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THE POLLUTIONAL DEGRADATION OF THE JORDAN RIVER AS SHOWN BY AQUATIC INVERTEBRATES

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by

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ABSTRACT

A study of the aquatic invertebrates of the Jordan River was conducted in cooperation with the Utah Department of Fish and Game for gathering information for the eventual classification of this river system by the Utah Water Pollution Control Board. These organisms can be used for the assessment of biological degradation of the river. In addition, previous aquatic invertebrate studies conducted by Dr. A. R. Gaufin of the University of Utah in 1956-58 were compared with the recent data to determine if the quality of the water had improved or degraded during the intervening years.

Over a period of one year at monthly and bimonthly intervals a total of eight sample collections were obtained for each station. Sampling stations were selected on the upstream and downstream side of each major pollutant source to obtain maximum information on pollutional effects. The organisms obtained were sorted, counted, and identified to genera or species where possible. Standard limnological methods were used for physical-chemical determinations. These tests include dissolved oxygen, temperature, carbon dioxide, total alkalinity, settleable solids, total hardness, and specific conductance.

Graphs and tabulated data depict a river of degrading water quality. The aquatic invertebrates have declined in kinds of organisms found at each station. In the southern portions of the river where pollution is minimal there are found many species and few numbers of each, where in the northern sections there is a high degree of pollution, the numbers of species are few and the numbers of each are high. The biochemical

oxygen demand and dissolved oxygen comparisons show a river of higher organic pollution in 1965-66 than in 1956-58. The graphs for settleable solids, total hardness, total alkalinity and specific conductance are discussed with emphasis on the effects these factors might have on the quality of the water.

Recommendations to improve the quality of the Jordan River water, based on findings of this investigation, include exclusion or adequate treatment of wastes from the principal contributors of B.O.D., tertiary treatment of all domestic wastes, instigation of a total spray irrigation system to eliminate returning silted irrigation water to the river, prevention of livestock and water from feed lots and corrals from reaching the river, and an extensive program for stream and habitat improvement including cessation of continuous dredging operations. These recommendations could eventually establish a satisfactory warm water fishery in the northern sections of the river and also improve the cold water fishery already found in the southern sections.

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INTRODUCTION

Pollution of the Jordan River is an obvious and well-known fact. In the past several years the Utah Pollution Control Board has received much criticism of this condition, with requests for control. The Utah State Pollution Control Board decided that classification of the river would receive strong support. After holding a preliminary meeting, it was determined that there was not enough information available to intelligently classify the Jordan River. To this end, the Board initiated a program for gathering the information necessary for classification of the river. Classification is essential for the control of pollution and to provide water of adequate quality for all uses. It is the recognition and use of these characteristics that make possible the establishment of water of a quality sufficient to sustain fisheries and wildlife habitat.

Classification depends upon accurate information on discharge rates, quality of water in the river, and the nature, strength and amounts of all pollutants, including those from natural sources. The uses of the water as well as the recovery characteristics are also necessary for classification.

The Utah Pollution Control Board, after preliminary meetings with other State agencies, developed a cooperative program designed to obtain the necessary data for classification purposes. Specifically, the data needed included: complete chemical analysis, biochemical oxygen demand (B.O.D.), coliform organisms (M.P.N.), dissolved oxygen (D.O.), heavy metals, radioactive, and bottom fauna analysis.

A plan for the classification of the Jordan River was outlined and approved by the Utah Water Pollution Control Board in November, 1964. The Utah Department of Fish and Game was invited to participate by providing all pertinent data on stream bottom fauna, existing fish species, and any other biological indicators of pollution for incorporation into the final report.

In 1965, a program was initiated by the Utah Department of Fish and Game to provide such data. In January, physical-chemical water analyses were begun and in June a survey of aquatic invertebrates was started. This information was to be compared with a similar set of data obtained by Dr. A. R. Gaufin in 1956-58, to show changes in numbers and kinds of aquatic invertebrates and in the physical-chemical characteristics of the river in the intervening years. The use of aquatic invertebrates not only shows the type and quantity of animals present but also indicates how severe the pollution may be (Gaufin and Tarzwell, 1952, 1956).

Once the data from the various studies have been analyzed, and after holding public hearings attended by the affected parties, the Utah Pollution Control Board can then classify the river.

LITERATURE REVIEW

HISTORICAL

This country, since its beginning, has misused one of its most important natural resources--water. It has permitted its farms, cities, and industries to discharge wastes and sewage into its rivers, streams, and lakes, mostly without plan, control, or thought.

Water pollution had grown to such menacing proportions that President Johnson, in his Message to Congress of February 8, 1965, was moved to say:

> "Every major river system is now polluted. Waterways that were once sources of pleasure and beauty and recreation are forbidden to human contact and objectional to sight and smell. Furthermore, this pollution is costly, requiring expensive treatment for drinking water and inhibiting the operation and growth of industry. I recommend enactment to provide a national program to prevent water pollution at its source rather than attempting to cure pollution after it occurs.
>
> "The Secretary of Health, Education, and Welfare will undertake an extensive program to clean up the nation's most polluted rivers. With the cooperation of states and cities, we can bring the most serious problems of river pollution under control."

With this statement, the President has shown the seriousness of this problem and initiated an all-out attack on the pollution of our waters.

Prior to 1948, the Public Health Service was the primary government authority engaged in studies on water pollution. Work was initiated at the beginning of the twentieth century when water-borne diseases were quite prevalent. The Public Health Service Act of 1912 gave this department of government authority to conduct surveys and studies on water pollution, especially when it affected the health of man.

In 1948, the Eightieth Congress passed the Taft-Barkley Bill, Public Law 845, after nearly one-half of a century of evaluating the growing water pollution problem. Before the passage of this bill, over one hundred bills had been introduced in Congress for consideration for this purpose. The Water Pollution Control Act of 1948, which was to be administered by the Public Health Service, provided a Federal role of research, technical assistance, financial aid, and limited authority over interstate waters.

Public Law 660 was enacted in 1956 after two years of debate and study by both Houses. This act improved and extended the Federal role in the program by adding Federal grants to municipalities to assist them in building sorely needed sewage treatment plants. Additional grants for continued and expanded research programs, technical aid to states for assistance in setting up water pollution control boards, and for continued construction of sewage treatment plants, were provided for in this new bill.

The Federal Water Pollution Control Act (P.L. 89-234) of 1965 created a new administration within the Department of Health, Education, and Welfare but divorced from the Public Health Service. This new administration is responsible for setting up new research laboratories around the nation as well as continuing and expanding the program as set forward in the original bill. Since passage of the bill the authority has been transferred to the Department of Interior by congressional action.

CHARACTERIZATION OF THE JORDAN RIVER

The Jordan River was formed after the drying up of Lake Bonneville, a large fresh-water lake that once covered 19,250 square miles of Utah, Nevada, and Idaho. The lake, through action of its waves and the northwesterly prevailing winds, eventually built up a sand bar at the point now called the Jordan Narrows. The water level dropped as evaporation increased, induced by a dry and warmer climate. The river eventually eroded a deep channel through the sand bar to keep the Great Salt Lake and Utah Lake connected even though the levels of the lakes had dropped considerably (Pack, 1939).

The river leaves Utah Lake at an elevation of 4490 feet, and after flowing about fifty-five miles, enters the Great Salt Lake at an altitude of 4203 feet. A gradient of only 5.24 feet per mile indicates a silting-type river (Hynes, 1962). Before emptying into the Great Salt Lake the Jordan River water is used extensively for the maintenance and production of State and private waterfowl marshes.

According to the U. S. Geological Survey (Utah Water Pollution Control Board, 1964), the Jordan River flow at the Jordan Narrows (approximately 7.5 miles downstream from Utah Lake) varies from a maximum of 1410 cubic feet per second (June 10, 1952) to zero cubic feet per second when the irrigation control gates are closed. Below this point spring flows maintain a minimal water level in the river. The fifty-year average flow at this point is 356 cubic feet per second. The recorded maximum and minimum flows at 2100 South Street above the surplus canal are 1820 cubic feet per second and 89 cubic feet per second, respectively. The twenty-year average here is 339 cubic feet per second (Utah Water Pollution Control Board, 1964).

The volume of the river is augmented by the flow from the nearby canyons, domestic waste-water treatment plant effluents, and from industrial waste discharges. The following is a list of the most important of these arranged from south to north.

Tributary Streams

Corner Canyon Creek
Willow Creek
Dry Creek
Bingham Creek
Little Cottonwood Creek
Big Cottonwood Creek
Mill Creek
Parleys Creek
Emigration Creek
Red Butte Creek
City Creek

Domestic Waste-water Treatment Plant Effluents

Camp Williams (intermittent)
Utah State Prison
Sandy
Midvale
Kearns
Salt Lake County Cottonwood Sanitary District
Granger-Hunter Improvement District
Salt Lake City Suburban Sanitary District Number 1
South Salt Lake
South Davis County Sewer Improvement District - South Plant
South Davis County Sewer Improvement District - North Plant

Industrial Waste Discharges

Fur Breeder's Agricultural Co-op. (Midvale)
Utah-Idaho Sugar Company (West Jordan)
Vitro Minerals Corporation (Salt Lake City)
Rio Grande Railroad (Salt Lake City)

Since Utah Lake is receding due to the reduced inflow of water and increased evaporation, lake water has to be pumped into the river during the growing season. Flow is regulated by gates and diversion dams. This water is used heavily for industrial purposes and extensively for irrigation.

Many diversions have been constructed to make the water more readily available for these purposes. These diversions are listed as follows:

Utah Lake Distributing Canal
Utah and Salt Lake Canal
East Jordan Canal
Jordan and Salt Lake City Canal
South Jordan Canal
Galena Canal
Beckstead Ditch
North Jordan Canal
Mill Race Ditch
Brighton Canal
Surplus Canal
State Canal

The quality of the upper stretches of the river are of adequate quality for the maintenance of a trout fishery, and marshes at the delta of Great Salt Lake provide key production centers for waterfowl.

By means of certain physiographic and hydrologic characteristics, the river can be divided into three distinct sections, each of which displays characteristics not common to the other two.

The first division is that section from the outlet of Utah Lake to about 14600 South (Bluffdale Road) at the south end of Salt Lake Valley. The river in this area is deep, wide, meandering, and heavily silted. Through the summer months, the heavily silted Utah Lake water is pumped into the Jordan River. Water in this condition will support very little plant life. In the winter months, when no pumping is done, the flow is restricted almost entirely to springs, and those areas that do not freeze usually support a high phytoplankton population.

The next division includes the section from the Bluffdale Road to about 4800 South Street. In this area, the stream runs swift and shallow with many riffles and pools. Dense growths of Nasturtium, Potamogeton, and Ceratophyllum occur throughout this section. Many areas in this section have been dredged, which has resulted in an unstable sand and gravel bottom. The reduction of stable fish food organisms here is probably due to the mechanical abrasion of sand particles against those organisms (Moffet, 1935) and suffocation by covering with silt.

The last division is from 4800 South to the Great Salt Lake. It is in this area that the river has become channelized, sluggish, and most highly polluted. The water is usually heavily silted and is offensive to both sight and smell. The bottom of this part of the river is covered by a thick layer of mud and silt in the places where dredging operations have not resulted in a shifting sand and gravel bottom.

The Jordan River and its tributaries are the receiving waters for a variety of waste effluents originating from industrial, municipal, and agricultural sources. This pollution may be classified under the following six major headings:

Natural -- Erosion of river banks and of the valley slopes leads to considerable natural pollution (Kline, 1962). In the western states, this has become a particularly serious problem because of reduced rainfall and often sparsely vegetated stream banks. This lack of proper cover, permits excessive erosion of the topsoil.

Physical -- Siltation could also be listed under this heading. Molar action against aquatic organisms by the larger particles (Moffet, 1935) tends to adversely affect these animals by its abrasive action. The finer particles tend to precipitate in the slower reaches of the river, and in so doing suffocate many organisms. Wallen (1951) using 380 fish of 16 species, found that these fish endured exposure to more than

100,000 mg/1 montmorillonite clay for over a week. Based on these results, he concludes that the direct effect of montmorillonite clay turbidity is not lethal at concentrations found in nature. However, recent studies show that concentrations of about 200 mg/1 were found to be directly harmful to rainbow trout (Herbert and Merkins, 1961). This turbidity also has a detrimental affect on plankton and fish growth (Buck, 1956). Quantitative studies of turbidity on entire aquatic organism communities remain to be done (Cardone and Kelly, 1961). Siltation of the Jordan River becomes extremely acute during the months of October through January when the Utah-Idaho Sugar Company is in operation. Tons of silt and large amounts of beet pulp are released into the river by way of Bingham Creek.

Hot water introduced into a river can be instrumental in killing or even changing the entire biota in that section. The hot water and steam used to flush down the trucks and killing floors at the Fur Breeder's Agricultural Co-op in Midvale could be a source of such contamination. The Utah-Idaho Sugar Company also deposits great quantities of hot water in its effluent. On November 9, 1965, temperature measurements at a point on Bingham Creek, one-fourth mile above the confluence with the Jordan River, showed a temperature of 71 degrees Fahrenheit. The Jordan River above the confluence of Bingham Creek showed a temperature of only 55 degrees Fahrenheit. This drastic change in temperature has a great influence on the biota in the immediate vicinity of the confluence of these two streams.

<u>Pathological</u> -- Infectious diseases pose another pollutional problem on the Jordan River. Bacteria, viruses, parasitic worms, etc., are

introduced through sewers, animal access to the river, and private septic tanks. Professor G. K. Borg of the University of Utah conducted a study in 1947-48 to determine the coliform count, B.O.D., dissolved, suspended, and total solids and stream flow in the river. These tests demonstrated that the river was contaminated in excess of class "D" stream standards. (See Appendix C.)

An investigation in 1949 by R. A. Knight also indicated a high pollution rate. In addition, he isolated two species of potentially pathogenic Salmonella bacteria.

Although all the sewage treatment plants are now treating sewage through secondary treatment and chlorination, poor treatment practice, drainage from private sewers, septic tanks, and water from stockyards and corrals on the banks of the river still present a pollution problem. Since the banks of the river are primarily of a humas-clay composition, which is not conducive to adequate filtration, the sewage from private septic tanks frequently drains directly through fissures into the river rather than being held for complete decomposition and the ultimate death of many pathogenic microorganisms.

Children, not aware of the health hazards, use this river for cooling off during the summer months. It is not known how many illnesses could be traced to this practice.

Organic -- Organic pollutants are perhaps the most prevalent and detrimental of any in the river. This type has been creating problems for many years. Organic pollution is found in sewage and industrial wastes. These pollutants are characterized by being oxygen-demanding in the breakdown processes. When sewage or similar products are added to a body of water, they may be added to a point to which the water is organically enriched. Beyond this concentration, the additive becomes a pollutant. As the bacteria and other decay-causing organisms break down the material, they use up the available dissolved oxygen supply. With a reduced oxygen content, certain clean-water organisms cannot survive and are replaced by those that can live under these reduced-oxygen conditions. The aquatic invertebrates present in an area can be used, with some reservations, as indicators of the severity of the pollution (Gaufin and Tarzwell, 1952).

The Utah-Idaho Sugar Company contributes large amounts of organic pollutants. It has been estimated that this company contributes 3,138,349 pounds of B.O.D. (Utah Department of Health, 1965) to the river annually. In sugar beet processing, chemical additives, silt from beet washings, and portions of shredded beet tops and tissue reach the river even though some screening and filtering is done. These discharges combine in the river to form extensive sludge-silt deposits. These sludge beds, plus unrecoverable sugar in solution create an excellent growth media for sewage fungus (Sphearotilus natans) and sewage worms (Tubifex tubifex). This condition exists in the river from the point of confluence to Cudahy Lane in Davis County, a distance of about twenty miles.

It has been shown by Quinn (1958) with his work on the periphyton of the Jordan River that these wastes drastically change the river biota by eliminating the beneficial organisms and replacing them with a heavy growth of the sewage fungus.

The Fur Breeder's Agricultural Co-op also adds considerable amounts of organic pollution in the form of meat scraps, blood, cereal, etc., from trucks, killing floor, and grinder washings which are flushed directly into the river. The calculated B.O.D. load introduced yearly is 68,640 pounds (Utah Department of Health, 1965).

Mineral -- This pollutant is composed of those elements and compounds leached from dumps and slag heaps, effluents from refining processes, acids, and fertilizers.

Midvale Smelter, although not operating at the present time, has in the past built up large slag and tailing dumps on the banks of the Jordan River. The sulfides and sulfites present in the tailings may be oxidized and leached out as acids to flow into the river. Unrecovered metals such as copper, zinc, lead, and silver can produce a toxic poisoning to fish and other aquatic organisms (Tarzwell and Henderson, 1960).

Fertilizers used by farmers in the area are washed into the river with returned irrigation water. These chemicals, when added to an unpolluted river may cause algal blooms and increased growth of higher aquatic plants; but, since this river already has an excess of nutrients, this addition causes pollution. Salts from the soil, plus phosphates, nitrates, and potassium used in fertilizers, are washed into the river to such an extent as to make total specific conductance as high as 3000 micromhos per centimeter. When some detergents are degraded in sewage treatment plants, large amounts of phosphates, which are an integral part of the detergent molecule, are released. These act to enhance plant growth and to pollute the river.

Radioactivity -- Radioactive chemicals are added to the river by the Vitro Chemical Plant on 3300 South. For fifteen years, this uranium refining industry has contaminated the Jordan River with radioactive wastes. At the present time they are refining vanadium, but the radioactive tailings are still present. These minerals which are acted upon by oxygen and precipitation may be leached into the river. Recent studies (Pendleton, et al., 1964) have shown that muskrats living in the Farmington Bay Bird Refuge had absorbed as high as 216 picocuries of Radium-226 per gram of body calcium. The maximum allowable amount of radium in normal human beings is only 0.1 picocuries per gram of calcium (Pendleton, et al., 1964). This comparison shows the high radioactivity found in the Farmington Bay marshes. Radioactivity can cause chromosonal aberrations resulting in mutations and freaks in aquatic organisms.

There is a relatively high incidence of abnormal muskrats taken on the Farmington Bay marshes during the trapping season. Evidence points strongly to radioactive pollutants from this source as being responsible.

MATERIALS AND METHODS

For the most part standard limnological methods were used in this study. In the first portion of this section the 1956-58 study is outlined and the second part is devoted to the 1965-66 study.

The specimens collected during the 1956-58 study contributed by Dr. Gaufin of the University of Utah, were labeled and in vials with 70% alcohol. These were then tabulated with regard to numbers and classification.

The sixteen stations shown on the map (Figure 1) that were used in this segment of the study are also listed below with a brief description. The findings at these stations give a good indication of the type of aquatic invertebrates that were present in the Jordan River a decade ago.

Station #1	Pumping Station (Utah Lake)
Station #2	Lehi-Fairfield Road
Station #3	Diversion Dam at Jordan Narrows
Station #4	14600 South, Bluffdale Road
Station #5	12400 South
Station #6	10600 South
Station #7	9000 South
Station #8	7800 South (Center Street, Midvale)
Station #9	6400 South
Station #10	4800 South
Station #11	3300 South
Station #12	2100 South

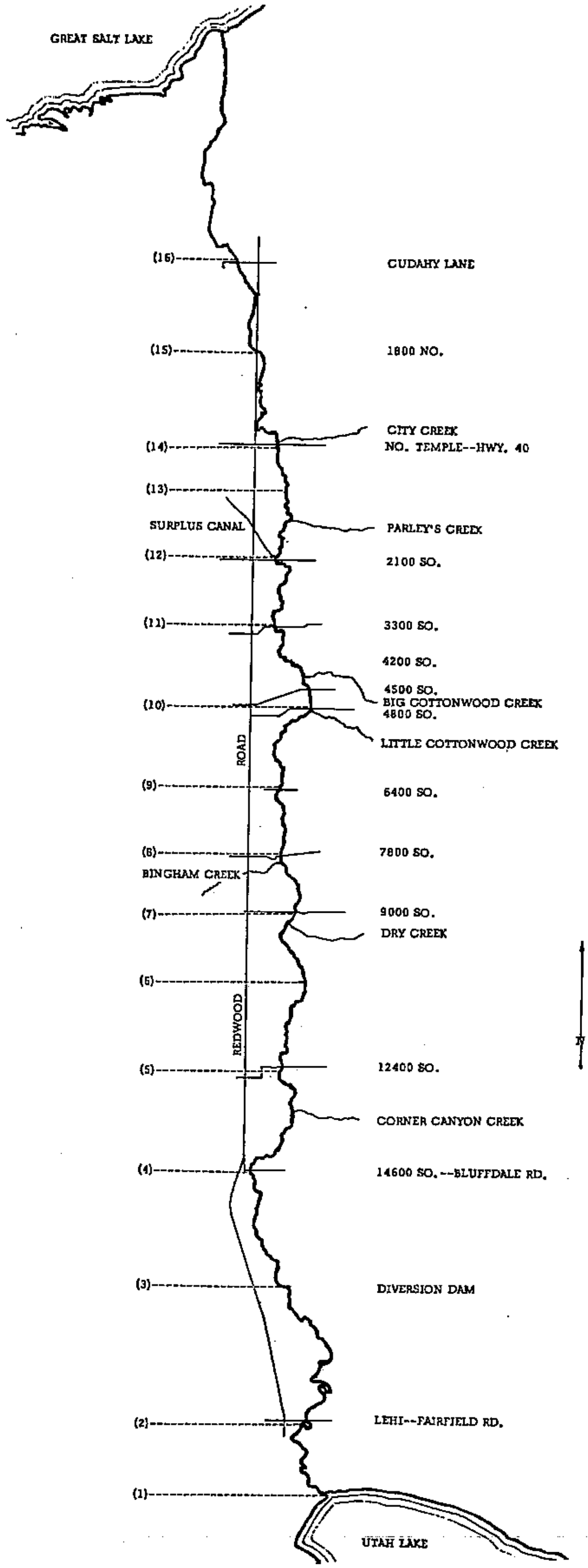

Figure 1. Stations Investigated in the 1956-58 Study.

Station #13	Jordan Junior High, 1040 West 6th South
Station #14	North Temple
Station #15	1800 North Redwood Road
Station #16	Cudahy Lane

Eighteen sampling stations used in the 1965-66 study were chosen to provide maximum information on the pollutants entering the river and the effect of each on the bottom fauna of the river. In many instances, a single station is used as a downstream sampling point for one pollution contributor, and the upstream sampling point for another. By using this method much needless duplication was avoided. Figure 2 gives the location of the sampling stations used in this study.

Below is a list and general description of each of the aforementioned stations.

