Pediastrum sp.			4					
Cyanophyta (blue green algae)								
Oscillatoria sp.	14		7	4		4	22	23
Anabaena sp.	14		17					
Lyngbya sp.	20			7				
Dactylococcopsis sp.	14		14					
Spirulina sp.				4				
Total Algae	3943	1464	5622	1943	1026	1561	2267	2476
Filamentous Bacteria	116	8	768	4	14		11	
Fungi Filaments			4					

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO EPA-908/2-74-001	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Clark Fork River Study Montana July - August, 1973		5. REPORT DATE January, 1974 6. PERFORMING ORGANIZATION CODE
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15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Environmental Protection Agency, Region VIII conducted an intensive field investigation of the Clark Fork River in the vicinity of Missoula, Montana during the period July 23 - August 3, 1973. The water quality and biological study of the 79 km (49 mile) reach of the river from Missoula downstream to Alberton, Montana indicated that detrimental effects of seepage and/or discharges from the Hoerner Waldorf paper mill ponds could not be evidenced by the dissolved oxygen and biochemical oxygen demand (BOD) concentrations in the river. A slight color and conductivity increase attributable to pond seepage was evident and persisted to the downstream limit of the study. The benthic community evidenced greater effects from the discharges of the Missoula wastewater treatment plant and Dailey Meat Packing plant than from the Hoerner Waldorf pond seepage.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

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