# WATER RECYCLING OF SEWAGE EFFLUENT BY IRRIGATION: A FIELD STUDY ON OAHU

Final Progress Report for August 1971 to June 1975

Technical Report No. 94

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# ABSTRACT

*The specific project objectives were to: (1) evaluate by field lysimeters and pilot plots and augment by laboratory studies the feasibility of utilizing water reclaimed from sewage for irrigation under Hawaiian conditions; (2) assess the probable effects of surface-applied reclaimed water on groundwater quality particularly in terms of potential viral transmission and long-term buildup of solids; (3) evaluate the effects of various water quality parameters on the soil, percolation, and vegetative growth when grassland or sugarcane is irrigated with sewage effluents; (4) explore any problem in sugarcane culture, either in technology or in crop quality that might be involved in the irrigation of sugarcane with water reclaimed from sewage.*

*The central Oahu project site area is located near the Mililani Sewage Treatment Plant (STP) which, in 1975, received approximately 3217* $m^3$*/day (0.85 mgd) of essentially domestic sewage from the nearby expanding Mililani Town development. The STP utilizes the Rapid Bloc activated sludge process (secondary treatment) that achieves a suspended solids and* $BOD_5$ *removal rate that averages 90%. The location of the project site was chosen in part because the adjacent field soils are of the Oxisol order similar to that on which approximately 90% of the sugarcane cultivated under irrigated conditions on Oahu is grown. The general project site area receives an average annual rainfall of approximately 102 cm (40 in.), and is situated at an elevation approaching 152 m (500 ft).*

*The research activities were grouped into three major areas: soils and irrigation, viral analysis, and water quality analysis. In general, the values of guideline chemical parameters for the Mililani STP effluent are below the maximum value for irrigation of sensitive crops. Pesticides and heavy metal concentrations were either below the level of concern or level of detectability. Nitrogen was given special emphasis for several reasons: its use as a major component of most fertilizers; its known adverse effect (lowered sugar yields) on matured sugarcane; its essential solubility in the nitrite and nitrate form; its relationship in concentrations above 10 mg/ℓ as N to methomoglobinemia, the disease of infants; and its potential role in the eutrophication of open bodies of water receiving excessive nitrogen loads.*

*Commencing in August 1971, the project activities consisted of: the installation of field grass-sod, bare soil, and field lysimeters at the Mililani STP; coordinating laboratory facilities and analytical capabilities for determining the constituents in water, waste water, and soils; development of virus culturing and assaying techniques under field conditions, and studying the application of secondary effluent to maturing sugarcane in OSC Field No. 240, located approximately 3.2 km (2 miles) from the Mililani STP. The results of these studies helped establish procedures and guidelines for the principal focus of the project, the sequential application of sewage effluent, ditch water, and combinations thereof, to sugarcane in 30 test plots with uniform areas of 0.04 ha (0.1 acre) each in the newly planted (February 1973) OSC Field No. 246, located approximately 1.6 km (1 mile) from the Mililani STP. The test plots were divided into three basic irrigation schemes of ten plots each: A, B, and*

C. Plots "A" were scheduled to received only ditch water for the 2-yr growth cycle, "B" plots to receive secondary effluent for the first half of the growth cycle and ditch water thereafter, and "C" plots to have only effluent irrigation applications for the full growth cycle.

Fifty ceramic point samplers were installed in representative "A", "B", and "C" plots at depths of 23 to 30 cm and 46 to 53 cm (9 to 12 in. and 18 to 21 in.), which resulted in the shallower points being positioned in the tillage zone and the deeper points being positioned approximately 15 cm (6 in.) below the tillage zone. Thus, leachate collected by the shallower points represented liquid available to the sugarcane root zone, whereas, leachate collected from the deeper points is assumed to be generally unavailable to the sugarcane and potentially may percolate to the groundwater table. Two 1.52-m (5 ft) deep field lysimeters were also installed in a furrow row adjacent to the test plot. The sugarcane growing on one lysimeter was irrigated with ditch water while sugarcane on the other lysimeter received secondary effluent. Sugarcane parameters were monitored periodically throughout the culture cycle.

Field No. 246 was harvested in March 1975 and the associated laboratory analysis of the yields was completed and evaluated in April 1975.

The Mililani STP secondary treated and chlorinated domestic and municipal sewage effluents containing insignificant amounts of toxic chemicals represent a generally usable irrigation supply for sugarcane and grasslands in central Oahu.

Application of sewage effluent for the first year of a 2-yr cane crop cycle increased the sugar yield by about 6% compared with the control plots. However, when sewage effluent was applied for the entire 2-yr crop cycle, sugar yield was reduced by about 6% and the cane quality by about 16% even though the total cane yield increased by about 11%.

There was no apparent evidence of significant surface clogging of the soil or of soil chemical properties impairment resulting from sewage effluent irrigation during the first full 2-yr sugarcane crop cycle. Under a no moisture stress condition, a 1-mgd supply is sufficient to irrigate 61 to 81 ha (150 to 200 acres) of sugarcane by the furrow method.

The quality of percolate from the effluent-irrigated sugarcane-cultured soil was of acceptable concentration from the standpoint of groundwater quality protection: the only possible concern was for nitrogen which sporadically exceeded the 10 mg/ℓ limit for drinking water during the first 6 to 7 months of cane growth. However, similar exceedance occurred in the ditch water-irrigated sugarcane plots and the plots irrigated with effluent during the first year and with ditch water during the second year. Furthermore, there was no major difference in the total quantity of nitrogen produced in the percolate among the three different treatments. Phosphorus, potassium, suspended solids, biochemical oxygen demand, total organic carbon, and boron were removed effectively from the applied effluent by means of irrigation; however, chloride in the percolate was essentially unaffected except for a transient increase during fertilization. Both total dissolved solids and chloride in the percolates met drinking water standards.