Station #1 — State Prison - 13000 South, just below diversion dam above Corner Canyon Creek. The bottom is composed of rubble and boulders about the size of a fist, with a dense growth of aquatic plants.

Station #2 — State Prison - 12800 South, 1000 feet below outfall of Corner Canyon Creek. The bottom strata at this station is of a shifting sand and gravel type. There are a few sparse islands of vegetation along the edges in which can be found small sludge beds.

Station #3 — Sandy - 9000 South, just above bridge. At this station the bottom is shifting sand and gravel. The vegetation patches present here are quite sparse. There are mud and silt bars along the edge of the river, and some sludge beds, although not as extensive as at Station #2.

Station #4 — Sandy Sewage - Lower - 8500 South, Southeast corner of the Fur Breeder's Agricultural Co-op Experimental Ranch fence. At this point there are extensive sludge beds collected between the roots and stems of the vegetation. The center of the river is shifting sand.

Fur Breeder's Agricultural Co-op - Upper

Station #5 Fur Breeder's Co-op - Lower - 8400 South, 1000 feet below Fur Breeder outfall. In the shifting sand and gravel from this station can be found pieces of meat and offal from the Fur Breeder's Agricultural Co-op. The few vegetation islands harbor sludge beds.

Utah-Idaho Sugar Company - Upper

Station #6 Utah-Idaho Sugar Company - Lower - 7800 South, 1000 feet below U & I outfall. At this station below the bridge can be found the shifting sand and gravel with a few boulders scattered around. No vegetation of any importance is present. During the months of October through January when the U & I is operating, the river is very heavily silted and dense growths of sewage fungus are found along the shores.

Station #7 Utah-Idaho Sugar Company - Bingham Creek, one quarter mile from the confluence of the river. The bottom at this station is of fine rubble and sand. The vegetation is mostly filamentous algae. When the U & I Sugar Company is operating the algae is almost non-existant and is replaced by the sewage fungus.

Station #8 Midvale Smelter (U. S. Smelting, Refining, and Mining Company)

Station #9 Midvale Sewage - Lower - 6400 South, above bridge. The river bed here is composed of gravel and coarse sand with a few vegetation beds along the shore.

Kearns Sewage - Upper

Station #10 Kearns Sewage - Lower - 4800 South, above bridge. Sludge beds along the shore and shifting sand comprise the bottom of the river at this sampling point.

Murray Sewage - Upper

Station #11 Murray Sewage - Lower - 4500 South, 1000 feet below outfall. Approximately 1000 feet below the Murray Treatment Plant are found steep banks with rushes and willows along the edges. The river bottom is of shifting sand bars and sludge beds in the slower reaches of the river.

Big Cottonwood Creek - Upper

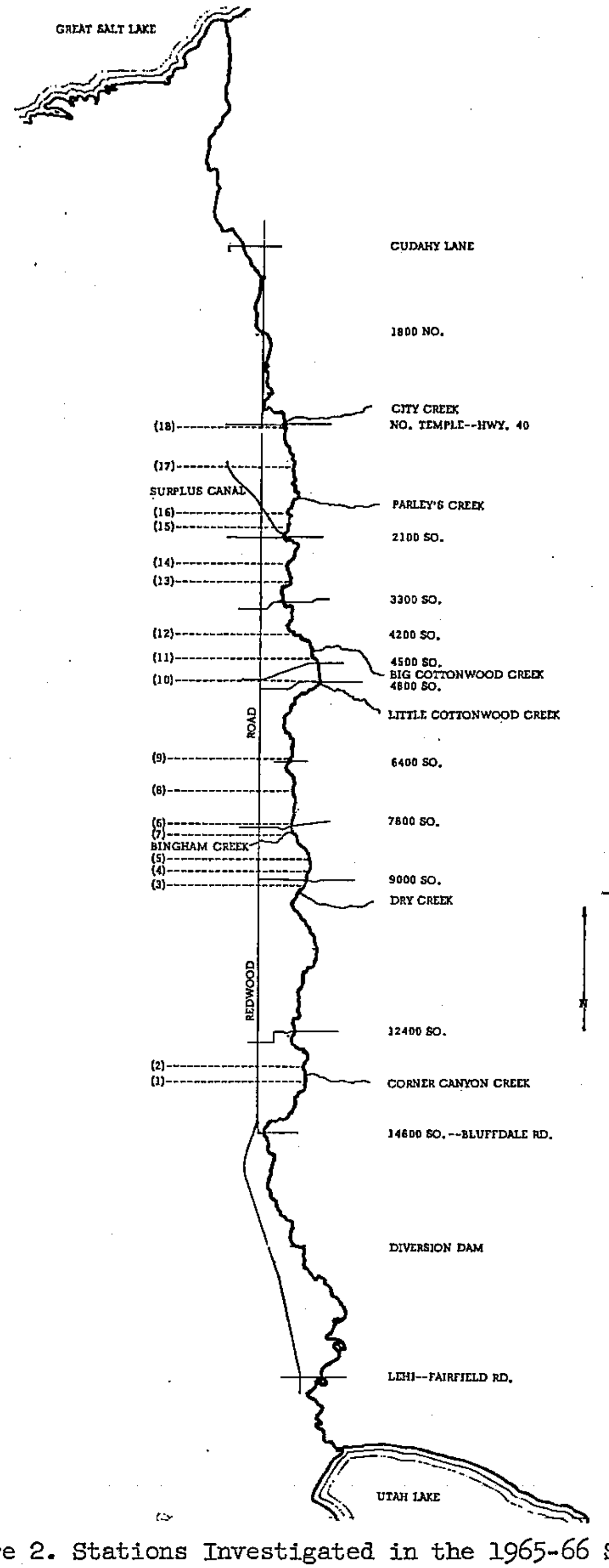

Figure 2. Stations Investigated in the 1965-66 Study.

Station #12 Big Cottonwood Creek - Lower - 4200 South (reached by boat or down cliff). At this sampling station the river is very deep and the bottom is of shifting sand.

Hunter-Granger - Upper

Station #13 Hunter-Granger - Lower - 3000 South, above S.L. Suburban-Vitro, north of 3300 South. The bottom strata is of shifting sand and many sludge beds. There is very little vegetation growing in this area.

S.L. Suburban-Vitro - Upper

Station #14 S.L. Suburban-Vitro - Lower - 2900 South, 1000 feet below outfall. Shifting sand, sludge beds and deposited colored mud and silt are the features of this sampling area.

Station #15 South Salt Lake - Upper - 2100 South, above outfall just below diversion dam on surplus canal. In the area of this sampling station is found extensive, deep sludge beds. The center of the river is shifting sand and gravel.

Station #16 South Salt Lake - Lower - 1900 South, 1000 feet below outfall. This area is similar to the above station except the sludge beds are more numerous and deeper.

Station #17 Parleys Creek - Lower - 1100 South - Fremont Avenue, 1000 feet below Parleys Creek outfall. The river bed at this point is shifting sand and gravel from shore to shore. The sludge beds have diminished somewhat but in the slower stretches of the river some may be found.

Station #18 North Temple - just above City Creek confluence. At this station the river bottom has deteriorated to a large sludge bed. The river is deep, sluggish, and highly silted.

The stations were sampled at monthly intervals during the months of June through September, 1965, and then were sampled every other month for the duration of the investigation. A total of eight samples from each station were made over a period of one year.

Different sampling methods were necessary in the different portions of the river due to the substrate changes in the river bed. At

Station Number 1, it was possible to use a Surber Square Foot Sampler as the water was shallow and the bottom was of a rubble nature. On Stations 2 through 11 it was necessary to use a hand screen as the river was too deep for a Surber Sampler and too shallow for using a boat. The bottom area was scraped and agitated by foot to dislodge the organisms and the contents from the disturbed area evaluated. Station Number 8 was sampled several times and then discontinued because the smelter was inoperative at this time.

Stations 12 through 18 were sampled by the use of a six inch square Ekman Dredge. The dredge was modified so that the current would not sweep it downstream before the sample was taken. The modification was accomplished by attaching a six-foot piece of three-quarter inch conduit with a triggering device running through the center of the conduit to release the jaws.

Stations 12 through 16 were sampled from a small aluminum boat because the river at these points was too deep for wading. Stations 17 and 18 were sampled by wading.

After each sample was taken, it was preserved in 10 percent formalin until it could be processed further. In the Utah Fish and Game Laboratory, the sample was washed through sieves of U. S. Series Numbers 12, 20, and 30 meshes to remove silt, sand, and excess formalin. After the debris that had passed through the number 30 sieve had been checked and no organisms were found, it was assumed that if any had passed through, the number was insignificant, and no further checking of these samples were done.

White porcelain pans were used to hold the sample while the organisms were being separated from the debris. After separation, the aquatic invertebrates were sorted, counted, and identified. The use of such texts as "Aquatic Insects of California" (Usinger, 1963), "Fresh Water Biology" (Needham and Needham, 1963), "Fresh Water Invertebrates of the United States" (Pennak, 1953), and "Fresh Water Biology" (Ward, Whipple, and Edmonson, 1959), were helpful in the identification of the organisms.

When the numbers of organisms were too large to count an aliquot of the sample was taken and the number of organisms in the aliquot was counted. This number was then equated to the entire sample to arrive at the total number.

The physical and chemical data was determined by methods outlined in "Standard Methods for Examination of Water and Waste-Water" (American Public Health Association, Inc., et al., 1962) and "Fresh Water Biology" (Needham and Needham, 1963).

These determinations included dissolved oxygen, percent saturation of oxygen, temperature, carbon dioxide, total alkalinity, total hardness, settleable solids, and specific conductance.

RESULTS

The results of the 1956-58 study gathered by Dr. Gaufin are listed in Figures 18 through 33, found in Appendix A. Also listed in these tables for each sample are the percentages of composition for each organism. Figure 6 illustrates the total kinds of organisms present at each station. In the histogram, Figure 3, the total numbers of individual organisms are displayed. Also shown in this graph is the portion of the sample which is composed of tubifex worms (checked portion). Figure 4 shows the stations at which specific organisms were present. Histograms of the B.O.D. concentrations and D.O. are shown for each station, Figure 9 and Figure 11, respectively. The above graphs and tables will be discussed in detail in a following section.

The 1965-66 study results are tabulated in Figures 34 through 50, Appendix A, and the physical-chemical data is recorded in Figures 51 through 64, Appendix B. The total numbers of organisms present are shown graphically in a histogram, Figure 8. Figure 5 represents only those organisms present at each station, whereas in Figure 7 the numbers of kinds of organisms is given. For the physical-chemical data in graphic form, see the following histograms: Figures 10, and 12 through 16.

DISCUSSION

An overall look at the organisms present in 1956-58 indicates a highly eutrophic river, to the point of reducing some of the more fastidious organisms in the lower sections. Figure 3 shows the total number of individual organisms for each station and pickup. The checked portions of the graph indicate the number of tubifex worms found in each sample.

In this study there is an almost uniform number of organisms present at all stations, thus indicating a relatively uniform degree of pollution. Sewage treatment plant effluents were lower because a number of plants now present were nonexistent ten years ago.

To better characterize the river of 1956-58, examination of Figure 6 reveals that at the northern stations there were fewer kinds of organisms than at the southern portion. Exceptions to this are found at Stations 1 and 2. In the area of these stations the highly silted Utah Lake water is inhibitory to the maintenance and propagation of many organisms. Station 3 at the Jordan Narrows shows a lesser degree of effect on the fauna as the silt is precipitated with the movement of the water downstream. From Station 4 at Bluffdale, the area with the largest number of kinds of organisms, the numbers decrease to a low at 3300 South (Station 11). The severe reduction (Figure 6, Station 11) in bottom fauna is attributable to gross discharges of meat packing waste by the Valley Meat Company. A slight recovery at 2100 South, Station 12, would at first glance indicate less pollution; however, this station was below the Vitro Chemical Plant which was

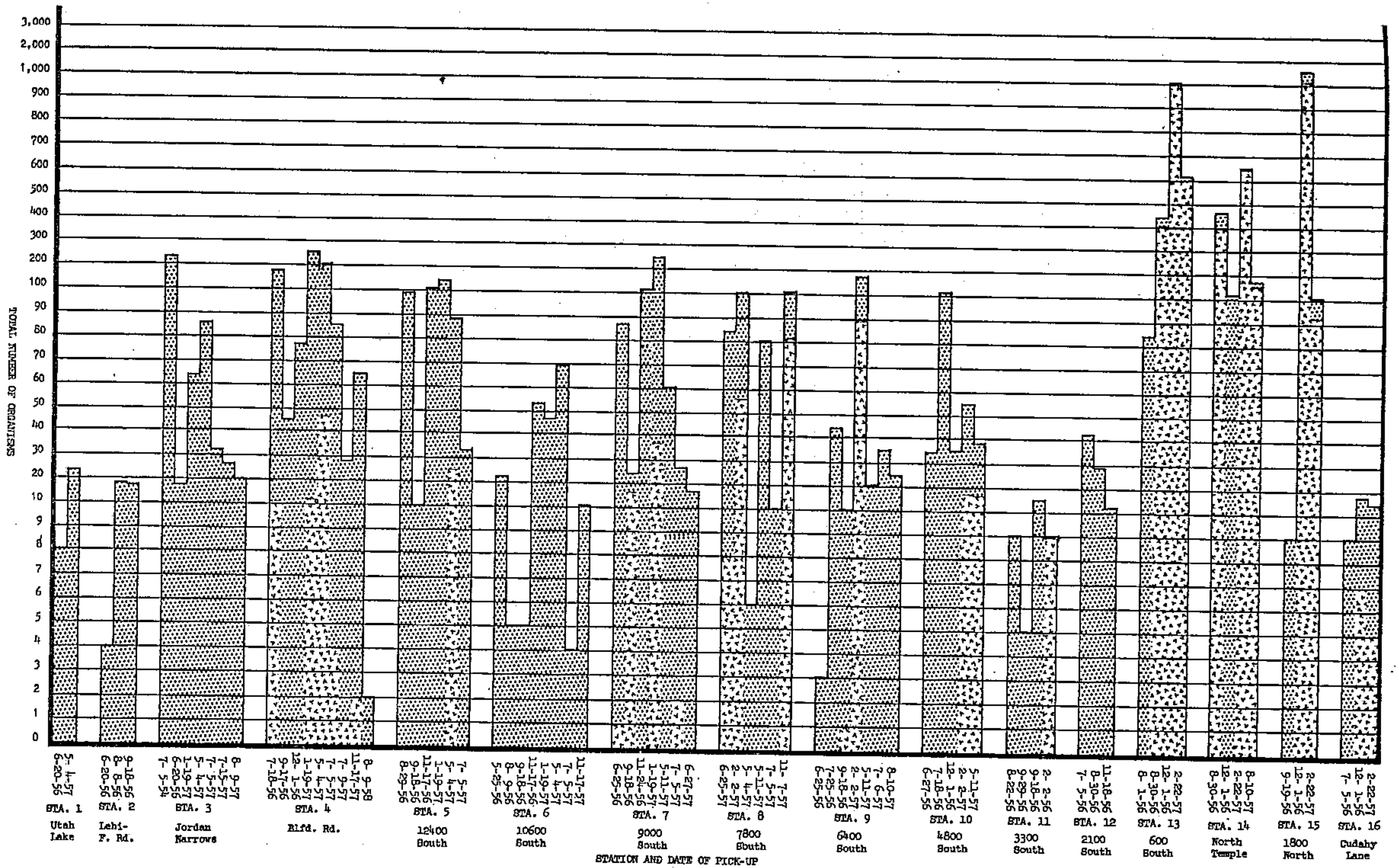

Figure 3. Total Numbers of Aquatic Invertebrates of Each Station--1956-58 Study.

discharging an acidic and radioactive effluent as a byproduct of uranium milling. There is an intervening distance of about 1.6 miles between Stations 11 and 12, which would allow a partial recovery from this toxic waste. This is also true for Station 13 located at 600 South. From this point there is a steady decline in the quality of the bottom fauna. This characteristic is probably due to a combination of latent effects of upstream organic pollutants and habitat alteration due to dredging activity and sludge formation. The Jordan River at that time was clean enough so that it would support fair numbers of Ephemeroptera, Odonata, Hemiptera, Coleoptera, and Diptera (Figure 4).

Crustacea and the representatives of the Order Odonata were found to be present in ninety-four percent of the stations sampled. This would indicate that these organisms were quite tolerant to the pollution that was present in the river at that time. The sewage worm (Tubifex tubifex) inhabited eighty-one percent of the stations. Specimens of the Order Trichoptera which were found in forty-four percent of the stations were able to survive the pollutants present in the river down to Station 12. Below this point the concentration of pollutants became too great for survival of these organisms. The absence of the Order Plecoptera from all but one station (Jordan Narrows) indicates the presence of some pollution, as these organims are found primarily in clean water environments.

The aquatic Lepidopteran, Paragyractus sp., was found only in one station; namely, Station 4, Bluffdale Road. At this station many diverse organisms were found which did not occur elsewhere on the river. This is probably due to the fact that in the stations above this point there were large amounts of silted irrigation water flowing from

Station Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Annelida	o	o	x	x	x	x	x	x	x	x	x	o	x	x	x	x
Crustacea	x	x	o	x	x	x	x	x	x	x	x	x	x	x	x	x
Mollusca	x	x	x	x	x	x	x	x	x	x	o	x	x	x	x	o
Ephemeroptera	o	x	x	x	x	x	x	x	x	x	x	x	x	x	o	o
Odonata	x	o	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Plecoptera	o	o	x	o	o	o	o	o	o	o	o	o	o	o	o	o
Hemiptera	x	x	x	x	x	x	x	x	x	x	o	x	x	o	x	o
Coleoptera	o	o	x	x	x	x	x	x	x	x	o	x	x	o	x	x
Diptera	x	x	x	x	x	x	x	x	x	x	x	x	o	x	o	o
Trichoptera	o	o	x	x	x	x	x	x	o	o	o	x	o	o	o	o
Lepidoptera	o	o	o	x	o	o	o	o	o	o	o	o	o	o	o	o

Figure 4. Organisms Present at Each Station, 1956-58 Study.

Station Number	1	2	3	4	5	6	7	9	10	11	12	13	14	15	16	17	18
Annelida	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Crustacea	x	x	x	x	x	x	x	x	x	x	x	x	o	o	x	o	o
Isopoda	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o
Mollusca	x	x	x	x	x	x	x	o	o	o	x	o	x	o	o	x	x
Ephemeroptera	x	x	o	o	o	o	o	x	x	x	x	x	o	o	o	o	o
Odonata	x	x	x	x	x	o	o	x	o	o	o	o	o	o	x	o	o
Plecoptera	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o
Hemiptera	x	o	x	x	x	o	o	o	o	o	x	o	o	o	o	o	o
Coleoptera	x	x	x	x	x	o	x	o	x	o	x	o	o	o	o	o	o
Diptera	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Trichoptera	x	x	x	x	o	o	x	x	x	o	x	x	o	o	o	o	o
Collembola	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o

Figure 5. Organisms Present at Each Station, 1965-66 Study.

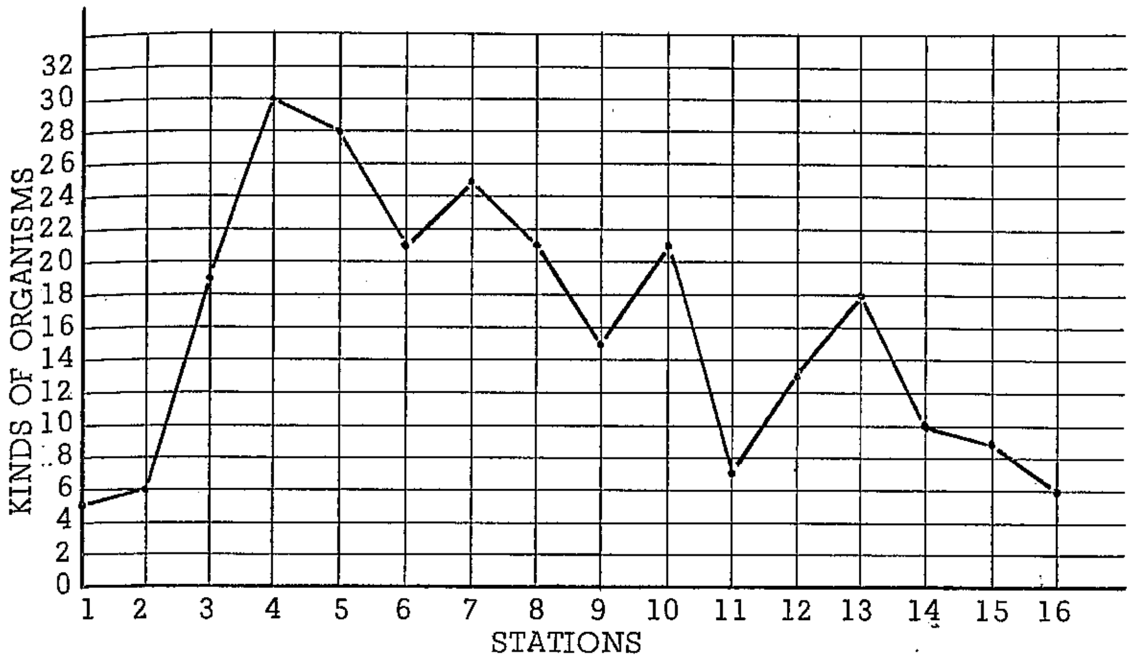

Figure 6. Total Kinds of Organisms at Each Station, 1956-58 Study.

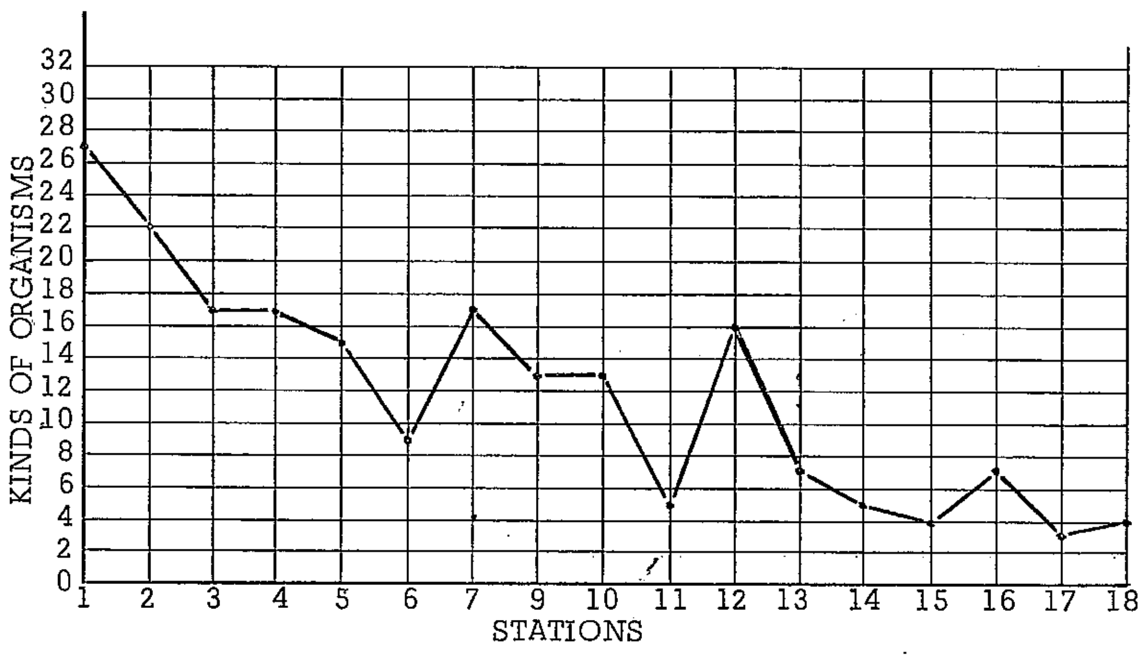

Figure 7. Total Kinds of Organisms at Each Station, 1965-66 Study.

Utah Lake which is inhibitory to many aquatic invertebrates. In the sections below Bluffdale station, organic and industrial pollution was probably the limiting factor.

The Phylum Mollusca, which consists here of two Classes, the Pelecypoda and the Gastropoda, were found to be present at eighty-eight percent of the stations (Figure 4). The predominant group was the Gastropoda which was represented by pulmonate snails. These snails are able to live in a reduced oxygen supply, such as is found in the lower Jordan River. The Pelecypoda were found predominantly in Stations 4 and 5. In Stations 13 and 14 only one specimen was present in each of these areas.

The mayfly, <u>Tricorythodes sp.</u>, was the most common of the Order Ephemeroptera represented in the stations sampled. This mayfly appears to be suited to this type of environment because of a specialized adaptation of plates to cover the gills.

Dissolved oxygen levels shown in Figure 11 indicate a deteriorating river from south to north. The numbers at the bottom of each set of readings indicate the month in which the sample was taken. All stations south of Station 8 at 7800 South had progressively lower D.O. At 7800 South and continuing on north there was a rapid fall-off of D.O., especially in the months of October through December. This was undoubtedly due to the addition of the Utah-Idaho Sugar Company waste. At about 3000 South below the combined Vitro Chemical-Salt Lake City Suburban Sanitary District waste ditch there was a depressed D.O. level in all months but March. This condition was probably due primarily to the combined waste discharges immediately upstream. Other factors contributing to D.O. depression at this station were caused by accumulated loadings from sewage treatment plants upstream and during the period, October through January, to waste effluent from the Utah-Idaho Sugar Company.

At stations located downstream from 7800 South, B.O.D. readings for the same time period coincide inversely with the D.O. results seen in Figure 11. As the B.O.D. loadings increased D.O. levels dropped off. In the river above 7800 South the average B.O.D. was less than 5 milligrams per liter, indicating a river of Class "C" rating (see Appendix C). Below Station 8 at 7800 South the B.O.D. level increased greatly, again due to the Utah-Idaho Sugar Company waste. During the period of October through January when this company was operating, the B.O.D. rose to very high levels and the D.O. was reduced.

The carbon dioxide and pH below the Vitro Chemical Company outfall are typical of a polluted river. In March, 1956, the carbon dioxide level was elevated to over 200 milligrams per liter and the pH was as low as 5.1. In November, 1955, a massive fish kill was experienced on the Jordan River due to this highly acidic effluent. An estimated eighty percent of all fish present were killed at this time (Utah Fish and Game Bulletin, 1955).

In the 1965-66 study, Figure 8 shows the total number or organisms per square foot. This histogram illustrates that as the pollution increases, the numbers of organisms diminish and are eventually replaced by those organisms which are tolerant to the pollution present in the river. The checked portions of the graph indicate the numbers of tubifex worms found in each sample at each station.

Station 1, located at the northeast corner of Utah State Prison shows increased growth and numbers of organisms in the spring and summer. The population decreased in the winter and again increased during the spring. The largest number of kinds of organisms were found at this station (Figure 7). The reduction in the number of organisms at 12800 South, Station 2, was probably due to the introduction of sewage effluent from the Utah State Prison and the absence of a stable bottom resulting from previous dredging operations. The further degradation of the river at 9000 South, Station 3, was probably due to the addition of organic pollution in the form of drainage from feed lots, pastures, and the addition of inorganic nutrients and silt carried in by returned irrigation water.

Station 4 at 8500 South shows a continuing degradation of the river based on the numbers of organisms (Figures 7 and 8). Although the number of types of individuals was the same as at the previous station, the numbers of each were less. This trend was probably due to the addition of the Sandy Sewage Treatment Plant effluent.

Station 5 is located approximately 1000 feet below the Fur Breeder's Agricultural Co-op plant, and shows a markedly reduced population of aquatic invertebrates. By examining Figure 8, the lowest number of organisms, and therefore the highest level of pollution, can be seen in the months of May through November. The main reason for this is, as the mink kits are whelped in late April through May, the increase in usage of mink food is almost immediate. Because of the higher volume of feed produced at this time, a larger volume of waste in the form of meat scraps, cereal, and blood is introduced into the river. This results in a zone of immediate pollution. Bottom substrates are completely smothered by this highly putrescible material and D.O. levels are reduced. As a result very few organisms occur and these are only the most tolerant species.

The picture at Station 6 is somewhat different. This station is located just below the confluence with Bingham Creek at 7800 South. Bingham Creek is used by the Utah-Idaho Sugar Company to dispose of their wastes of silt, beet pulp, and unreclaimed sugar. The sugar beet harvest begins in October and the mill runs continuously to about the first part of January. The graph for Station 6 (Figure 8) shows plainly the consequences of adding this waste to the river by the drastic drop in the numbers of organisms in the months of November and January. The low numbers of organisms at this station in September are probably also due to the influence of the Fur Breeder's Agricultural Co-op wastes introduced immediately upstream. At almost any time of the year large quantities of pieces of meat and fat can be found at this location.

Station 7 is located on Bingham Creek one-fourth mile above the confluence with the Jordan River. The graph (Figure 8) plainly shows the affect of the sugar beet wastes on the aquatic invertebrates present in the creek. Although the numbers of organisms of this station are generally higher than those of adjacent stations, the addition of this high B.O.D. waste effectively eliminates nearly all life in the stream.

At 6400 South, Station 9, the aquatic invertebrates tend to recover in numbers. The effect of the large influx of B.O.D. from the Utah-Idaho Sugar Company is still evident in the November and January

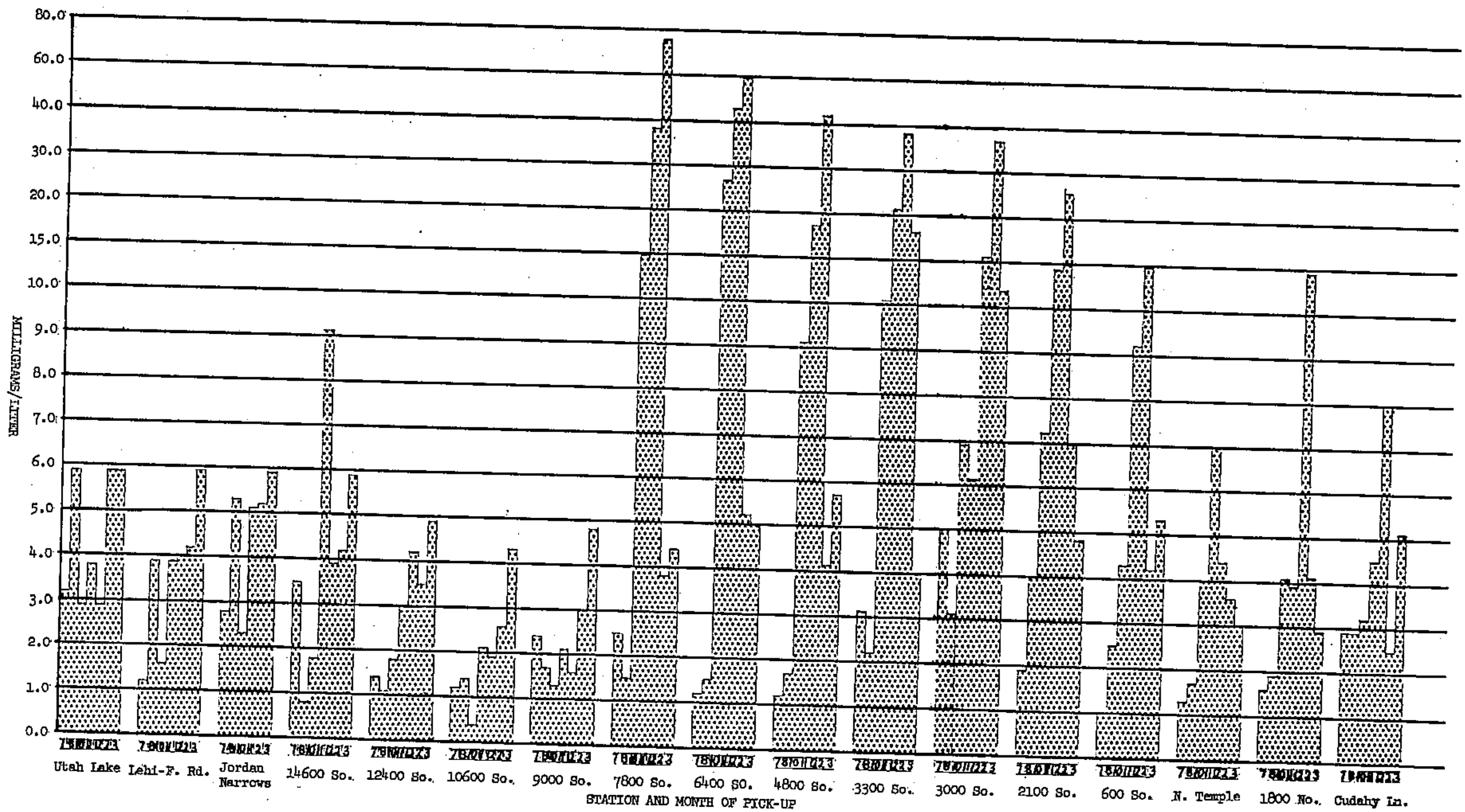

Figure 9. Histogram of B.O.D.--1956-58 Study.

samples, and the increased number of organisms could be due to the improved habitat. At this station there are less extensive shifting sand and gravel beds.

At 4200 South, Station 12, the river reflects some degree of recovery. This is probably due to dilution water entering from Big Cottonwood Creek immediately upstream even though these waters are polluted to a degree by the effluent from a treatment plant at this location. This dilution acts to reduce the concentration of pollutants at this point. Stoneflies were found only at this station. A single specimen was picked up here in May, 1966, probably having been washed in from Big Cottonwood Creek. Other organisms, such as aquatic Collembola and the Isopod, Asellus, were also found here, again probably washed in from Big Cottonwood Creek where in other studies these organisms were found in abundance. The Dipteran, Psychoda, was abundant at this station. These flies are common in trickling filters of waste-water treatment plants. The method of elimination of this nuisance is flooding the filter until the larva are drowned. The waste water is then flushed out and many of the dead larva are washed out also. This practice would explain the high numbers of these Diptera below this outfall as well as other sewage treatment plant outfalls.

In the environments of Stations 13 through 18 only those animals which could live in high polluted conditions were present. The tubifex worms are well suited for occupancy in these environments, while at the same time virtually all other organisms are excluded. Tubifex worms require, for optimum growth, a soft sludge substrate in which to burrow, and large quantities of organic nutrients. They can exist on low D.O. concentrations and are extremely tolerant to other types of pollution which would eliminate most other aquatic organisms.

Destruction of the original habitat by dredging has left very few areas available in which organisms might grow. The center of the river is almost entirely shifting sand and gravel with a few vegetation islands and little provision for any other type of cover. The margins of the river include a few vegetative patches and many sludge bars. Few, if any, organisms can survive the molar action of the sand and gravel in the center of the river, therefore, the majority of the animals present are those which can survive the near-septic environment of the sludge bars. This situation is typical of the lower sections of the Jordan River.

In the lower sections of the river the reaction of aquatic organisms to the sugar refinery waste is essentially the opposite to that of the preceding section. Downstream from 4500 South, Station 11, instead of a decrease of organisms there is an increase of numbers of organisms and a marked decrease in kinds of organisms. In this case, tubifex worms have taken over virtually all available space. Figures 5 and 7 show that as the organic pollution load of the river becomes greater there are fewer numbers of kinds of organisms able to survive in such an environment. These pollution tolerant organisms, having few natural predators and optimum conditions for growth and reproduction increase to tremendous numbers (see Station 18, Figure 8).

Tabular physical-chemical data for the 1965-66 study is recorded in Appendix B. These results include water temperature, carbon dioxide, and pH. Graphic data shown in Figures 10 and 12 through 16 depict

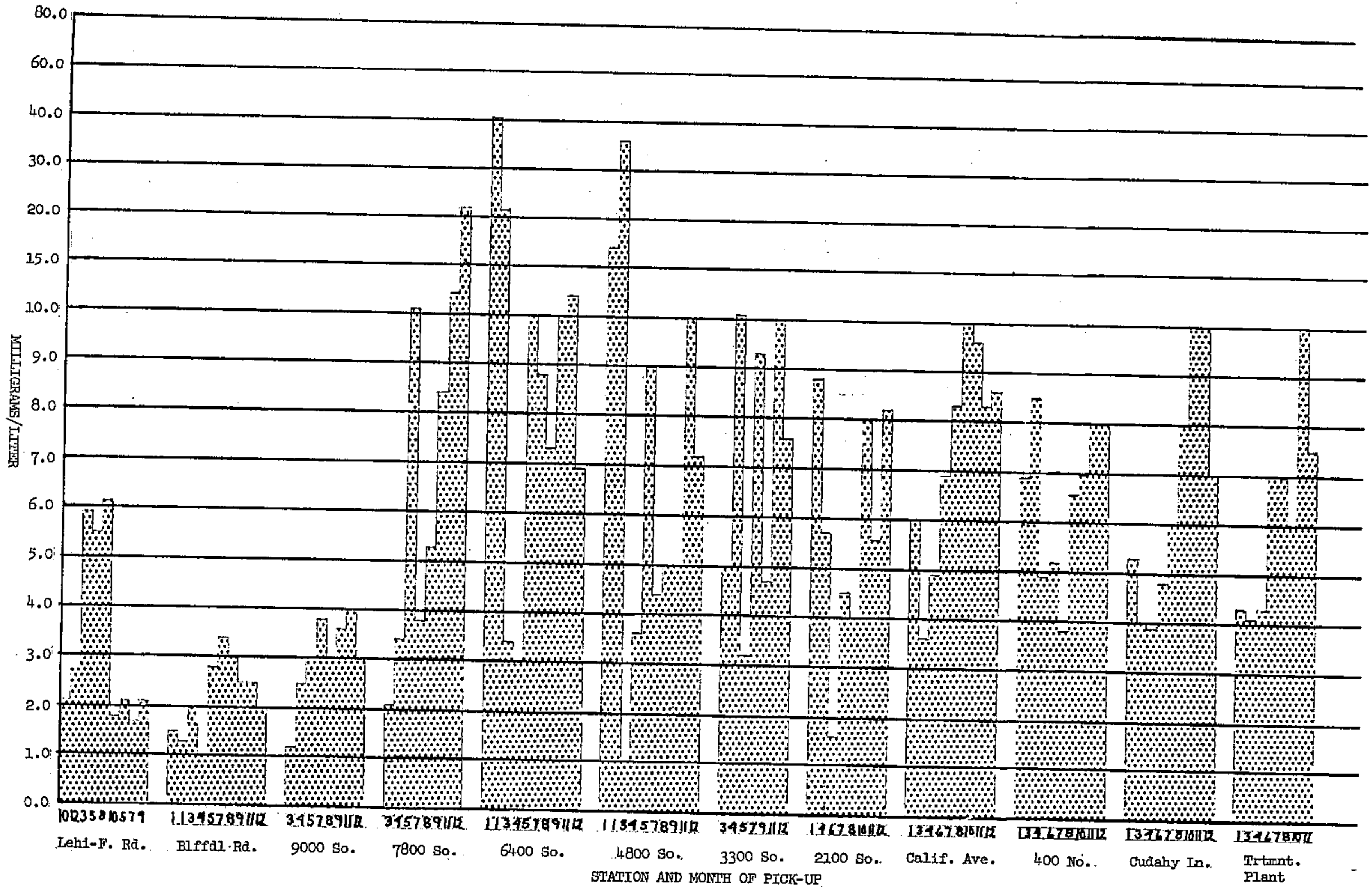

Figure 10. Histogram of B.O.D.--1965-66 Study.

physical-chemical data for the respective determinations: B.O.D., D.O., settleable solids, total hardness, specific conductance, and total alkalinity.

The D.O. level generally declines from south to north. The extremely high reading at the Lehi-Fairfield Road station could be due to an ice cover and large amounts of vegetation trapped underneath. The sample was taken at 3:25 p.m. These factors, the ice cover to prevent escape of dissolved oxygen produced by the vegetation and exposure of the vegetation to the sun, could result in this high reading. Depression of the D.O. level during the warmer months is not uncommon for many lower elevation rivers.

Biochemical Oxygen Demand concentrations as determined by the Utah State Health Department for 1965 are shown graphically in Figure 10. The first three stations at Lehi-Fairfield Road, Bluffdale Road, and 9000 South, are typically low in B.O.D. At 7800 South the picture changes dramatically, especially during the months in which the Utah-Idaho Sugar Company is operating. B.O.D. of the river generally lessens in the northern stations. The peaks are during October through January and the lowest levels are during the remainder of the year.

Settleable solids for the 1965-66 study are shown in Figure 13. The values for the stations at Lehi-Fairfield Road, Bluffdale Road, and 9000 South seem to be very low for the silted condition of the river. Actually, most of the matter is in colloidal form and did not precipitate in the time allowed for the test. During the summer months the use of irrigation water increases the settleable solids at these stations. At Bingham Creek when the Utah-Idaho Sugar Company is operating there

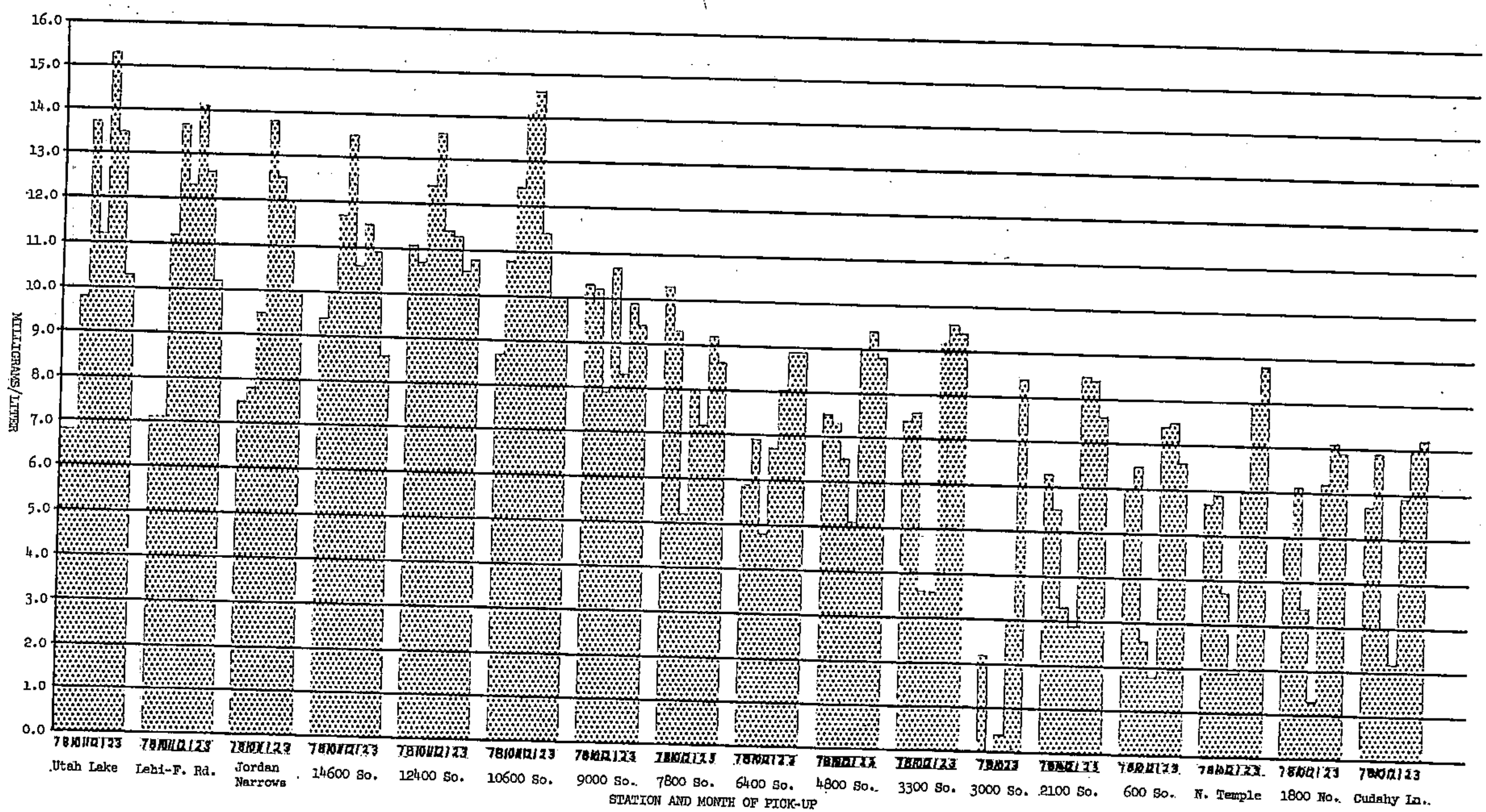

Figure 11. Histogram of D.O.--1956-58 Study.

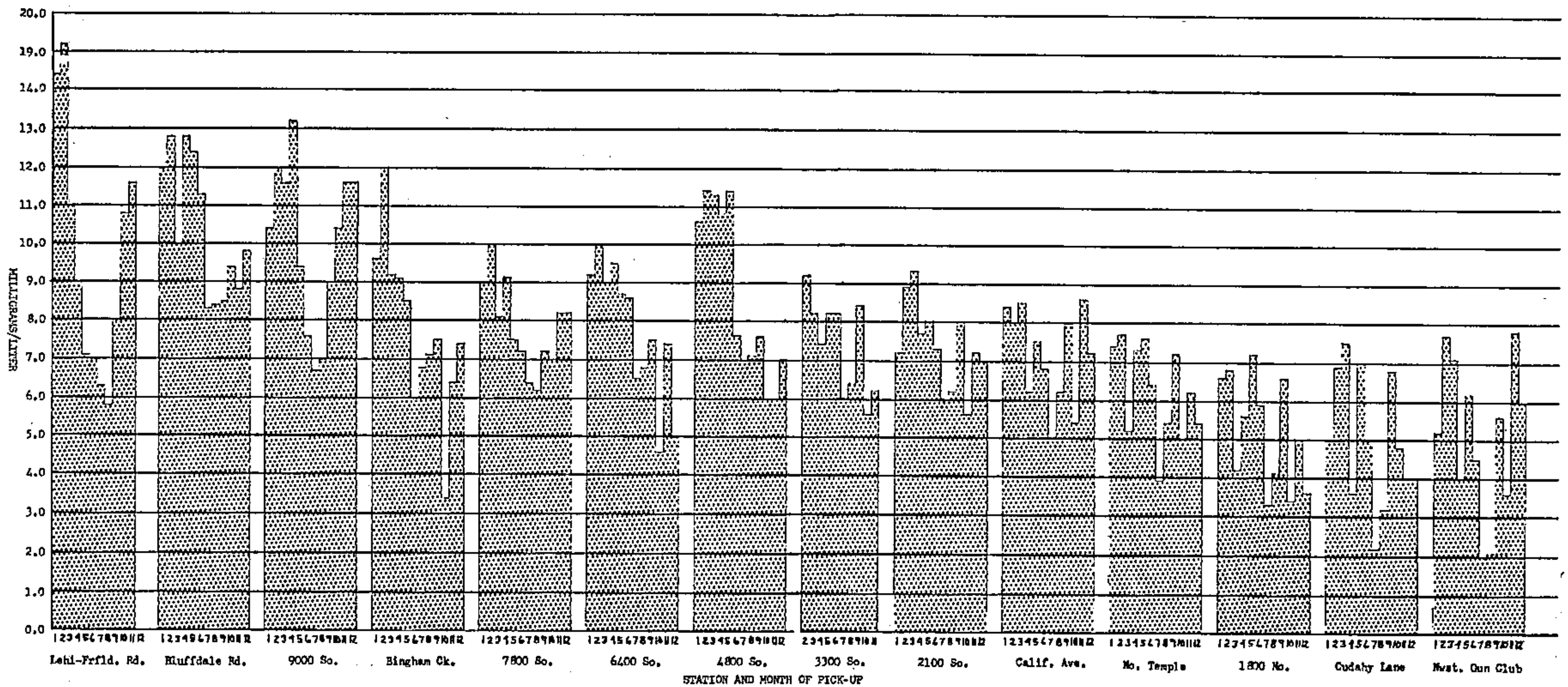

Figure 12. Histogram of D.O.--1965-66 Study.

is an excessive amount of settleable solids due to the washing of sugar beets before processing. These high readings drop off immediately when processing ceases. The silt at 7800 South, 6400 South, and 4800 South is reduced appreciably from the values found in Bingham Creek. The values at stations downstream from 4800 South do not reflect the silt load to any great extent. The large amount of settleable solids found at North Temple, 1800 North, and Cudahy Lane in March and April was due to dredging operations at First South and 1300 South, respectively.

Results of the hardness titrations are shown in Figure 14. Utah Lake water is relatively soft as indicated by the low readings at Lehi-Fairfield Road and Bluffdale Road stations. Below this point where most of the water is removed for irrigation purposes the river is restricted to hard water springs along the bed of the river. The next five stations show an increase in hardness due to these springs. From 3300 South the hard spring water is diluted by softer water from the nearby canyons. In almost every case the reduction of hardness by the spring runoff is demonstrated strikingly.

Specific conductance (Figure 15) is closely allied to hardness as shown in similar values of histograms for the two tests. Utah Lake water has a comparatively low specific conductance and the next five stations as in the preceding histogram are high in dissolved solids and specific conductance. When there is more dilution of Jordan River water by additional water from the canyons the specific conductance is lowered.

Total alkalinity is almost constant throughout the river. Exceptions are during the spring runoff from 3300 South northward where there is a reduction. Bingham Creek has the hardest water and the highest specific conductance, and is also the highest in total alkalinity.

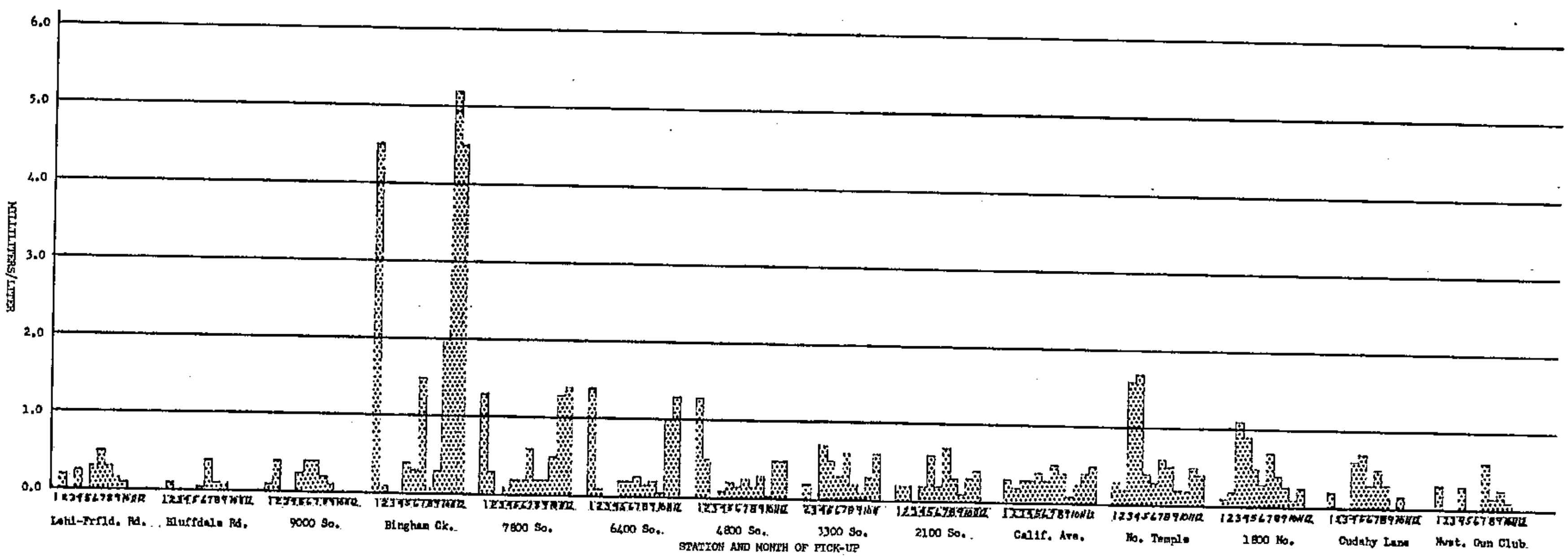

Figure 13. Histogram of Settleable Solids--1965-66 Study.

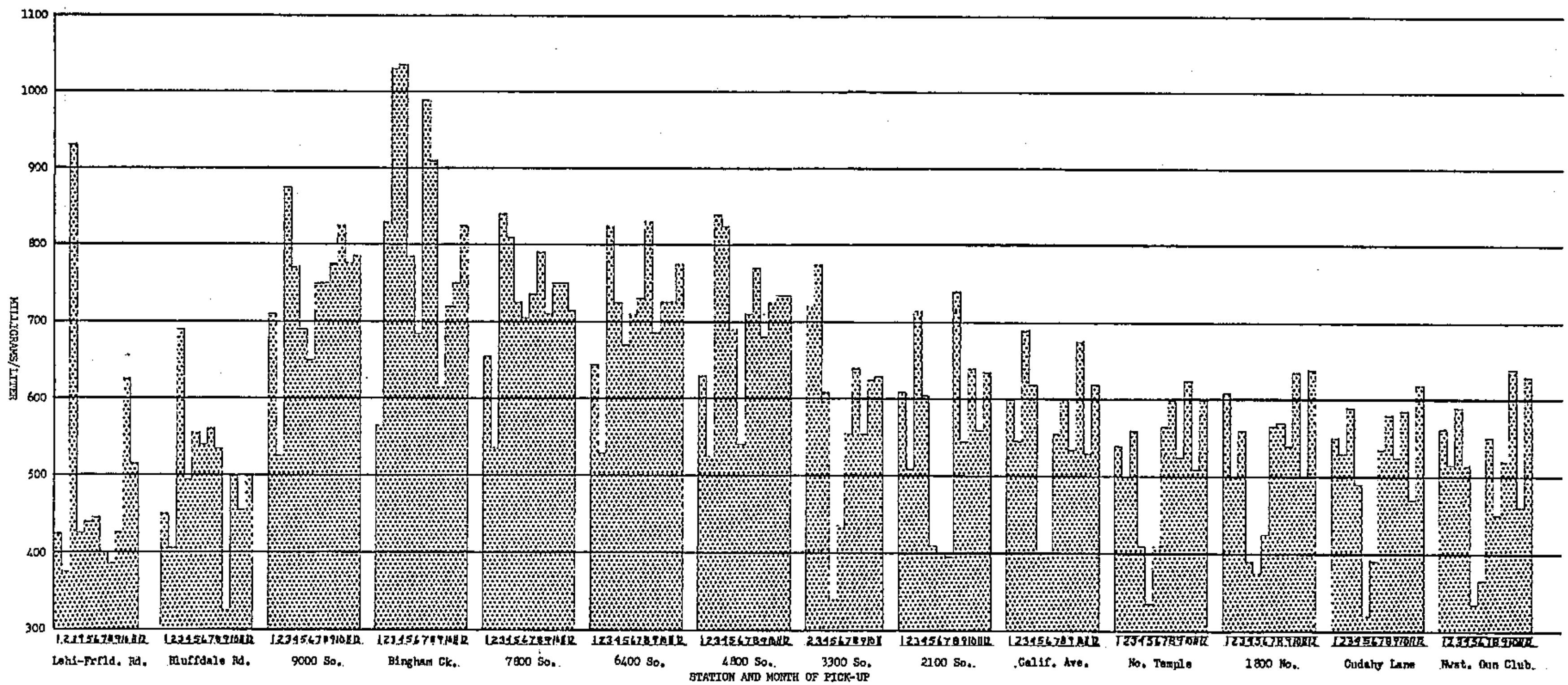

Figure 14. Histogram of Total Hardness--1965-66 Study.

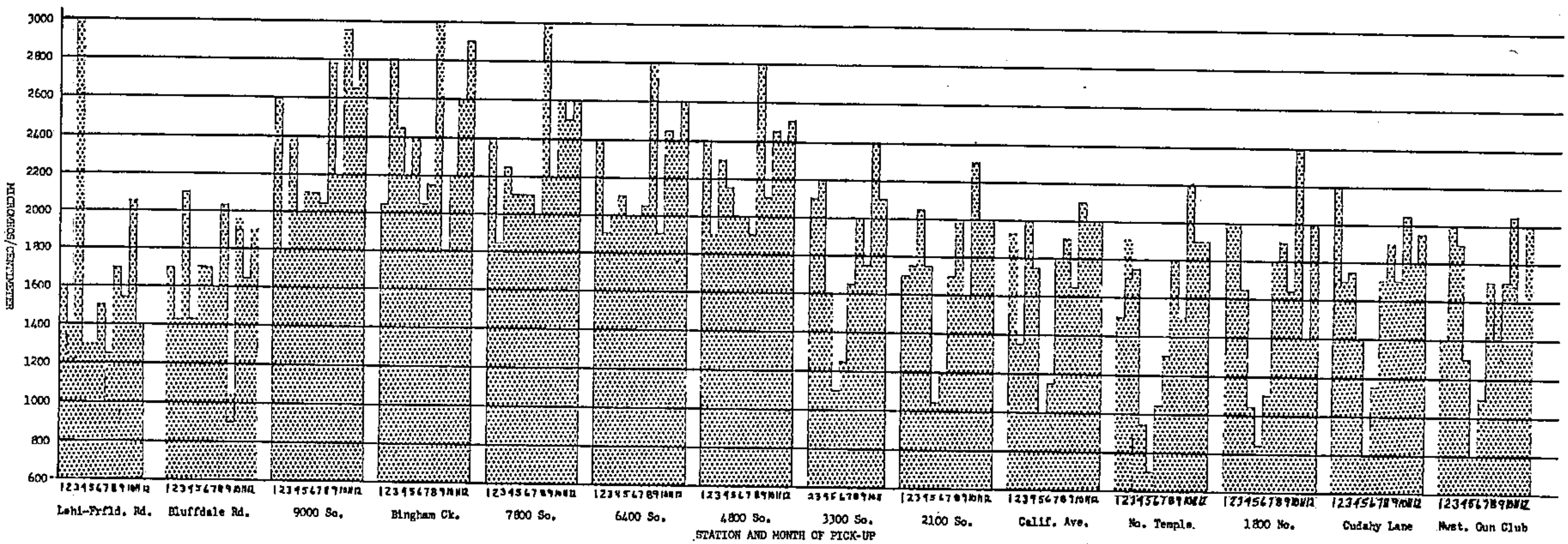

Figure 15. Histogram of Specific Conductance--1965-66 Study.

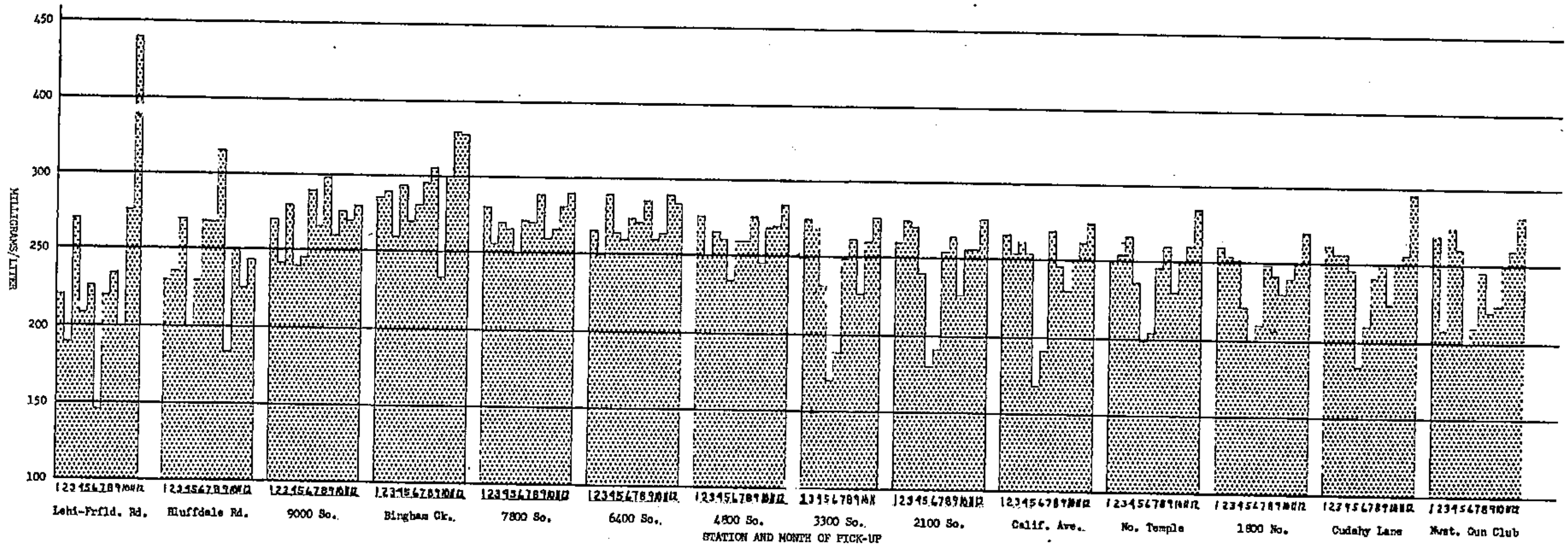

Figure 16. Histogram of Total Alkalinity--1965-66 Study.

CONCLUSIONS AND RECOMMENDATIONS

The Jordan River of the Bonneville Basin in the time period from 1956 to 1966 has deteriorated in the quality of water and in the aquatic invertebrates present. When comparing the two studies it is necessary to be cognizant of the fact that the sampling station numbers differed in the two studies. The following figure indicates the relationship of the stations in the two studies.

1956-58 Study		1965-66 Study	
Station	Address	Station	Address
1	Utah Lake		
2	Lehi-Fairfield Road		
3	Jordan Narrows		
4	14600 South	1	13000 South
5	12400 South	2	12800 South
6	10600 South		
7	9000 South	3	9000 South
		4	8500 South
		5	8400 South
8	7800 South	6	7800 South
		7	Bingham Creek
9	6400 South	9	6400 South
10	4800 South	10	4800 South
		11	4500 South
		12	4200 South
11	3300 South	13	3000 South
		14	2900 South
12	2100 South	15	2100 South
		16	1900 South
13	600 South	17	1100 South
14	North Temple	18	North Temple
15	1800 North		
16	Cudahy Lane		

Figure 17. Comparison of Stations.

Comparison of the total numbers of organisms present (Figures 6 and 7) is somewhat difficult in that the 1956-58 study was not based on a consistent sampling frequency as was the 1965-66 study. In other words, the histogram shows random results.

In comparing the kinds of organisms (Figures 6 and 7) it is apparent that there has been a significant reduction in numbers and kinds of organisms during the intervening time. This indicates a more grossly polluted river which has resulted in elimination of the less tolerant animals.

Histograms for B.O.D. (Figures 9 and 10) show that the level is higher in 1965-66 than in 1956-58. This is understandable when the increase in human population is considered. In 1956-58 many homes were serviced by septic tanks with the waste water filtering into the ground. In 1965-66 almost all of the homes in the Salt Lake basin are connected to a sewage treatment plant. Even though there are many more waste treatment plants in the valley at this time the increased amount of effluent put into the river has raised the B.O.D. loadings. At peak efficiency modern secondary waste water treatment plants remove only about eighty percent of the putrescible solids. Few, if any, of Utah's secondary treatment plants are capable of removing more than eighty percent of the total. A more realistic figure would be sixty to seventy percent. Obviously, a rather large volume of oxygen depleting organic waste is still allowed to enter the receiving water even after treatment.

Although the increased B.O.D. and reduced D.O. are important in reducing the aquatic invertebrate populations, other serious factors cannot be overlooked. A key factor is the substrate of the river. When dredging removes the original rubble and gravel bottom, it leaves a shifting sand and fine gravel substrate. This new habitat does not provide the hiding places, protection, and food production of the old one and the organisms either move or are killed by the abrasive action of the silt and sand. Conversely, as long as this unstable bottom exists colonization by invertebrates which would normally occupy these habitats is impossible.

Several recommendations could be made to improve the quality of the water in the Jordan River. The first and foremost action should be the prevention of the Fur Breeder's Agricultural Co-op and the Utah-Idaho Sugar Company from dumping waste into the river without adequate treatment. At the present time (October 6, 1966) the Fur Breeder's Agricultural Co-op is constructing an enclosed oxidation lagoon system for treatment of their wastes. This will eliminate one of the principal offenders if the process works as it is claimed.

The second step in reclaiming the river would be to instigate tertiary sewage treatment on all treatment plants discharging effluent into the river. This program will become increasingly important as the population in the valley grows and the shortage of water necessitates reuse.

Step three includes the prevention of silted and used irrigation water being returned to the river. Fertilizers present a problem in that they induce abnormally high growths of aquatic plants which block channels, restrict flow, and act to trap silt and sediment. Cumulative toxic effects are frequent by-products of normal pesticide applications. Often these effects may be directly toxic to aquatic forms of life. A large step in controlling this pollution would be to instigate a total spray irrigation program. The initial cost is high but the results are better and there is not the waste of water as in the direct irrigation method. More efficient use of available water becomes a necessity as greater demands are placed on the water supply.

The fourth step in restoration of the river is to prevent waste-water from feed lots and corrals entering the river and the direct access to the river by livestock.

In many places dredging of the river over the past years has resulted in a relatively clear channel. In these locations the river bottom is of shifting sand and gravel with little or no vegetation or boulders, behind or under which aquatic invertebrates or fish can hide. Elimination of this practice with an adequate flood control program and the following corrective measures will be necessary. A program of stream improvement for fish and aquatic invertebrate habitats should be initiated. Properly placed boulders, gabions, and windfalls could, in time, establish at least a good warm water fishery from 4800 South northward. From 4800 South, southward, to 9000 South an acceptable trout fishery could be established in these cold water areas. From 9000 South to the Associated Canal Companies Diversion Dam in the Jordan Narrows a reasonably good population of rainbow and brown trout occurs. Brown trout are self-sustaining but appear to be on the decline. Rainbow trout are planted as fingerlings and catchables by the Department of Fish and Game. A minimum number of 25,000 fish are placed in this section each year where it has been demonstrated they make good growth and provide an adequate fishery on a year round basis.

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APPENDIX A

AQUATIC INVERTEBRATE TEST DATA

1956-58 STUDY

Figure 18.

STATION 1. Utah Lake	6-20-56		5-4-57	
	Nos.	%	Nos.	%
Crustacea				
Hyalella azteca	...	...	3	13.0
Mollusca				
Gastropoda	7	87.5	...	....
Odonata				
Gomphus externus	...	...	11	47.8
Hemiptera				
Corisella decolor	1	12.5	...	....
Diptera				
Tendipedidae				
Chironomus decorus	...	...	9	39.1
TOTAL	8	100.0	23	99.9

Figure 19.

STATION 2. Lehi-Fairfield Rd.	6-20-56		8-8-56		9-18-56	
	Nos.	%	Nos.	%	Nos.	%
Crustacea						
Hyalella azteca	...	...	...	...	1	5.9
Mollusca						
Gastropoda	1	25.0	...	...	...	...
Ephemeroptera						
Callibaetis sp.	2	50.0	...	...	...	...
Ephoron album	...	...	18	100.0	...	...
Hemiptera						
Corisella decolor	1	25.0	...	...	5	29.4
Diptera						
Tendipedidae						
Chironomus decorus	...	...	...	...	11	64.7
TOTAL	4	100.0	18	100.0	17	100.0

Figure 20.

STATION 3. Jordan Narrows	7-15-54		6-20-56		1-19-57	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex tubifex	...	...	...	...	...	...
Hirudinea	...	...	...	...	3	4.7
Mollusca						
Gastropoda	...	...	2	11.8	1	1.6
Ephemeroptera						
Baetis sp.	5	2.2	...	...	...	...
Ephemerella sp.	...	...	...	...	1	1.6
Callibaetis sp.	...	...	2	11.8	...	...
Tricorythodes minutus	2	0.9	...	...	...	...
Ephoron album	71	31.4	...	...	...	...
Odonata						
Gomphus externus	64	28.3	...	...	...	...
Plecoptera						
Alloperla sp.	...	...	...	...	...	...
Hemiptera						
Corisella decolor	...	...	...	...	...	...
Coleoptera						
Stenelmis sp.	...	...	...	...	1	1.6
Ordobrevia sp.	...	...	...	...	...	...
Diptera						
Tendipedidae						
Hydrobaeninae	...	...	...	...	1	1.6
Chironomus decorus	...	...	10	58.8	...	...
Cryptochironomus sp.	...	...	...	...	...	...
Ephydridae	...	...	3	17.6	...	...
Simulidae						
Simulium sp.	...	...	...	...	...	...
Trichoptera						
Hydropsyche sp.	84	37.2	...	...	57	89.1
TOTAL	226	100.0	17	100.0	64	100.2

Figure 20. (continued)

	5-4-57		7-5-57		7-15-57		8-9-57	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%
	Several		...	...	...	...	...	...
	13	15.1	1	3.1	...	...	...	...
	2	2.3	2	6.3	...	...	...	...
	...	...	1	2.1	...	...	...	...
	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...
	...	...	2	6.3	13	48.1	...	...
	...	...	4	12.5	...	...	...	...
	1	1.2	1	3.1	...	...	...	...
	...	...	1	3.1	...	...	...	...
	...	...	3	9.4	3	11.1	...	...
	...	...	...	...	...	...	...	...
	3	2.5	...	...	...	...	...	...
	...	...	...	...	1	3.7	...	...
	...	...	2	6.3	10	37.0	...	...
	19	22.1	...	...	...	...	...	...
	...	...	...	...	...	...	...	...
	8	9.3	...	...	...	...	...	...
	40	46.5	15	46.9	...	...	20	100.0
TOTAL	86	100.0	32	100.1	27	99.9	20	100.0

Figure 21.

STATION 4. 14600 South	7-18-56 Nos.	%	9-17-56 Nos.	%	12-1-56 Nos.	%	1-19-57 Nos.	%
Annelida								
Hirudinea	11	6.8	...	...	...	...	12	4.7
Crustacea								
Gammarus sp.	...	...	...	...	...	...	5	2.0
Hyalella sp.	...	...	...	...	...	...	18	7.0
Mollusca								
Gastropoda	5	2.8	...	...	...	...	1	0.4
Pelecypoda	1	0.6	...	...	...	...	...	...
Ephemeroptera								
Baetis sp.	...	...	...	...	...	...	14	5.5
Callibaetis sp.	...	...	...	...	...	...	1	0.4
Tricorythodes minutus	60	34.1	1	2.2	1	1.3	2	0.8
Odonata								
Ischnura sp.	...	...	5	11.1	...	...	...	...
Argia sp.	...	...	5	11.1	...	...	...	...
Hemiptera								
Ambrysus mormon	10	5.7	11	24.4	...	...	7	2.7
Corisella decolor	3	1.7	3	6.7	...	...	27	10.5
Gerris gillettei	...	...	...	...	...	...	...	...
Sigara grossolineata	...	...	1	2.2	...	...	6	2.3
Coleoptera								
Optioservus sp.	1	0.6	...	...	...	...	...	...
Microcylloepus sp.	1	0.6	...	...	...	...	...	...
Stenelmis sp.	...	...	...	...	...	...	4	1.6
Agabus sp.	...	...	...	...	...	...	...	...
Gyrinus punctellus	3	1.7	...	...	...	...	...	...
Diptera								
Tendipedidae								
Hydrobaeninae	...	...	3	6.7	...	...	17	6.6
Chironomus decorus	...	...	4	8.9	...	...	2	0.8
Paratendipes sp.	...	...	...	...	...	...	14	5.5
Calospectra sp.	...	...	...	...	...	...	3	1.2
Simulidae								
Simulium sp.	4	2.3	8	17.8	...	...	79	30.9
Tipulidae								
Holorusia sp.	1	0.6	...	...	...	...	...	...
Tipula sp.	...	...	1	2.2	...	...	...	...
Trichoptera								
Hydropsyche sp.	76	43.2	...	...	73	94.8	44	17.2
Brachycentrus sp.	...	...	...	...	1	1.3	...	...
Helicopsyche sp.	...	...	...	...	2	2.6	...	...
Lepidoptera								
Paragyractis sp.	...	...	3	6.7	...	...	...	...
TOTAL	176	99.6	45	100.0	77	100.0	256	100.1

Figure 21. (continued)

	5-4-57		7-5-57		7-9-57		11-17-57		8-9-58	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
	47	22.8	4	4.7	1	3.6	2	3.1	...	...
	5	2.4	11	12.9	1	3.6	...	...	1	50.0
	17	8.3	14	16.5	1	3.6	6	9.2	1	50.0
	4	1.9	1	1.2	3	10.7	...	...	...	...
	...	...	7	8.2	5	17.9	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	...	...	1	1.2	...	...	...	...	...	...
	20	9.7	...	...	2	7.1	1	1.5	...	...
	1	0.5	...	...	...	...	...	...	...	...
	2	0.9	...	...	1	3.6	...	...	...	...
	10	4.9	6	7.1	5	17.9	...	...	...	...
	1	0.5	18	21.1	...	...	...	...	...	...
	1	0.5	1	1.2	...	...	...	...	...	...
	3	1.5	7	8.2	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	7	3.4	...	...	...	...	...	...	...	...
	1	0.5	...	...	...	...	...	...	...	...
	13	6.3	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	3	1.5	1	1.2	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	20	9.7	6	7.1	9	32.1	...	...	...	...
	1	0.5	1	1.2	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	30	14.6	8	9.4	...	...	56	86.2	...	...
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
TOTAL	206	100.0	85	101.2	28	100.1	65	100.0	2	100.0

Figure 22.

STATION 5. 12400 South	8-29-56		9-18-56		11-17-56	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex tubifex	...	...	...	...	...	...
Hirudinea	9	9.3	...	...	...	...
Crustacea						
Gammarus sp.	10	10.3	...	...	56	47.9
Hyalella sp.	15	15.5	...	...	6	5.1
Mollusca						
Gastropoda	7	7.2	...	...	11	9.4
Pelecypoda	1	1.0	...	...	5	4.3
Ephemeroptera						
Baetis sp.	2	2.1	...	...	...	...
Tricorythodes minutus	8	8.2	...	...	...	...
Heptagenia elegantula	2	2.1	...	...	...	...
Odonata						
Ischnura sp.	4	4.1	...	...	4	3.4
Argia sp.	1	1.0	...	...	...	...
Hetaerina sp.	...	...	...	...	1	0.9
Hemiptera						
Ambrysus mormon	1	1.0	...	...	2	1.7
Corisella decolor	...	...	...	...	3	2.6
Gerris gillettei	...	...	...	...	...	...
Gerris remigis	2	2.1	...	...	1	0.9
Sigara grossolineata	1	1.0	...	...	9	7.7
Coleoptera						
Agabus sp.	...	...	...	...	...	...
Gyrinus punctellus	...	...	...	...	7	5.9
Rhantus sp.	...	...	...	...	...	...
Diptera						
Tendipedidae						
Hydrobaeninae	...	...	...	...	...	...
Chironomus decorus	...	...	7	70.0	...	...
Calospectra sp.	...	...	...	...	...	...
Procladius sp.	...	...	3	30.0	...	...
Simulidae						
Simulium sp.	...	...	...	...	...	...
Tipulidae						
Holorusia sp.	...	...	...	...	...	...
Tabanidae						
Tabanus sp.	...	...	...	...	...	...
Trichoptera						
Hydropsyche sp.	34	35.1	...	...	12	10.3
TOTAL	97	99.8	10	100.0	117	100.1

Figure 22. (continued)

	1-19-57		5-4-57		7-5-57	
	Nos.	%	Nos.	%	Nos.	%
	Few		25	28.4	...	...
	2	1.4	4	4.5	...	...
	13	9.2	11	12.5	13	39.4
	15	10.6	6	6.8	2	6.1
	...	...	2	2.3	7	21.2
	...	...	...	...	1	3.0
	...	...	...	...	...	...
	...	...	1	1.1	...	...
	...	...	...	...	1	3.0
	8	5.7	3	3.4	...	...
	...	...	...	...	...	...
	...	...	...	...	...	...
	...	...	...	...	...	...
	3	2.1	...	...	...	...
	...	...	1	1.1	...	...
	6	4.3	...	...	...	...
	...	...	2	2.3	...	...
	...	...	3	3.4	...	...
	...	...	19	21.6	2	6.1
	...	...	...	...	1	3.0
	2	1.4	5	5.7	...	...
	...	...	...	...	...	...
	69	48.9	...	...	...	...
	...	...	...	...	2	6.1
	19	13.5	3	3.4	2	6.1
	2	1.4	...	...	...	...
	...	...	1	1.1	...	...
	2	1.4	3	3.4	2	6.1
TOTAL	141	99.9	88	101.0	33	100.0

Figure 23.

STATION 6. 10600 South	5-25-56		8-9-56		9-18-56	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex tubifex	...	...	...	...	...	...
Hirudinea	1	4.5	...	...	...	...
Crustacea						
Gammarus sp.	7	31.8	...	...	...	...
Hyalella sp.	2	9.1	...	...	...	...
Mollusca						
Gastropoda	...	...	...	...	2	30.0
Ephemeroptera						
Tricorythodes minutus	...	...	...	...	...	...
Odonata						
Ischnura sp.	4	19.2	...	...	1	20.0
Hetaerina sp.	2	9.1	...	...	...	...
Enallagma sp.	1	4.5	...	...	...	...
Ophiogomphus severus	...	...	...	...	...	...
Hemiptera						
Corisella decolor	...	...	...	...	1	20.0
Gerris remigis	...	...	...	...	...	...
Sigara grossolineata	...	...	...	...	2	30.0
Coleoptera						
Agabus sp.	...	...	...	...	...	...
Gyrinus punctellus	5	22.7	...	...	...	...
Diptera						
Tendipedidae						
Hydrobaeninae	...	...	...	...	...	...
Chironomus decorus	...	...	...	...	...	...
Paratendipes sp.	...	...	...	...	...	...
Calospectra sp.	...	...	...	...	...	...
Simulidae						
Simulium sp.	...	...	...	...	...	...
Trichoptera						
Hydropsyche sp.	...	...	5	100.0	...	...
TOTAL	22	99.9	5	100.0	5	100.0

Figure 23. (continued)

11-17-56		1-19-57		5-4-57		7-5-57		11-17-57	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
...	...	...	...	Few		...	...	...	...
1	1.9	7	14.9	1	1.4	...	...	...	...
5	9.4	7	14.9	2	2.9	...	...	...	...
4	7.5	10	21.3	13	20.3	2	50.0	...	...
...	...	...	...	...	...	1	25.0	...	...
...	...	...	...	3	4.3	...	...	...	...
4	7.5	3	6.4	...	...	...	...	...	...
...	...	...	...	1	1.4	1	25.0	...	...
...	...	...	...	4	5.8	...	...	...	...
1	1.9	...	...	1	1.4	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	1	1.4	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	1	1.4	...	...	...	...
...	...	...	...	3	4.3	...	...	...	...
15	28.3	4	8.5	7	10.1	...	...	10	90.0
1	1.9	...	...	...	...	...	...	...	...
...	...	...	...	12	17.4	...	...	1	9.1
...	...	3	6.4	...	...	...	...	...	...
22	41.5	13	27.7	16	23.2	...	...	...	...
...	...	...	...	3	4.3	...	...	...	...
53	99.9	47	100.1	69	99.6	4	100.0	11	100.0

Figure 24.

STATION 7. 9000 South	6-25-56		9-18-56		11-24-56	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex tubifex	1	1.1	16	69.6	...	...
Hirudinea	5	5.7	...	...	1	0.9
Crustacea						
Gammarus sp.	8	9.2	3	13.0	8	7.0
Hyalella sp.	...	...	...	...	25	21.7
Mollusca						
Gastropoda	12	13.8	...	...	4	3.5
Ephemeroptera						
Callibaetis sp.	2	2.3	...	...	...	...
Tricorythodes minutus	...	...	...	...	...	...
Odonata						
Ischnura sp.	6	6.9	2	8.7	26	22.6
Argia sp.	...	...	...	...	...	...
Hetaerina sp.	...	...	...	...	...	...
Ophiogomphus severus	...	...	...	...	2	1.8
Hemiptera						
Graptocorixa sp.	8	9.2	...	...	...	...
Corisella decolor	3	3.4	2	8.7	4	3.5
Gerris gillettei	6	6.9	...	...	...	...
Gerris remigis	...	...	...	...	...	...
Sigara grossolineata	...	...	...	...	3	2.6
Coleoptera						
Agabus sp.	7	8.0	...	...	1	0.9
Gyrinus punctellus	...	...	...	...	...	...
Laccophilus decipiens	...	...	...	...	...	...
Laccobius sp.	1	1.1	...	...	...	...
Diptera						
Tendipedidae						
Hydrobaeninae	20	22.9	...	...	...	...
Chironomus decorus	...	...	...	...	33	28.7
Paratendipes sp.	2	2.3	...	...	...	...
Simulidae						
Simulium sp.	6	6.9	...	...	8	7.0
Trichoptera						
Hydropsyche sp.	...	...	...	...	...	...
TOTAL	87	99.7	23	100.0	115	100.2

Figure 24. (continued)

	1-19-57		5-11-57		7-5-57		6-27-57	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%
	37	15.0	...	...	2	7.4	...	...
	...	...	3	4.9	5	18.5	...	...
	4	1.6	8	13.1	3	11.1	...	...
	124	50.4	30	49.2	2	7.4	11	64.7
	4	1.6	...	...	...	...	2	11.8
	...	...	...	...	2	7.4	...	...
	...	...	...	...	1	3.7	...	...
	41	16.7	9	14.8	...	...	...	...
	...	...	...	...	1	3.7	...	...
	...	...	...	...	2	7.4	...	...
	5	2.0	4	6.6	...	...	...	...
	...	...	...	...	...	...	...	...
	7	2.8	...	...	...	...	3	17.6
	...	...	...	...	...	...	...	...
	...	...	1	1.6	...	...	...	...
	1	0.4	...	...	...	...	...	...
	5	2.0	...	...	...	...	...	...
	...	...	5	8.2	2	7.4	...	...
	...	...	...	...	5	18.5	...	...
	...	...	...	...	1	3.7	...	...
	...	...	1	1.6	...	...	...	...
	11	4.5	...	...	...	...	...	...
	...	...	...	...	...	...	1	5.9
	...	...	...	...	1	3.7	...	...
	7	2.8	...	...	...	...	...	...
TOTAL	246	99.8	61	100.0	27	99.9	17	100.0

Figure 25.

STATION 8. 7800 South	6-25-56		2-2-57		5-4-57	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex tubifex	8	9.5	56	53.8	Many	
Hirudinea	8	9.5	...	...	...	...
Crustacea						
Gammarus sp.	9	10.7	1	1.0	1	16.7
Hyalella sp.	...	...	4	3.8	...	...
Mollusca						
Gastropoda	10	11.9	6	5.8	...	...
Ephemeroptera						
Callibaetis sp.	17	20.2	...	...	...	...
Odonata						
Ischnura sp.	...	...	...	...	...	...
Argia sp.	1	1.2	...	...	...	...
Enallagma sp.	...	...	5	4.8	...	...
Ophiogomphus severus	1	1.2	...	...	...	...
Hemiptera						
Graptocorixa sp.	1	1.2	...	...	...	...
Gerris gillettei	2	2.4	...	...	...	...
Coleoptera						
Agabus sp.	16	19.0	...	...	...	...
Gyrinus punctellus	3	3.5	...	...	...	...
Hydrophilus sp.	...	...	...	...	...	...
Diptera						
Tendipedidae						
Hydrobaeninae	...	...	28	26.9	5	83.3
Paratendipes sp.	4	4.8	...	...	...	...
Simulidae						
Simulium sp.	...	...	1	1.0	...	...
Trichoptera						
Hydropsyche sp.	...	...	3	2.9	...	...
Platycentropus sp.	4	4.8	...	...	...	...
Limnephilis sp.	...	...	...	...	...	...
TOTAL	84	99.9	104	100.0	6	100.0

Figure 25. (continued)

	5-11-57		7-5-57		11-7-57	
	Nos.	%	Nos.	%	Nos.	%
	...	...	...	...	82	75.2
	...	...	...	...	14	12.8
	...	...	...	...	...	...
	13	16.0	3	30.0	8	7.3
	...	...	1	10.0	5	4.6
	...	...	...	...	...	...
	5	6.2	1	10.0	...	...
	...	...	...	...	...	...
	...	...	...	...	...	...
	1	1.2	...	...	...	...
	...	...	...	...	...	...
	...	...	...	...	...	...
	12	14.8	...	...	...	...
	...	...	...	...	...	...
	1	1.2	...	...	...	...
	45	55.6	2	20.0	...	...
	...	...	...	...	...	...
	3	3.7	3	30.0	...	...
	...	...	...	...	...	...
	...	...	...	...	...	...
	1	1.2	...	...	...	...
TOTAL	81	99.9	10	100.0	109	99.9

Figure 26.

STATION 9. 6400 South	6-25-56		7-25-56		9-18-56	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
<u>Tubifex</u> <u>tubifex</u>	...	...	...	...	1	9.1
Hirudinea	...	...	...	...	1	9.1
Crustaces						
<u>Gammarus</u> <u>sp</u>.	...	...	8	18.2	...	...
<u>Hyalella</u> <u>sp.</u>	...	...	3	6.8	...	...
Mollusca						
Gastropoda	...	...	...	...	...	...
Ephemeroptera						
<u>Tricorythodes</u> <u>minutus</u>	...	...	6	13.6	...	...
Odonata						
<u>Ischnura</u> <u>sp</u>.	...	...	1	2.3	1	9.1
<u>Enallagma</u> <u>sp.</u>	...	...	...	...	...	...
<u>Ophiogomphus</u> <u>severus</u>	...	...	1	2.3	...	...
Hemiptera						
<u>Corisella</u> <u>decolor</u>	3	100.0	...	...	...	...
Coleoptera						
<u>Agabus</u> <u>sp</u>.	...	...	...	...	...	...
<u>Gyrinus</u> <u>punctellus</u>	...	...	5	11.4	...	...
Diptera						
Tendipedidae						
Hydrobaeninae	...	...	...	...	...	...
<u>Chironomus</u> <u>decorus</u>	...	...	11	25.0	8	72.7
Simulidae						
<u>Simulium</u> <u>sp</u>.	...	...	9	20.5	...	...
TOTAL	3	100.0	44	100.1	11	100.0

Figure 26. (continued)

	2-2-57		5-11-57		7-6-57		8-10-57	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%
	89	50.9	...	...	...	...	...	...
	...	...	...	...	2	5.7	2	8.3
	...	...	...	...	...	...	1	4.2
	3	1.7	15	71.4	20	57.1	18	75.0
	...	...	...	...	1	2.9	...	...
	...	...	...	...	1	2.9	1	4.2
	...	...	4	14.0	1	2.9	...	...
	1	0.5	...	...	1	2.9	...	...
	...	...	...	...	...	...	...	...
	...	...	...	...	2	5.7	...	...
	...	...	1	4.8	...	...	...	...
	...	...	1	4.8	...	...	...	...
	82	46.9	...	...	3	8.6	2	8.3
	...	...	...	...	...	...	...	...
	...	...	...	...	4	11.4	...	...
TOTAL	175	100.0	21	100.0	35	100.1	24	100.0

Figure 27.

STATION 10. 4800 South	6-27-56		7-18-56		12-1-56	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex tubifex	...	...	...	...	...	...
Crustacea						
Gammarus sp.	...	...	6	5.4	...	...
Hyalella sp.	...	...	24	21.6	7	20.0
Mollusca						
Gastropoda	...	...	1	0.9	...	...
Ephemeroptera						
Epeorus sp.	1	2.9	...	...	...	...
Tricorythodes minutus	...	...	60	54.0	...	...
Odonata						
Ischnura sp.	...	...	...	...	...	...
Argia sp.	...	...	1	0.9	...	...
Enallagma sp.	...	...	...	...	1	2.9
Ophiogomphus severus	...	...	...	...	...	...
Hemiptera						
Ambrysus mormon	...	...	10	9.0	...	...
Graptocorixa sp.	33	97.1	...	...	...	...
Corisella decolor	...	...	3	2.7	...	...
Gerris remigis	...	...	...	...	1	2.9
Sigara grossolineata	...	...	1	0.9	...	...
Coleoptera						
Optioservus sp.	...	...	1	0.9	...	...
Gyrinis punctellus	...	...	3	2.7	23	65.7
Microcylleopus sp.	...	...	1	0.9	...	...
Diptera						
Tendipedidae						
Hydroabaeninae	...	...	...	...	2	5.7
Chironomus decorus	...	...	...	...	1	2.9
Cryptochironomus sp.	...	...	...	...	...	...
TOTAL	34	100.0	111	99.9	35	100.1

Figure 27. (continued)

	2-2-57		5-11-57	
	Nos.	%	Nos.	%
	17	30.9	16	42.1
	...	...	...	...
	1	1.8	11	28.9
	...	...	...	...
	...	...	...	...
	...	...	...	...
	...	...	1	2.6
	...	...	...	...
	...	...	...	...
	1	1.8	...	...
	...	...	...	...
	...	...	...	...
	...	...	...	...
	...	...	...	...
	...	...	...	...
	...	...	...	...
	25	45.5	...	...
	1	1.8	...	...
	10	18.2	5	13.2
	...	...	2	5.2
	...	...	3	7.9
TOTAL	55	100.0	38	100.0

Figure 28.

STATION 11. 3300 South	8-22-56 Nos.	%	9-29-56 Nos.	%	9-18-56 Nos.	%	2-2-57 Nos.	%
Annelida								
Tubifex tubifex	...	...	...	...	...	...	9	100.0
Crustacea								
Gammarus sp.	...	...	...	...	3	20.0	...	...
Hyalella sp.	...	...	5	100.0	3	20.0	...	...
Ephemeroptera								
Tricorythodes minutus	9	100.0	...	...	2	13.3	...	...
Odonata								
Ischnura sp.	...	...	...	...	3	20.0	...	...
Diptera								
Tendipedidae								
Hydrobaeninae	...	...	...	...	3	20.0	...	...
Simulidae								
Simulium sp.	...	...	...	...	1	6.7	...	...
TOTAL	9	100.0	5	100.0	15	100.0	9	100.0

Figure 29.

STATION 12. 2100 South	7-5-56		8-30-56		11-18-56	
	Nos.	%	Nos.	%	Nos.	%
Crustacea						
Hyalella sp.	2	4.8	...	...	...	...
Mollusca						
Gastropoda	...	...	7	24.1	...	...
Ephemeroptera						
Callibaetis sp.	6	14.3	7	24.1	...	...
Stenonema sp.	1	2.4	...	...	...	...
Tricorythodes minutus	3	7.1	...	...	...	...
Heptagenia elegantula	...	...	1	3.4	...	...
Odonata						
Ischnura sp.	...	...	9	31.0	...	...
Enallagma sp.	13	31.0	...	...	...	...
Hemiptera						
Corisella decolor	2	4.8	...	...	...	...
Gerris gillettei	1	2.4	...	...	...	...
Coleoptera						
Gyrinus punctellus	4	9.5	...	...	...	...
Diptera						
Telmatoscopus furcatus	10	23.8	5	17.2	...	...
Trichoptera						
Hydropsyche sp.	...	...	...	...	12	100.0
TOTAL	42	100.1	29	99.8	12	100.0

Figure 30.

STATION 13. 600 South	8-1-56 Nos.	%	8-30-56 Nos.	%	12-1-56 Nos.	%	2-22-57 Nos.	%
Annelida								
Tubifex tubifex	...	...	400	90.9	1000	94.4	600	96.9
Hirudinea	...	...	...	...	1	0.1	...	...
Crustacea								
Gammarus sp.	...	...	...	...	1	0.1	...	...
Hyalella sp.	27	32.1	5	1.1	52	4.9	...	...
Mollusca								
Gastropoda	7	8.3	26	5.9	5	0.5	16	2.6
Pelecypoda	...	...	1	0.2	...	...	...	...
Ephemeroptera								
Callibaetis sp.	2	2.4	1	0.2	...	...	...	...
Tricorythodes minutus	20	23.8	1	0.2	...	...	...	...
Heptabenia elegantula	3	3.6	...	...	...	...	...	...
Odonata								
Ischnura sp.	...	...	4	0.9	...	...	2	0.3
Enallagma sp.	2	2.4	...	...	...	...	...	...
Hemiptera								
Gerris gillettei	3	2.6	...	...	...	...	1	0.2
Hesperocorixa laevigata	2	2.4	...	...	...	...	...	...
Coleoptera								
Agabus sp.	2	2.4	...	...	...	...	...	...
Halipus sp.	2	2.4	...	...	...	...	...	...
Gyrinus punctellus	10	11.4	1	0.2	...	...	...	...
Tropisternus lateralis	2	2.4	...	...	...	...	...	...
Laccophilus decipiens	2	2.4	1	0.2	...	...	...	...
TOTAL	84	100.0	440	99.8	1059	100.0	619	99.9

Figure 31.

STATION 14. North Temple	8-30-56 Nos.	%	12-1-56 Nos.	%	2-22-57 Nos.	%	8-10-57 Nos.	%
Annelida								
Tubifex tubifex	400	85.8	Many		650	99.8	150	85.7
Hirudinea	...	...	...	...	...	...	5	2.9
Crustacea								
Gammarus sp.	1	0.2	3	2.6	...	...	...	...
Hyalella sp.	30	6.4	86	74.1	...	...	...	...
Mollusca								
Gastropoda	30	6.4	26	22.4	1	0.2	1	0.6
Pelecypoda	1	0.2	...	...	...	...	...	...
Ephemeroptera								
Callibaetis sp.	1	0.2	...	...	...	...	...	...
Tricorythodes minutus	...	...	...	...	...	...	17	9.7
Odonata								
Ischnura sp.	3	0.6	1	0.9	...	...	...	...
Diptera								
Tendipedidae								
Hydrobaeninae	...	...	...	...	...	...	2	1.1
TOTAL	466	99.8	116	100.0	651	100.0	175	100.0

Figure 32.

STATION 15. 1800 North	9-19-56		12-1-56		2-22-57	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
<u>Tubifex tubifex</u>	...	...	1250	80.0	92	89.3
Hirudinea	...	...	1	0.1	...	...
Crustacea						
<u>Hyalella sp</u>.	...	...	182	11.6	...	...
Mollusca						
Gastropoda	...	...	65	4.2	11	10.7
Odonata						
<u>Ischnura sp</u>.	2	22.2	65	4.2	...	...
<u>Hetaerina sp</u>.	1	11.1	...	...	...	...
Hemiptera						
<u>Hesperocorixa Laevigata</u>	2	22.2	...	...	...	...
<u>Notonecta undulata</u>	1	11.1	...	...	...	...
Coleoptera						
<u>Peltodytes callosus</u>	3	33.3	...	...	...	...
TOTAL	9	99.9	1563	99.9	103	100.0

Figure 33.

STATION 16. Cudahy Lane	7-5-56		12-1-56		2-22-57	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
<u>Tubifex tubifex</u>	...	...	7	38.9	5	35.7
Crustaces						
<u>Gammarus sp</u>.	1	11.1	1	5.6	...	...
<u>Hyalella sp</u>.	...	...	2	11.1	6	42.8
Odonata						
<u>Ischnura sp</u>.	...	...	8	44.4	3	21.4
<u>Enallagma sp</u>.	7	77.8	...	...	...	...
Coleoptera						
<u>Hydroporus sp</u>.	1	11.1	...	...	...	...
TOTAL	9	100.0	18	100.0	14	99.9

1965-66 STUDY

Figure 34.

STATION 1. 13000 South	6-14-65		7-9-65		8-10-65	
Organisms/sq. ft.	2530		2728		722	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	120	1.6	63	2.3	250	34.6
Hirudinea	137	1.8	131	4.8	78	10.8
Crustacea						
Gammarus sp.	1400	18.5	1617	59.3	14	1.9
Hyalella sp.	5600	73.8	483	17.7	222	30.7
Mollusca						
Gastropoda	115	1.5	4	0.1	7	1.0
Ephemeroptera						
Baetis sp.	1	<0.1	1	<0.1	...	...
Tricorythodes sp.	...	...	...	...	...	...
Odonata						
Enallagma sp.	...	...	...	...	...	...
Ischnura sp.	2	<0.1	1	<0.1	3	0.4
Argia sp.	...	...	...	...	...	...
Hemiptera						
Corisella sp.	1	<0.1	...	...	...	...
Ambrysus sp.	...	...	1	<0.1	...	...
Coleoptera						
Heterelmis sp.	8	0.1	...	...	...	...
Optioservus sp.	4	0.1	...	...	...	...
Agabus sp.	7	0.1	...	...	...	...
Dubiraphia sp.	1	<0.1	...	...	...	...
Diptera						
Simulidae						
Simulium sp.	31	0.4	...	...	4	0.5
Muscidae						
Limnophora sp.	4	0.1	...	...	...	...
Empididae						
Wiedmannia sp.	...	...	...	...	...	...
Stratiomyidae						
Euparyphus sp.	1	<0.1	...	...	...	...
Tendipedidae						
Hydrobaeninae	57	0.8	24	0.9	...	...
Paratendipes sp.	...	...	...	...	131	18.1
Cryptochironomus sp.	36	0.5	368	13.5	8	1.1
Calospectra sp.	...	...	...	...	...	...
Trichoptera						
Hydropsyche sp.	31	0.4	35	1.3	5	0.7
Helicopsyche sp.	33	0.4	...	...	...	...
Hydroptila sp.	...	...	...	...	...	...
TOTAL	7590	100.1	2728	99.9	722	99.8

Figure 34. (continued)

9-3-65		11-9-65		1-3-66		3-23-66		5-9-66	
156.7		467.3		42.7		45.2		53	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
46	9.8	489	34.9	56	6.6	461	22.6	67	4.2
28	6.0	314	22.4	190	22.3	87	4.3	66	4.2
135	28.7	46	3.3	32	3.8	24	1.2	26	1.6
64	13.6	219	15.6	250	29.3	332	16.3	294	18.5
17	3.6	...	...	...	...	12	0.6	26	1.6
...	...	...	...	2	0.2	6	0.3	5	0.3
...	...	...	...	...	...	...	...	1	0.1
2	0.4	...	...	1	0.1	...	...	...	...
6	1.3	2	0.2	3	0.4	3	0.2	3	0.2
...	...	...	...	1	0.1	1	<0.1	6	0.4
...	...	...	...	...	...	...	...	...	...
...	...	...	...	1	0.1	...	...	1	0.1
...	...	...	...	3	0.4	1	<0.1	10	0.6
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	1	0.1
1	0.2	...	...	...	...	...	...	...	...
84	17.9	21	1.5	139	16.3	77	3.8	16	1.0
...	...	...	...	2	0.2	1	<0.1	4	0.3
...	...	...	...	...	...	7	0.3	3	0.2
...	...	...	...	...	...	...	...	1	0.1
28	6.0	204	14.6	71	8.3	72	3.5	753	47.4
14	3.0	...	...	3	0.4	...	...	...	...
45	9.6	...	...	...	...	99	4.9	62	3.9
...	...	...	...	15	1.8	...	...	...	...
...	...	107	7.6	84	9.8	850	41.8	228	14.3
...	...	...	...	...	...	...	...	4	0.3
...	...	...	...	...	...	...	...	13	0.8
470	100.1	1402	99.5	853	100.1	2033	99.9	1590	100.2

Figure 35.

STATION 2. 12800 South	6-14-65		7-12-65		8-10-65	
Organisms/sq.ft.	195.3		80.8		78.1	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	51	8.7	700	43.3	2400	96.1
Hirudinea	7	1.2	124	7.7	5	0.2
Crustacea						
Gammarus sp.	3	0.5	8	0.5	...	...
Hyalella sp.	498	85.3	642	39.8	40	1.6
Mollusca						
Gastropoda	5	0.9	2	0.1	1	<0.1
Pelecypoda	...	...	...	...	1	<0.1
Ephemeroptera						
Baetis sp.	...	...	...	...	...	...
Odonata						
Ischnura sp.	...	...	2	0.1	...	...
Enallagma sp.	1	0.2	...	...	...	...
Argia sp.	...	...	...	...	...	...
Coleoptera						
Agabus sp.	...	...	...	...	...	...
Haliplus sp.	...	...	...	...	...	...
Heterelmis sp.	...	...	...	...	...	...
Diptera						
Simulidae						
Simulium sp.	...	...	...	...	...	...
Muscidae						
Limnophora sp.	...	...	1	0.1	...	...
Tendipedidae						
Hydrobaeninae	7	1.2	38	2.4	8	0.3
Paratendipes sp.	10	1.7	...	...	7	0.2
Chironomus sp.	...	...	...	...	...	...
Cryptochironomus sp.	...	...	93	5.8	17	0.7
Calospectra sp.	...	...	...	...	...	...
Trichoptera						
Hydropsyche sp.	...	...	...	...	1	<0.1
Hydroptila sp.	...	...	...	...	...	...
TOTAL	584	100.0	1615	100.1	2498	100.0

Figure 35. (continued)

9-3-65		11-9-65		1-3-66		3-23-66		5-16-66	
26.4		105.6		11.2		34.9		81.8	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
138	26.2	552	43.6	62	27.7	966	92.4	291	17.8
18	3.4	6	0.5	12	5.4	2	0.2	211	12.9
...	...	...	...	4	1.8	3	0.3	2	0.1
234	44.4	235	18.5	103	46.0	18	1.7	529	32.4
...	...	5	0.5	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	1	0.4	...	...	14	0.9
18	3.4	18	1.4	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	1	0.1
...	...	...	...	...	...	1	0.1	3	0.2
...	...	...	...	...	...	...	...	1	0.1
...	...	...	...	...	...	...	...	3	0.2
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
17	3.2	338	26.7	12	5.4	29	2.8	360	22.0
...	...	...	...	...	...	...	...	69	4.2
...	...	...	...	1	0.4	...	...	...	...
96	18.2	2	0.2	...	...	3	0.3	...	...
...	...	...	...	7	3.1	...	...	4	0.2
1	0.2	6	0.5	...	...	3	0.3	134	8.2
...	...	...	...	...	...	...	...	3	0.2
527	99.9	1267	100.1	224	100.0	1046	100.1	1635	100.1

Figure 36.

STATION 3. 9000 South	6-14-65		7-14-65		8-11-65	
Organisms/sq.ft.	224		18.8		12.9	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	94	56.0	34	4.5	147	28.5
Hirudinea	16	9.5	29	3.9	8	1.6
Crustacea						
Hyalella sp.	44	26.2	195	25.9	17	3.3
Mollusca						
Gastropoda	3	1.8	...	...	...	...
Odonata						
Enallagma sp.	1	0.6	...	...	...	...
Ischnura sp.	1	0.6	...	...	...	...
Hemiptera						
Corisella sp.	...	...	...	...	1	0.2
Gerris sp.	...	...	1	0.1	...	...
Coleoptera						
Dubiraphia sp.	1	0.6	...	...	...	...
Diptera						
Simulidae						
Simulium sp.	1	0.6	273	36.3	244	47.4
Tipulidae						
Tipula sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	3	1.8	168	22.3	72	14.0
Paratendipes sp.	...	...	...	...	...	...
Chironomus sp.	...	...	6	0.8	...	...
Cryptochironomus sp.	4	2.4	45	6.0	24	4.7
Trichoptera						
Hydropsyche sp.	...	...	1	0.1	2	0.4
Hydroptila sp.	...	...	...	...	...	...
TOTAL	168	100.1	752	99.9	515	100.1

Figure 36. (continued)

9-8-65		11-9-65		1-5-66		3-23-66		5-16-66	
8.5		19.2		17.5		7.3		7.7	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
28	16.6	247	19.8	130	12.4	44	20.2	32	13.9
2	1.2	11	0.9	1	0.1	3	1.4	11	4.8
36	21.3	79	6.3	54	5.2	11	5.0	20	8.7
...	...	...	...	...	...	...	...	2	0.9
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	1	0.4
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
38	22.5	165	13.2	220	21.0	113	51.8	6	2.6
...	...	8	0.6	3	0.3	2	0.9	...	...
45	26.6	731	58.6	602	57.5	5	2.3	133	57.8
...	...	...	...	15	1.4	...	...	...	...
...	...	...	...	6	0.6	...	...	1	0.4
20	11.8	1	0.1	16	1.5	38	17.4	22	9.6
...	...	6	0.5	...	...	2	0.9	...	...
...	...	...	...	...	...	...	...	2	0.9
59	100.0	1248	100.0	1047	99.9	218	99.9	230	100.0

Figure 37.

STATION 4. 8500 South	6-15-65		7-14-65		8-11-65	
Organisms/sq.ft.	56		35.3		11.6	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	9	4.0	64	11.3	89	38.4
Hirudinea	16	7.1	29	5.1	8	3.4
Crustacea						
Hyalella sp.	192	85.7	219	38.8	39	16.8
Mollusca						
Gastropoda	3	1.3	...	...	...	...
Odonata						
Enallagma sp.	1	0.4	...	...	...	...
Ischnura sp.	1	0.4	...	...	...	...
Hemiptera						
Corisella sp.	...	...	...	...	7	3.0
Hebrus sp.	...	...	...	...	...	...
Coleoptera						
Gyrinus sp.	...	...	...	...	1	0.4
Heterelmis sp.	...	...	...	...	1	0.4
Diptera						
Simulidae						
Simulium sp.	1	0.4	8	1.4	9	3.9
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	...	...	142	25.2	49	21.1
Paratendipes sp.	...	...	...	...	23	9.9
Cryptochironomus sp.	...	...	102	18.1	6	2.6
Calospectra sp.	...	...	...	...	...	...
Trichoptera						
Hydropsyche sp.	1	0.4	...	...	...	...
TOTAL	224	99.7	564	99.9	232	99.9

Figure 37. (continued)

9-8-65		11-9-65		1-5-66		3-23-66		5-16-66	
7.8		17.8		29.6		41.9		3.0	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
13	8.3	105	14.9	29	2.5	44	3.5	48	80.0
2	1.3	14	2.0	3	0.3	7	0.6	2	3.3
73	46.8	76	10.7	61	5.2	71	5.6	1	1.7
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	6	0.9	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	1	0.1	...	...	...	...	...	...
23	14.7	70	9.8	495	42.0	947	75.3	2	3.3
...	...	2	0.3	43	3.7	...	...	1	1.7
40	25.6	436	61.3	509	43.2	104	8.3	6	10.0
5	3.2	...	...	...	...	79	6.3	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	35	3.0	...	...	...	...
...	...	...	...	3	0.3	5	0.4	...	...
156	99.9	711	100.0	1178	100.2	1257	100.0	60	100.0

Figure 38.

STATION 5. 8400 South	6-15-65		7-14-65		8-11-65	
Organisms/sq.ft.	1.4		4.2		3	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	1	1.2	9	5.4	14	11.6
Hirudinea	9	10.5	...	...	1	0.6
Crustacea						
Hyalella sp.	67	77.9	13	7.7	2	1.7
Mollusca						
Gastropoda	4	4.7	...	...	...	...
Odonata						
Enallagma sp.	1	1.2	1	0.6	...	...
Hemiptera						
Corisella sp.	2	2.3	...	...	...	...
Hebrus sp.	...	...	...	...	...	...
Coleoptera						
Heterelmis sp.	...	...	...	...	...	...
Diptera						
Simulidae						
Simulium sp.	1	1.2	1	0.6	50	41.3
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Tipulidae						
Tipula sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	...	...	77	45.8	30	24.8
Paratendipes sp.	...	...	67	39.9	24	19.8
Cryptochironomus sp.	1	1.2	...	...	...	...
Calospectra sp.	...	...	...	...	...	...
TOTAL	86	100.2	168	100.0	121	99.8

Figure 38. (continued)

9-8-65		11-9-65		1-5-66		3-23-66		5-16-66	
3.2		10.4		4.6		26.7		2.1	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
13	20.6	26	12.6	9	9.8	107	13.4	29	69.0
...	...	2	1.0	...	...	...	...	1	2.4
4	6.3	2	1.0	2	2.2	5	0.6	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	2	1.0	...	...	...	...	...	...
...	...	...	...	...	...	...	...	1	2.4
46	73.0	139	67.1	4	4.3	642	80.1	...	...
...	...	...	...	22	23.9	...	...	...	...
...	...	1	0.5	...	...	...	...	...	...
...	...	35	16.9	51	55.4	27	3.4	11	26.2
...	...	...	...	3	3.3	...	...	...	...
...	...	...	...	...	...	20	2.5	...	...
...	...	...	...	1	1.1	...	...	...	...
63	99.9	207	100.1	92	100.0	801	100.0	42	100.0

Figure 39.

STATION 6. 7800 South	6-15-65		7-15-65		8-11-65	
Organisms/sq.ft.	10.3		6		4.4	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	15	6.0	39	20.3	39	22.3
Hirudinea	2	0.8	1	0.5	...	...
Crustacea						
Gammarus sp.	7	2.8	9	4.7	...	...
Hyalella sp.	175	70.6	9	4.7	5	2.9
Mollusca						
Gastropoda	2	0.8	...	...	...	...
Diptera						
Simulidae						
Simulium sp.	...	...	2	1.0	...	...
Tendipedidae						
Hydrobaeninae	29	11.7	132	68.8	131	74.9
Paratendipes sp.	14	5.6	...	...	...	...
Cryptochironomus sp.	4	1.6	...	...	...	...
TOTAL	248	99.9	192	100.0	175	100.1

Figure 39. (continued)

9-8-65		11-9-65		1-5-66		3-23-66		5-16-66	
0.8		2.2		1.8		3.2		2.8	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
15	93.8	29	67.4	28	77.8	78	81.3	26	46.8
...	...	1	2.3	...	...	...	...	1	1.8
...	...	4	9.3	...	...	...	...	1	1.8
1	6.3	1	2.3	1	2.8	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	11	11.5	4	7.1
...	...	8	18.6	6	16.7	7	7.3	22	39.3
...	...	...	...	1	2.8	...	...	2	3.6
...	...	...	...	...	...	...	...	...	...
16	100.1	43	99.9	36	100.1	96	100.1	56	100.0

Figure 40.

STATION 7. Bingham Creek	6-15-65		7-14-65		8-11-65	
Organisms/sq.ft.	62.9		270		53.5	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	118	7.8	500	15.4	500	58.4
Hirudinea	16	1.1	9	0.3	8	0.9
Crustacea						
Gammarus sp.	86	5.7	394	12.2	64	7.5
Hyalella sp.	179	11.9	1706	52.7	130	15.2
Mollusca						
Gastropoda	2	0.1	8	0.2	19	2.2
Nematoda	...	...	...	...	...	...
Coleoptera						
Dubiaraphia sp.	...	...	...	...	...	...
Dyatiscus sp.	1	0.1	8	0.2	2	0.2
Hydrophilus sp.	...	...	...	...	...	...
Diptera						
Simulidae						
Simulium sp.	...	...	...	...	3	0.4
Muscidae						
Limnophora sp.	4	0.3	8	0.2	...	...
Tipulidae						
Antocha sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	1103	73.0	600	18.5	128	15.0
Calospectra sp.	...	...	...	...	...	...
Trichoptera						
Hydropsyche sp.	...	...	6	0.2	1	0.1
Limnephilis sp.	1	0.1	...	...	1	0.1
Hydroptila sp.	...	...	1	<0.1	...	...
TOTAL	1510	100.1	3240	100.0	856	100.0

Figure 40. (continued)

9-8-65		11-9-65		1-5-66		3-9-66		5-16-66	
156.4		2.5		0.7		18.5		18.1	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
830	26.5	38	77.6	11	78.6	197	35.5	128	35.5
63	2.0	...	...	...	...	1	0.2	6	1.7
350	11.2	...	...	1	7.1	33	5.9	15	4.2
751	24.0	...	...	...	...	...	...	65	18.0
9	0.3	...	...	...	...	127	22.9	2	0.6
...	...	...	...	...	...	...	...	10	2.8
...	...	1	2.0	...	...	...	...	...	...
1	<0.1	2	4.1	...	...	...	...	...	...
...	...	8	16.3	...	...	...	...	...	...
1	<0.1	...	...	...	...	1	0.2	2	0.6
1	<0.1	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	1	0.3
1122	35.9	...	...	1	7.1	192	34.6	131	36.3
...	...	...	...	...	...	...	...	1	0.3
...	...	...	...	...	...	4	0.7	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
3128	100.0	49	100.0	14	99.9	555	100.0	361	100.3

Figure 41.

STATION 9. 6400 South	6-15-65		7-15-65		8-11-65	
Organisms/sq.ft.	4.6		10.0		16.7	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	14	7.6	4	1.0	36	5.4
Hirudinea	9	4.9	...	...	...	...
Crustacea						
Gammarus sp.	1	0.5	...	...	...	...
Hyalella sp.	81	44.0	7	1.7	25	3.7
Ephemeroptera						
Tricorythodes sp.	...	...	...	...	...	...
Odonata						
Enallagma sp.	...	...	1	0.2	...	...
Diptera						
Simulidae						
Simulium sp.	17	9.3	175	43.5	258	38.6
Tipulidae						
Tipula sp.	...	...	...	...	...	...
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	20	10.9	108	26.9	349	52.2
Paratendipes sp.	42	22.8	107	26.6	...	...
Trichoptera						
Hydropsyche sp.	...	...	...	...	...	...
Hydroptila sp.	...	...	...	...	1	0.1
TOTAL	184	100.0	402	99.9	669	100.0

Figure 21. (continued)

9-8-65		11-23-65		1-5-66		3-23-66		5-16-66	
6-3		1.9		4.5		3.4		6.7	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
22	16.3	31	81.6	64	71.9	74	73.3	56	42.1
1	0.7	1	2.6	1	1.1	...	...	...	...
...	...	...	...	1	1.1	...	...	...	...
16	11.9	1	2.6	4	4.5	...	...	5	3.8
1	0.7	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
31	23.0	...	...	1	1.1	5	5.0	9	6.8
...	...	...	...	1	1.1	...	...	...	...
...	...	...	...	1	1.1	2	2.0	5	3.8
64	47.4	5	13.2	16	18.0	18	17.8	54	40.6
...	...	...	...	...	...	1	1.0	4	3.0
...	...	...	...	...	...	1	1.0	...	...
...	...	...	...	...	...	...	...	...	...
135	100.0	38	100.0	89	99.9	101	100.1	133	100.1

Figure 42.

STATION 10. 4800 South	6-15-65		7-15-65		8-11-65	
Organisms/sq.ft.	0.7		3.5		0.0	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	1	3.9	7	5.1	...	...
Hirudinea	...	...	...	...	...	...
Crustacea						
Gammarus sp.	...	...	...	...	...	...
Hyalella sp.	11	42.3	9	6.5	...	...
Ephemeroptera						
Baetis sp.	...	...	2	1.4	...	...
Tricorythodes sp.	...	...	...	...	...	...
Coleoptera						
Optioservus sp.	...	...	1	0.7	...	...
Diptera						
Simulidae						
Simulium sp.	...	...	...	...	...	...
Muscidae						
Limnophora sp.	...	...	1	0.7	...	...
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	9	34.6	117	84.8	...	...
Paratendipes sp.	5	19.2	...	...	...	...
Trichoptera						
Hydropsyche sp.	...	...	1	0.7	...	...
TOTAL	26	100.0	138	99.9	...	...

Figure 42. (continued)

9-28-65		11-23-65		1-13-66		3-23-66		5-18-66	
0.8		1.3		1.4		3.0		2.3	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
32	91.4	18	72.0	20	37.0	69	75.8	31	67.4
1	2.9	...	...	...	...	...	...	2	4.3
...	...	...	...	1	1.9	...	...	...	...
1	2.9	...	...	12	22.2	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	1	2.2
...	...	...	...	...	...	...	...	...	...
...	...	...	...	2	3.7	1	1.1	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	7	13.0	11	12.1	1	2.2
...	...	7	28.0	12	22.2	10	11.0	7	15.2
...	...	...	...	...	...	...	...	4	8.7
1	2.9	...	...	...	...	...	...	...	...
35	100.1	25	100.0	54	100.0	91	100.0	46	100.0

Figure 43.

STATION 11. 4500 South	6-18-65		7-15-65		8-11-65	
Organisms/sq. ft.	1.4		0.8		0.025	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	32	58.2	12	37.5	1	...
Hirudinea	...	...	...	...	...	...
Crustacea						
Hyalella sp.	8	14.5	...	...	...	...
Ephemeroptera						
Baetis sp.	...	...	...	...	...	...
Diptera						
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	10	18.2	15	46.9	...	...
Paratendipes sp.	5	9.1	5	15.6	...	...
TOTAL	55	100.0	32	100.0	1	100.0

Figure 43. (continued)

9-9-65		11-23-65		1-13-66		3-30-66		5-18-66	
68		1.3		0.9		5.3		1.7	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
131	96.3	16	64.0	14	37.8	94	89.5	30	45.5
...	...	1	4.0	...	...	...	...	...	...
2	1.5	2	8.0	4	10.8	...	...	1	1.5
...	...	...	...	...	...	...	...	2	3.0
...	...	...	...	3	8.1	...	...	11	16.7
1	0.7	6	24.0	15	40.5	11	10.5	21	31.8
2	1.5	...	...	1	2.7	...	...	1	1.5
136	100.0	25	100.0	37	99.9	105	100.0	66	100.0

Figure 44.

STATION 12. 4200 South	7-1-65		8-3-65		8-26-65	
Organisms/sq.ft.	0.5		2.5		0.5	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	1	...	5	...	1	...
Hirudinea	...	...	...	...	...	...
Crustacea						
Hyalella sp.	...	...	...	...	...	...
Isopoda						
Asellus sp.	...	...	...	...	...	...
Collembola						
Proisostoma sp.	...	...	...	...	...	...
Mollusca						
Gastropoda	...	...	...	...	...	...
Ephemeroptera						
Ephemerella sp.	...	...	...	...	...	...
Baetis sp.	...	...	...	...	...	...
Plecoptera						
Nemovra sp.	...	...	...	...	...	...
Hemiptera						
Graptocorixa sp.	...	...	...	...	...	...
Coleoptera						
Optioservus sp.	...	...	...	...	...	...
Diptera						
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Stratiomyidae						
Euparyphus sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	...	...	...	...	...	...
Paratendipes sp.	...	...	...	...	...	...
Cryptochironomus sp.	...	...	...	...	...	...
Trichoptera						
Hydropsyche sp.	...	...	...	...	...	...
TOTAL	1	100.0	5	100.0	1	100.0

Figure 44. (continued)

9-9-65		11-29-65		1-13-66		3-30-66		5-18-66	
6.5		0.6		30		11.7		9.1	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
4	30.8	5	45.5	27	90.0	94	40.3	77	14.1
...	...	...	...	...	...	3	1.3	2	0.4
1	7.7	...	...	1	3.3	35	15.0	4	0.7
...	...	...	...	...	...	...	...	1	0.2
...	...	...	...	...	...	5	2.1	93	16.9
...	...	...	...	...	...	...	...	14	2.6
...	...	...	...	...	...	...	...	14	2.6
...	...	...	...	...	...	15	6.4	3	0.5
...	...	...	...	...	...	...	...	1	0.2
...	...	...	...	...	...	...	...	1	0.2
...	...	...	...	...	...	1	0.4	4	0.7
...	...	2	18.2	...	...	1	0.4	285	52.0
...	...	...	...	...	...	...	...	1	0.2
...	...	4	36.4	2	6.7	65	27.9	60	10.9
7	53.8	...	...	...	...	...	...	...	...
1	7.7	...	...	...	...	12	5.2	1	0.2
...	...	...	...	...	...	1	0.4	...	...
13	100.0	11	100.1	30	100.0	233	99.8	548	100.0

Figure 45.

STATION 13. 3000 South	7-1-65		8-3-65		8-26-65	
Organisms/sq.ft.	2.7		2		13	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	3	37.5	2	...	13	80.0
Crustacea						
Hyalella sp.	...	...	...	...	...	...
Ephemeroptera						
Baetis sp.	...	...	...	...	...	...
Diptera						
Simulidae						
Simulium sp.	...	...	...	...	...	...
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	5	62.5	...	...	...	...
Paratendipes sp.	...	...	...	...	1	20.0
TOTAL	8	100.0	2	100.0	14	100.0

Figure 46.

STATION 14. 2900 South	7-1-65		8-3-65		8-26-65	
Organisms/sq.ft.	0.01		2.5		4	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	4	...	5	...	4	...
Mollusca						
Gastropoda	...	...	...	...	...	...
Diptera						
Empididae						
Hemeromia sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	...	...	...	...	...	...
Trichoptera						
Limnephilis sp.	...	...	...	...	...	...
TOTAL	4	100.0	5	100.0	4	100.0

Figure 45. (continued)

9-9-65		11-29-65		1-13-66		3-9-66		5-18-66	
5		72		20		52		82	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
4	80.0	34	94.4	18	90.0	12	92.3	16	39.0
...	...	...	...	...	...	...	...	2	4.9
...	...	...	...	...	...	...	...	3	7.3
...	...	...	...	...	...	...	...	2	4.9
...	...	...	...	1	5.0	...	...	...	...
...	...	...	...	...	...	1	7.7	17	41.5
1	20.0	2	5.6	1	5.0	...	...	1	2.4
5	100.0	36	100.0	20	100.0	13	100.0	41	100.0

Figure 46. (continued)

9-9-65		11-29-65		1-13-66		3-9-66		5-18-66	
6		30		14		56		0.1	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
6	...	26	86.7	13	92.9	26	92.9	2	...
...	...	1	3.3	...	...	...	...	...	...
...	...	...	...	...	...	1	3.6	...	...
...	...	...	...	1	7.2	1	3.6	...	...
...	...	3	10.0	...	...	...	...	...	...
6	100.0	30	100.0	14	100.1	28	100.1	2	100.0

Figure 47.

STATION 15. 2100 South	7-7-65		8-5-65		9-8-65	
Organisms/sq.ft.	17		170		49	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	33	97.1	169	99.4	49	...
Diptera						
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Muscidae						
Limnophora sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	1	3.0	1	0.6	...	...
TOTAL	34	100.1	170	100.0	49	100.0

Figure 48.

STATION 16. 1900 South	7-7-65		8-5-65		9-8-65	
Organisms/sq.ft.	187.5		502		323	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	375	...	500	99.6	323	...
Crustacea						
Hyalella sp.	...	...	...	...	...	...
Odonata						
Anax sp.	...	...	...	...	...	...
Diptera						
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
Tendipedidae						
Hydrobaeninae	...	...	2	0.4	...	...
Chironomus sp.	...	...	...	...	...	...
Cryptochironomus sp.	...	...	...	...	...	...
TOTAL	375	100.0	502	100.0	323	100.0

Figure 47. (continued)

10-4-65		11-29-65		1-25-66		3-9-66		5-23-66	
38		49.3		286		95		104	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
38	...	36	97.3	141	98.6	94	98.9	104	...
...	...	...	...	1	0.7	...	...	...	...
...	...	...	...	1	0.7	...	...	...	...
...	...	1	2.7	...	...	1	1.1	...	...
38	100.0	37	100.0	143	100.0	95	100.0	104	100.0

Figure 48. (continued)

10-4-65		11-29-65		1-25-66		3-9-66		5-23-66	
60		684		898		706		457	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
60	...	682	99.6	446	99.3	689	97.6	448	97.8
...	...	...	...	...	...	1	0.1	...	...
...	...	...	...	...	...	1	0.1	...	...
...	...	1	0.2	...	...	...	...	...	...
...	...	1	0.2	3	0.7	13	1.8	6	1.3
...	...	...	...	...	...	1	0.1	...	...
...	...	...	...	...	...	1	0.1	4	0.9
60	100.0	684	100.0	449	100.0	706	99.8	457	100.0

Figure 49.

STATION 17. 1100 South	7-8-65		8-2-65		9-8-65	
Organisms/sq.ft.	877		801		56	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	2629	99.9	800	99.9	56	...
Mollusca						
Gastropoda	9	0.1	1	0.1	...	...
Diptera						
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
TOTAL	2638	100.0	801	100.0	56	100.0

Figure 50.

STATION 18. North Temple	7-9-65		8-2-65		9-8-65	
Organisms/sq.ft.	400		2400		6709	
	Nos.	%	Nos.	%	Nos.	%
Annelida						
Tubifex sp.	400	...	2400	...	6704	99.9
Hirudinea	...	...	...	...	1	<0.1
Mollusca						
Gastropoda	...	...	...	...	4	<0.1
Diptera						
Psychodidae						
Psychoda sp.	...	...	...	...	...	...
TOTAL	400	100.0	2400	100.0	6709	99.9

Figure 49. (continued)

9-28-65		11-23-65		1-25-66		3-9-66		5-23-66	
653		6		2274		6960		519	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
653	...	55	91.7	2274	...	3480	...	601	...
...	...	...	...	...	...	...	...	...	...
...	...	5	8.3	...	...	...	...	...	...
653	100.0	60	100.0	2274	100.0	3480	100.0	601	100.0

Figure 50. (continued)

9-28-65		11-23-65		1-25-66		3-9-66		5-23-66	
2131		7850		22,960		20,680		2435	
Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
2121	99.5	7850	...	34,450	99.9	20,680	...	2435	...
3	0.1	...	...	...	...	...	...	...	...
4	0.2	...	...	2	<0.1	...	...	...	...
3	0.1	...	...	...	...	...	...	...	...
2131	99.9	7850	100.0	34,452	100.0	20,680	100.0	2435	100.0

APPENDIX B

PHYSICAL-CHEMICAL TEST DATA

Figure 51.

STATION 1. Lehi-Fairfield Road

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Saturation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hardness mg/l	Settleable Solids ml/l	Specific Conductance micromhos/cm
3-11-65	8:05 am	11.0	41	85	0.5	8.1	270	930	trace	3000
4-21-65	1:20 am	9.0	59	89	0.0	8.2	208	425	0.25	1300
5-19-65	12:45 am	7.1	65	75	0.0	8.2	226	440	trace	1300
6-28-65	9:55 am	7.0	64	71	0.0	8.1	146	445	0.3	1500
7-27-65	11:05 am	6.3	76	72	0.0	8.3	220	400	0.5	1250
8-24-65	10:20 am	5.8	72	66	0.0	8.1	234	385	0.3	1700
9-29-65	1:30 pm	8.0	54	74	0.0	8.2	200	425	0.15	1550
10-25-65	10:00 am	10.8	51	97	0.2	8.2	276	625	0.1	2050
11-30-65	10:50 am	11.6	35	50	7.0	8.0	440	515	0.0	1400
12-20-65										
1-27-66	12:30 pm	14.4	34	104	0.0	8.2	236	425	trace	1600
2-23-66	3:25 pm	19.2	42	140	0.0	8.3	190	375	0.2	1400

Figure 52.

STATION 2. Bluffdale Road

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Saturation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hardness mg/l	Settleable Solids ml/l	Specific Conductance micro-mhos/cm
3-11-65	8:35 am	10.0	41	77	0.5	8.0	270	690	trace	2100
4-21-65	1:40 pm	12.8	65	135	0.0	8.3	200	495	trace	1450
5-19-65	1:05 pm	12.4	66	130	0.0	8.4	230	550	trace	1700
6-28-65	10:20 am	11.3	64	118	0.0	8.0	268	540	0.05	1700
7-27-65	11:30 am	8.3	72	95	5.0	7.8	268	560	0.4	1600
8-24-65	10:40 am	8.4	66	90	3.0	7.6	316	535	0.1	2050
9-29-65	1:50 pm	8.5	56	80	0.2	8.0	184	325	0.1	900
10-25-65	10:30 am	9.4	55	88	0.6	7.8	250	500	trace	1900
11- -65	11:15 am	8.8	52	79	4.0	7.6	226	455	0.0	1650
12-20-65		9.8	46	81	5.0	8.2	244	500	trace	1800
1-27-66	1:00 pm	12.0	40	92	0.0	8.2	230	450	trace	1700
2-23-66	3:35 pm	12.8	44	104	0.0	8.4	236	405	0.1	1450

Figure 53.

STATION 3. 9000 South

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Saturation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hardness mg/l	Settleable Solids ml/l	Specific Conductance micromhos/cm
1-28-65	1:30 pm	11.2	49	97	0.0	8.0	192	710	0.0	2600
2-11-65	11:30 am	12.3	42	97	0.0	7.7	293	885	0.03	2800
3-11-65	9:10 am	11.6	43	93	0.8	7.8	280	875	0.0	2300
4-21-65	2:00 pm	13.2	63	136	0.0	8.2	240	770	0.0	2000
5-19-65	1:30 pm	9.4	64	97	0.3	8.0	246	690	0.25	2100
6-28-65	10:55 am	7.6	64	79	5.0	7.8	290	650	0.4	2100
7-27-65	11:55 am	6.7	72	76	4.0	7.8	266	750	0.4	2050
8-24-65	11:05 am	7.0	67	76	4.0	7.7	298	750	0.2	2800
9-29-65	2:15 pm	8.5	55	80	0.6	7.9	260	775	0.1	2200
10-25-65	10:45 am	10.4	53	95	0.2	7.8	276	825	trace	2950
11-30-65	11:30 am	11.6	45	97	3.0	7.7	270	775	0.0	2650
12-20-65		11.6	44	95	3.0	8.0	280	785	trace	2700
1-27-66	1:15 pm	10.4	44	85	2.0	7.9	270	710	0.1	2600
2-23-66	4:00 pm	12.0	42	95	0.0	8.3	242	525	0.4	1800

Figure 54.

STATION 4. 7800 South

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Satur-ation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hard-ness mg/l	Settle-able Solids ml/l	Specific Conduct-ance micro-mhos/cm
1-28-65	1:50 pm	6.4	49	56	0.0	7.2	286	735	1.3	2600
2-10-65	11:45 am	11.5	39	87	0.0	7.8	298	825	0.03	2700
3-11-65	9:40 am	8.1	46	67	0.7	7.4	270	840	trace	2250
4-21-65	2:10 pm	9.1	61	91	0.3	8.0	266	810	0.1	2100
5-19-65	1:40 pm	7.5	62	76	0.5	7.6	250	725	0.2	2100
6-28-65	11:25 am	7.2	62	73	5.0	7.8	272	705	0.2	2100
7-27-65	12:45 pm	6.4	70	71	5.0	7.6	270	735	0.6	2000
8-24-65	11:15 am	6.2	64	64	8.0	7.6	288	790	0.2	3000
9-29-65	2:30 pm	7.2	55	67	0.4	7.8	260	710	0.2	2200
10-25-65	11:05 am	7.0	58	68	1.2	7.8	266	750	0.5	2600
11-30-65	11:45 am	8.2	48	70	8.0	8.0	276	750	1.3	2500
12-20-65		8.2	48	70	...	...	290	715	1.4	2600
1-27-66	1:30 pm	9.0	46	75	4.0	7.8	280	655	1.3	2400
2-23-66	4:05 pm	10.0	46	83	...	8.2	256	535	0.3	1850

Figure 55.

STATION 5. Bingham Creek

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Satur-ation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hard-ness mg/l	Settle-able Solids ml/l	Specific Conduct-ance micro-mhos/cm
2-11-65	12:00 N	9.7	50	85	...	7.7	292	940	0.15	2800
3-11-65	10:00 am	9.2	50	82	0.7	7.7	260	1030	trace	2350
4-21-65	2:20 pm	9.1	61	91	0.4	8.0	294	1035	trace	2200
5-19-65	1:45 pm	8.5	61	86	0.5	7.8	270	785	0.4	2400
6-28-65	11:35 am	6.0	63	76	6.0	8.0	282	685	0.3	2050
7-27-65	1:00 pm	6.8	68	74	6.0	7.6	296	990	1.5	2150
8-24-65	11:25 am	7.1	62	72	6.0	7.4	306	910	0.1	3000
9-29-65	2:40 pm	7.5	55	70	0.5	7.6	234	615	0.2	1800
10-25-65	11:15 am	3.4	66	36	0.8	7.5	300	720	2.0	2200
11-30-65	11:50 am	6.4	56	61	...	8.4	330	750	5.2	2600
12-20-65		7.4	60	75	...	...	228	825	4.5	2900
1-27-66	1:40 pm	9.6	46	80	5.0	7.8	286	565	4.5	2050
2-23-66	4:10 pm	12.0	46	96	...	8.1	290	840	0.1	2675

Figure 56.

STATION 6. 6400 South

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Saturation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hardness mg/l	Settleable Solids ml/l	Specific Conductance micromhos/cm
2-11-65	12:15 pm	9.0	43	72	...	7.6	281	770	0.1	2400
3-11-65	10:15 am	9.0	46	75	0.6	7.6	290	825	trace	2000
4-21-65	2:30 pm	9.5	62	97	0.5	8.0	264	725	trace	2100
5-19-65	2:00 pm	8.7	62	90	0.5	7.8	260	670	0.2	2000
6-28-65	12:00 N	7.6	62	77	7.0	7.8	274	710	0.2	2000
7-27-65	1:10 pm	6.5	70	72	6.0	7.6	272	730	0.25	2050
8-24-65	11:35 am	6.8	63	70	6.0	7.5	286	830	0.15	2800
9-29-65	2:50 pm	7.5	55	70	0.7	7.8	260	685	0.2	1900
10-25-65	12:45 pm	4.6	58	44	0.7	7.6	264	725	0.06	2450
11- -65	12:05 pm	7.4	46	62	7.0	7.6	290	725	1.0	2400
12-20-65		5.0	46	42	...	...	284	775	1.3	2600
1-27-66	1:50 pm	9.2	48	79	5.0	7.8	266	645	1.4	2400
2-23-66	4:20 pm	10.0	44	81	...	8.2	250	530	0.3	1900

Figure 57.

STATION 7. 4800 South

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Satur-ation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hard-ness mg/l	Settle-able Solids ml/l	Specific Conduct-ance micro-mhos/cm
1-28-65	2:10 pm	5.6	49	49	...	7.2	267	750	0.6	2400
2-11-65	12:40 pm	9.2	43	74	...	7.6	263	805	0.1	2200
3-11-65	10:50 am	11.3	46	95	0.8	7.7	266	840	trace	2300
4-21-65	4:50 pm	10.8	62	110	0.4	7.8	262	825	0.1	2150
5-19-65	2:15 pm	11.4	63	117	0.3	8.0	234	690	0.2	2000
6-28-65	1:25 pm	7.6	62	77	5.0	7.8	260	540	0.15	2000
7-27-65	1:30 pm	7.0	70	79	5.0	7.7	260	710	0.25	1900
8-24-65	11:50 am	7.1	64	74	4.0	7.6	276	770	0.15	2800
9-29-65	3:00 pm	7.6	54	70	0.5	7.7	246	680	0.3	2100
10-25-65	1:10 pm	6.0	60	60	0.8	7.6	268	725	0.04	2450
11- -65	12:20 pm	6.0	47	51	5.0	7.6	270	735	0.5	2400
12-20-65		7.0	46	58	...	...	284	735	0.5	2500
1-27-66	2:04 pm	10.6	48	90	5.0	7.6	276	630	1.3	2400
2-23-66	4:30 pm	11.4	45	95	...	8.1	250	525	0.5	1900

Figure 58.

STATION 8. 3300 South

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Satur-ation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hard-ness mg/l	Settle-able Solids ml/l	Specific Conduct-ance micro-mhos/cm
2-10-65	5:00 pm	9.2	42	72	...	7.8	275	720	0.2	2100
3-11-65	11:25 am	8.2	45	67	0.6	7.7	268	775	trace	2200
4-21-65	3:50 pm	7.4	65	77	0.6	7.7	232	610	0.7	1600
5-19-65	2:50 pm	8.2	57	79	0.6	7.8	170	340	0.5	1100
6-28-65	2:00 pm	8.2	59	81	2.0	7.9	188	435	0.3	1250
7-28-65	2:05 pm	6.0	71	67	4.0	7.7	248	555	0.6	1650
8-24-65	1:30 pm	6.4	65	67	4.0	7.7	262	640	0.2	2000
9-29-65	10:15 am	8.4	52	76	0.7	7.8	226	550	0.1	1750
10-25-65	1:45 pm	5.6	58	55	0.5	7.6	260	625	0.3	2400
11- -65	12:55 pm	6.2	44	51	6.0	7.6	276	630	0.6	2100

Figure 59.

STATION 9. 2100 South

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Satur-ation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hard-ness mg/l	Settle-able Solids ml/l	Specific Conduct-ance micro-mhos/cm
1-28-65	4:15 pm	4.8	46	40	...	7.4	262	735	0.3	2000
2-10-65	4:35 pm	8.9	42	71	...	7.8	281	705	0.2	2000
3-10-65	5:00 pm	9.3	53	85	0.8	7.6	270	715	trace	2050
4-21-65	3:00 pm	7.7	66	81	0.7	7.8	240	605	0.2	1750
5-19-65	3:20 pm	8.0	59	79	0.4	7.6	180	410	0.6	1050
6-29-65	9:50 am	7.3	60	72	7.0	7.6	192	400	0.2	1200
7-27-65	2:30 pm	6.0	74	70	4.0	7.5	254	395	0.7	1700
8-24-65	1:55 pm	6.2	68	68	6.0	7.6	264	740	0.3	2000
9-30-65	10:40 am	8.0	53	73	0.5	7.8	226	545	0.1	1600
10-25-65	2:05 pm	5.6	58	55	0.5	7.6	256	640	0.3	2300
11- -65	1:15 pm	7.2	44	57	5.0	7.6	256	560	0.4	2000
12-21-65		7.0	42	55	...	...	276	635	trace	2000
1-31-66	10:15 am	7.2	42	57	3.0	7.6	260	610	0.2	1700
2-23-66	10:30 am	...	42	..	5.0	7.8	274	510	0.2	1750

Figure 60.

STATION 10. California Avenue

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Saturation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hardness mg/l	Settleable Solids ml/l	Specific Conductance micromhos/cm
2-10-65	4:00 pm	8.0	42	63	...	7.8	288	660	0.2	2000
3-10-65	4:15 pm	8.5	52	77	0.8	7.6	262	690	0.3	2000
4-21-65	2:30 pm	6.2	65	65	0.3	7.6	254	620	0.3	1750
5-19-65	3:45 pm	7.5	60	75	0.3	7.7	168	400	0.4	1000
6-29-65	10:05 am	6.8	60	68	4.0	7.6	192	400	0.3	1150
7-28-65	9:20 am	5.0	69	55	8.0	7.7	268	555	0.5	1800
8-24-65	1:50 pm	6.2	66	65	2.0	7.6	246	600	0.4	1900
9-29-65	10:45 am	8.0	54	75	0.3	7.6	230	535	0.1	1650
10-25-65	2:20 pm	5.4	58	53	0.5	7.7	250	675	0.25	2300
11- -65	1:30 pm	8.6	45	71	5.0	7.6	262	530	0.4	2000
12-21-65		7.2	43	58	...	...	274	620	0.5	2000
1-31-66	10:30 am	8.4	42	66	3.0	7.6	266	600	0.3	1950
2-23-66	10:45 am	...	43	..	5.0	7.8	254	545	0.2	1350

Figure 61.

STATION 11. North Temple

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Saturation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hardness mg/l	Settleable Solids ml/l	Specific Conductance micro-mhos/cm
1-28-65	4:35 pm	6.6	40	51	...	7.5	...	450	1.0	1500
2-10-65	3:10 pm	7.7	40	60	...	7.7	267	600	0.3	1800
3-10-65	3:45 pm	5.2	48	44	1.1	7.9	266	560	1.6	1750
4-21-65	1:40 pm	7.3	63	75	0.6	7.9	236	410	1.7	950
5-20-65	8:55 am	7.6	53	61	0.4	7.8	198	335	0.4	700
6-29-65	10:30 am	6.4	62	65	3.0	7.7	204	410	0.3	1050
7-28-65	9:50 am	3.9	72	45	6.0	7.7	246	565	0.6	1300
8-24-65	1:25 pm	5.4	68	60	6.0	7.6	260	600	0.5	1800
9-29-65	11:15 am	7.2	54	67	0.4	7.6	230	525	0.2	1500
10-26-65	2:55 pm	5.0	56	48	0.6	7.6	250	625	0.2	2200
11- -65	1:55 pm	6.2	44	51	4.0	7.7	260	510	0.5	1900
12-21-65		5.4	44	44	...	...	284	600	0.4	1900
1-31-66	11:00 am	7.4	40	56	4.0	7.6	250	540	0.3	1500
2-23-66	11:10 am	...	43	..	5.0	7.8	254	500	0.2	1700

Figure 62.

STATION 12. 1800 North Redwood Road

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Satur-ation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hard-ness mg/l	Settle-able Solids ml/l	Specific Conduct-ance micro-mhos/cm
2-10-65	2:50 pm	6.8	40	52	...	7.6	263	595	0.5	1800
3-10-65	3:10 pm	4.2	50	37	1.2	8.4	252	560	1.1	1650
4-21-65	12:30 pm	5.6	60	56	0.5	8.0	222	390	0.9	1050
5-20-65	9:40 am	7.2	53	65	0.5	8.0	200	375	0.5	850
6-29-65	11:45 am	5.9	64	61	3.0	7.8	210	425	0.3	1100
7-28-65	11:05 am	3.3	73	38	5.0	7.9	248	565	0.7	1800
8-24-65	12:05 pm	4.1	68	45	6.0	7.5	242	570	0.4	1900
9-29-65	3:15 pm	6.6	57	63	0.5	7.6	230	540	0.25	1650
10-26-65	2:30 pm	3.4	57	33	0.5	7.4	240	635	0.1	2000
11- -65	2:40 pm	5.0	42	40	3.0	7.7	250	500	0.25	1400
12-21-65		3.6	40	28	...	...	270	640	trace	2000
1-31-66	11:35 am	6.6	40	51	3.0	7.6	260	610	0.1	2000
2-23-66	12:10 pm	...	45	..	5.0	7.9	254	500	0.2	2000

Figure 63.

STATION 13. Cudahy Lane

Date	Time	Dissolved Oxygen mg/l	Water Temp. °F.	% Satur-ation	Carbon Dioxide mg/l	pH	M.O. Alk. mg/l	Hard-ness mg/l	Settle-able Solids ml/l	Specific Conduct-ance micro-mhos/cm
1-28-65	4:50 pm	2.8	42	21	...	7.4	248	585	0.3	2000
2-10-65	2:30 pm	6.9	39	52	...	7.6	255	615	0.3	2000
3-10-65	2:45 pm	7.5	49	65	0.9	7.8	256	590	trace	1750
4-21-65	3:20 pm	3.6	62	37	0.4	7.8	246	490	0.6	1400
5-20-65	9:30 am	7.0	54	65	0.3	7.9	184	320	0.7	800
6-29-65	11:30 am	5.0	64	53	4.0	7.6	210	390	0.3	1150
7-28-65	10:45 am	2.2	75	25	6.0	7.9	242	535	0.5	1700
8-24-65	11:50 am	3.2	68	35	3.0	7.5	248	580	0.3	1900
9-29-65	3:00 pm	6.8	58	67	0.6	7.6	224	525	0.0	1700
10-26-65	2:15 pm	4.8	58	47	0.4	7.6	250	585	0.15	2050
11- -65	2:30 pm	4.0	43	32	5.0	7.7	256	470	trace	1800
12-21-65		4.0	39	30	...	...	296	620	trace	1950
1-31-66	11:25 am	5.0	40	39	3.0	7.6	262	550	0.2	2000
2-23-66	12:00 N	...	44	..	4.0	7.7	256	530	trace	1700

Figure 64.

STATION 14. New State Gun Club

Date	Time	Dissolved Oxygen mg/1	Water Temp. °F.	% Saturation	Carbon Dioxide mg/1	pH	M.O. Alk. mg/1	Hardness mg/1	Settleable Solids ml/1	Specific Conductance micromhos/cm
1-28-65	5:05 pm	4.0	41	31	...	7.4	260	660	trace	2400
2-10-65	1:50 pm	7.7	38	58	...	7.6	230	605	trace	2200
3-10-65	2:05 pm	7.1	48	62	1.3	7.2	274	590	trace	1900
4-10-65	3:00 pm	4.0	60	40	0.5	7.8	260	515	0.3	1300
5-20-65	9:20 am	6.2	56	60	0.5	7.8	200	335	trace	800
6-29-65	11:15 am	4.5	66	48	4.0	7.5	210	365	0.0	1100
7-28-65	10:20 am	2.0	74	23	6.0	7.9	246	550	0.6	1700
8-24-65	11:30 am	2.1	66	22	5.0	7.4	220	450	0.15	1400
9-29-65	2:45 pm	5.6	58	55	0.5	7.6	224	520	0.25	1700
10-26-65	2:00 pm	3.6	60	36	0.5	7.6	250	640	0.1	2050
11- -65	2:15 pm	7.8	40	59	4.0	7.8	260	460	trace	1600
12-21-65		6.0	36	44	...	...	282	630	trace	2000
1-31-66	11:10 am	5.2	38	39	2.0	7.7	268	560	0.3	1400
2-23-66	11:45 am	...	43	..	3.0	7.6	208	515	trace	2000

APPENDIX C

UTAH WATER QUALITY STANDARDS

UTAH STATE DEPARTMENT OF HEALTH
CODE OF WASTE DISPOSAL REGULATIONS
PART II - STANDARDS OF QUALITY FOR WATERS OF THE STATE

II-1. Application of Quality Standards

The following standards of quality shall be applied to waters of the State as appropriate. Classifications identified therewith may be assigned as specified in 26-15-4 (21), and 73-14-1 to 13, Utah Code Annotated, 1953.

II-2. Natural Pollutants

Any one of the classifications may be assigned to a given water notwithstanding the presence in said water of natural pollutants in excess of the limits established by the classification in which case the subscript "1" shall be added to the usual classification designation (A_1, B_1, C_1, etc.) to denote the modification of water quality. No change in waste discharge restrictions of the basic classification shall be inferred, except that the discharge of any wastes in such a way as to increase the concentration of any of the excessive natural pollutants in the classified water is prohibited.

II-3. Protection of Downstream Classifications

Wastes discharged to waters of the State under limitations imposed by a given classification shall be further controlled as required to protect water quality designated by all downstream classifications.

II-4. Class "A" Waters shall be so protected against pollution as to be suitable at all times without treatment for domestic water supplies, irrigation, stock watering, fish and wildlife propagation, recreation, as a source for industrial supplies, and for other uses as may be determined by the Boards.

No person shall discharge any wastes directly into Class "A" waters or dispose of any wastes in such a way as to result in

(1) characteristics of said waters exceeding the limits prescribed by "Public Health Service Drinking Water Standards, 1962" or

(2) chemical characteristics of said waters exceeding the recommendations for irrigation water quality as outlined in Chapter 5 of the U. S. Department of Agriculture "Agriculture Handbook No. 60," issued February, 1954.

II-5. <u>Class "B" Waters</u> shall be so protected against pollution as to be suitable at all times for domestic supplies which are treated before use by disinfection only. Class "B" waters shall be suitable without treatment for irrigation, stock watering, fish and wildlife propagation, recreation, as a source for industrial supplies, and for other uses as may be determined by the Boards.

No person shall discharge any wastes directly into Class "B" waters or dispose of any wastes in such a way as to result in

(1) physical and chemical characteristics of said waters exceeding the limits prescribed by "Public Health Service Drinking Water Standards, 1962" or

(2) chemical characteristics of said waters exceeding the recommendations for irrigation water quality as outlined in Chapter 5 of the U. S. Department of Agriculture "Agriculture Handbook No. 60," issued February, 1954, or

(3) a monthly arithmetical average "most probable number" (MPN) of coliform organisms in said waters exceeding 50 per 100 milliliters; or in an MPN exceeding this number in more than 20% of the samples collected during any month; or in an MPN exceeding 100 per 100 milliliters in more than 5% of such samples.

II-6. <u>Class "C" Waters</u> shall be so protected against pollution as to be suitable at all times for domestic water supplies which are treated before use by coagulation, sedimentation, filtration, and disinfection. Class "C" waters shall be suitable without treatment for irrigation, stock watering, fish and wildlife propagation, recreation (except swimming), as a source for industrial supplies, and for other uses as may be determined by the Boards.

No person shall discharge into Class "C" waters any wastes

(1) which result in chemical characteristics of said waters exceeding the limits prescribed by "Public Health Service Drinking Water Standards, 1962", or

(2) which result in chemical characteristics of said waters exceeding the recommendations for irrigation water quality as outlined in Chapter 5 of the U. S. Department of Agriculture "Agriculture Handbook No. 60," issued February, 1954, or

(3) which result in a monthly arithmetical average "most probable number" (MPN) of coliform organisms in said waters exceeding 5,000 per 100 milliliters; or in an

II-6. <u>Class "C" Waters</u> (continued)

MPN exceeding this number in more than 20% of the samples collected during any month; or in an MPN exceeding 20,000 per 100 milliliters in more than 5% of such samples, or

(4) which result in a monthly arithmetical average biochemical oxygen demand (BOD) in said waters exceeding 5 milligrams per liter (mg/l); or in a BOD exceeding this amount in more than 20% of the samples collected in any month; or in a BOD exceeding 10 mg/l in more than 5% of such samples, or

(5) which result in any slicks, floating solids, suspended solids or sludge deposits in said waters which are readily visible, or which result in appreciable change in color of said waters, or

(6) which result in a pH of said waters lower than 6.5 or greater than 9.0, or

(7) which contain any toxic wastes, phenols, or other deleterious substances in such concentrations or at such temperatures as will render said waters injurious to fish life and waterfowl, or unsafe or unsuitable as sources of water supply for domestic use, food processing or industrial use, or unsuitable for agricultural purposes, stock watering, or recreation.

II-7. <u>Class "D" Waters</u> shall be so protected against pollution as to be suitable at all times for limited irrigation, not including irrigation of lawns, recreational areas, pastures used for dairy cattle, root crops, or any low growing crops produced for human consumption. Such waters shall be suitable also as a source for industrial supplies and for other uses as may be determined by the Boards.

No person shall discharge into Class "D" waters any wastes

(1) which result in chemical characteristics of said waters exceeding the limits prescribed by "Public Health Service Drinking Water Standards, 1962", or

(2) which result in chemical characteristics of said waters exceeding the recommendations for irrigation water quality as outlined in Chapter 5 of the U. S. Department of Agriculture "Agriculture Handbook No. 60", issued February, 1954, or

(3) which result in a monthly arithmetical average "most probable number" (MPN) of coliform organisms in said

II-7. Class "D" Waters (continued)

waters exceeding 5,000 per 100 milliliters; or in an MPN exceeding this number in more than 20% of samples collected during any month; or in an MPN exceeding 20,000 per 100 milliliters in more than 5% of such samples, or

(4) which result in a monthly arithmetical average biochemical oxygen demand (BOD) in said waters exceeding 25 milligrams per liter (mg/l); or in a BOD exceeding this amount in more than 20% of the samples collected in any month; or in a BOD exceeding 50 mg/l in more than 5% of such samples, or

(5) which result in any slicks, floating solids, suspended solids, or sludge deposits in said waters which are readily visible, or which result in an appreciable change in color of said waters, or

(6) which result in a pH of said waters lower than 6.5 or greater than 9.0, or

(7) which contain any toxic wastes, phenols, or other deleterious substances in such concentrations or at such temperatures as will render said waters unsuitable for the uses designated for Class "D" waters above.

II-8. Class "E" Waters shall be protected against such pollution as may result in a health hazard or nuisance. Their uses shall be limited to those determined by the Boards.

No person shall discharge into Class "E" waters any wastes which will create a condition constituting or resulting in a health hazard or nuisance. The Boards may direct that such waters be suitably isolated by closed conduit, approved fencing, or other means.

II-9. Class "S" Waters shall be protected as Class "A" waters except for specific waste discharges permitted by action of the Boards. Such discharges shall be defined as to quantity, quality and duration and shall not interfere with existing uses of said waters.

II-10. Sampling and Analysis

For the purposes of this code, quality of waters of the State and of effluents discharged thereto shall be determined by analyses performed in a laboratory or laboratories certified as qualified by the Department. Samples for analysis shall be collected by methods in common use by government agencies charged with water pollution control responsibilities. "Composite" and "grab" samples shall be used, as dictated by circumstances, to determine total daily quantities as well as peak concentrations of different pollutants.

ERRATA

Item 1: Figure 8, Station 11, pickup for September 9, 1965, the content of tubifex worms found in this station should read 65.

Item 2: Page 45, line 1, "Figures 6 and 7" should read "Figures 3 and 8."

Item 3: Page 45, delete paragraph 3 found on this page and replace with the following information:

Histograms for B.O.D. (Figures 9 and 10) show that the level is lower in 1965-66 than in 1956-58. In 1956-58, many homes in the area were serviced by septic tanks with the waste water filtering into the ground or the raw sewage running directly into the river. In 1965-66 almost all of the homes in the Salt Lake basin had connected to a sewer treatment plant. At peak efficiency the modern secondary treatment plant removes about eighty percent of the putrescible solids. Few, if any, of Utah's secondary treatment plants are capable of removing this high amount and a more realistic figure would be sixty or seventy percent. Even with the population growth these treatment plants have reduced the B.O.D. content of the river. With an increasing growth in population projected for the coming years the treatment plants will have to improve their processes to keep up with the demand for clean water.

Item 4: Page 45, delete the words "increased" and "reduced" in the first line of paragraph 4.

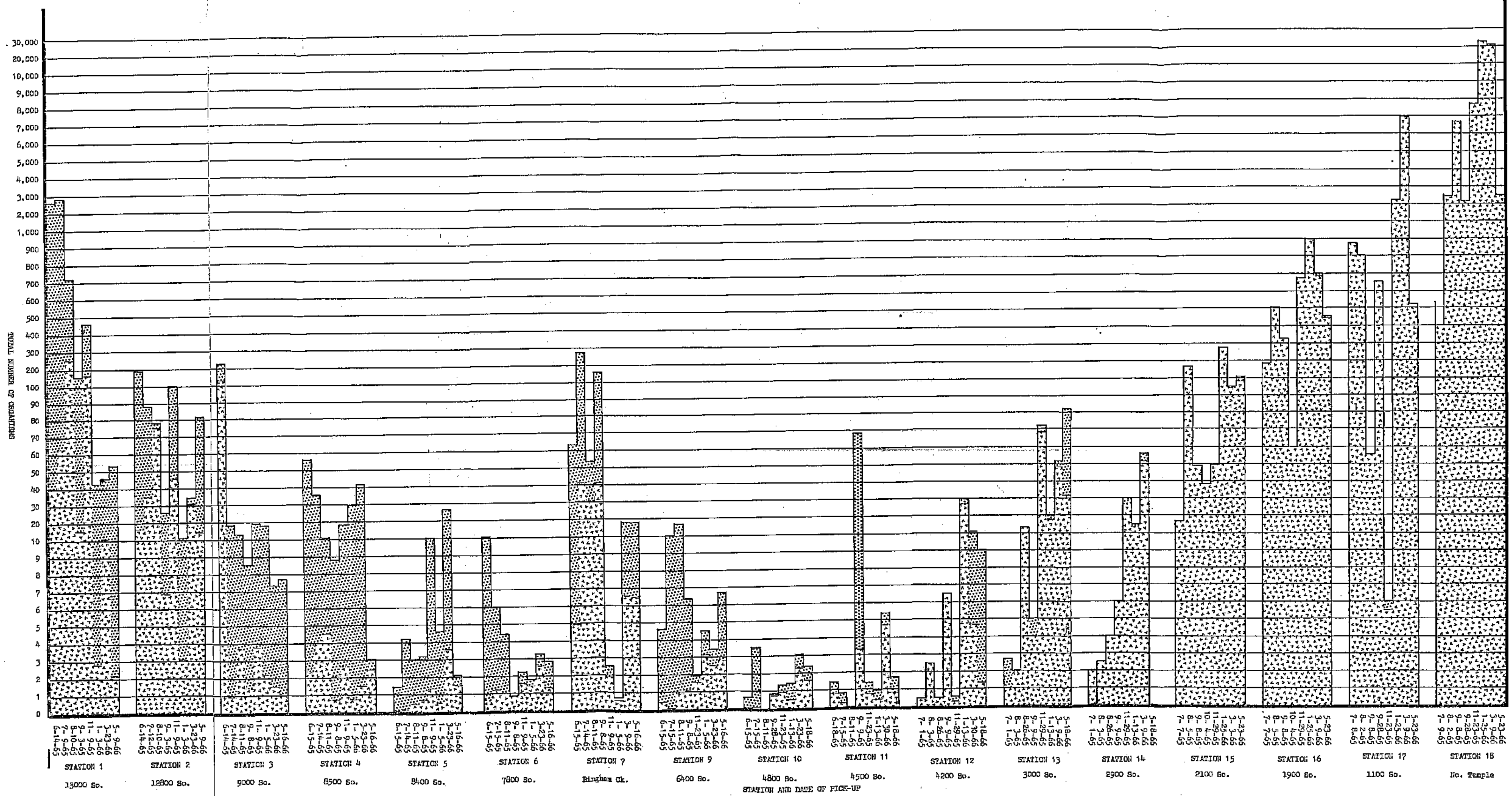

Figure 8. Total Numbers of Aquatic Invertebrates of Each Station--1965-66 Study.