*Human enteric viruses have been shown to be present in the majority of effluent samples examined and, hence, can be assumed to be present in the effluent applied to the irrigated field. However, the absence of these viruses in all sugarcane and grass percolates sampled over a 2-yr period, plus other project virus studies conducted, suggest strongly that the possibility of contaminating deep underground water sources is extremely remote.*

*Survival of poliovirus was minimal in an open field area which was exposed to direct sunlight, high temperature, and dessication. In contrast, the viability of the virus was maintained for up to two months in a field of mature sugarcane where the virus was protected from the physical elements.*

*Bermudagrass, with periodic cutting and harvesting, proved to be an excellent utilizer of sewage effluent applied nitrogen and, thus, excelled sugarcane from the standpoint of groundwater protection. Essentially no nitrogen was recovered from the percolate at the 1.52-m (5 ft) depth below the grassed surface, whereas nearly 25% of the total nitrogen applied from chemical fertilizers and sewage effluent was recovered at the same depth in sugarcane percolate. Up to 40.47 ha (100 acres) of grassland may be irrigated with 1 mil gal/day of effluent under a no moisture stress condition. However, it has been demonstrated that fallow or bare soil appears incapable of removing significant amounts of nitrogen from the applied effluent.*

*Disinfected sewage effluent, similar in composition to that used in the Mililani study, may be used for irrigation of sugarcane in the first year followed by irrigation with surface water in the second year, however, when used for the entire 2-yr crop cycle without added treatment, poorer sugar yield will result.*

*Establishing a virus monitoring and quality control program for the treated sewage effluent before application is an essential part of an irrigation recycling program. Furthermore, development of more effective methods of virus inactivation prior to recycling is highly recommended. Precautionary sanitation measures for field workers should be practiced.*

*Further research on the use of effluent for irrigation sugarcane would be desirable, specifically:*

1. *Repeat test plot studies for a ratoon crop cycle to confirm the yield and to assess long-term effects on the soil*
2. *Test with various dilutions of sewage effluent and with chemical ripeners to improve the yield*
3. *Investigate plugging of drip orifices in irrigation tubings in anticipation of extensive future use.*

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# INTRODUCTION

This is the final completion report for the project, "Recycling of Water from Sewage by Irrigation: A Pilot Field Study on Oahu" covering the period August 1971 to June 1975. Prior progress reports include two progress reports (Lau et al. 1972, 1974) and the 1975 interim progress report. The project originated as the result of an act of the 1971 Hawaii State Legislature to supplement the City and County of Honolulu's Water Quality Program for Oahu with a feasibility study of recycling sewage effluents by the Board of Water Supply. Funded jointly by the Board of Water Supply and the City and County of Honolulu, the project was conducted by the Water Resources Research Center of the University of Hawaii.

This report presents field and laboratory studies of changes in water quality factors, viral content in the applied and percolating water and in the soil, and sugar yields and quality when sugarcane fields as well as grasslands are irrigated with sewage effluent. An overall evaluation of the project results is presented together with proposed principles and guidelines for irrigation of sugarcane and grasslands with sewage effluent in Hawaii.

## Need for Study

The study was undertaken from the standpoint of both general national considerations and specific situations peculiar to Hawaii. At the National level, the concept that water resource conservation is necessary for the public welfare is accepted widely and the belief in the reclamation and reuse of water in order to maximize use and to minimize adverse environmental quality effects has become essentially a social and cultural ethic. Environmental standards have become so restrictive that there is generally no place that waste water may be discharged without first purifying it to a degree which approximates the minimum quality acceptable for uses such as irrigation of crops and grasslands, or as industrial cooling water. Consequently, in communities faced with the necessity of investing in more sophisticated treatment works to meet water quality standards, public clamor for reclamation is increasing. This national climate of attitudes and constraints, as evidenced in the 1972 Amendments to the Federal Water Pollution Control Act (PL 92-500), is shared by Hawaii. However, the need for study is a local, rather than a national, matter because most research on water reclamation and reuse has been done on the mainland under conditions not comparable to those in Hawaii in a number of significant ways.

First, essentially all of Oahu's water supply comes from groundwaters in contrast to the mainland where some 75% of the drinking water is derived from surface sources; thus, protection of the groundwater quality is of primary, rather than of secondary importance to Hawaii. Second, Hawaiian soil properties differ greatly from that of mainland soils to the degree that it is impossible to apply mainland soils criteria to the design of land disposal systems in Hawaii. Third, the urban areas of Hawaii, which are located mainly along the coast, have been able to discharge sewage into the ocean. Thus, there has been little pressure to invest heavily in sewage treatment. As a result, reuse of water is an alternative yet to be considered in planning waste water treatment systems for Hawaii. Fourth and finally, trends and projections of the economic growth and of the water needs of Oahu indicate the necessity to augment Oahu's water resources for its future needs. Reuse of water, desalination of ocean water or brackish groundwater, and artificial rainmaking are the more common alternatives that are being considered in Hawaii. At the present state of the art, reuse is the most feasible means from the standpoint of technology and economics.

From the foregoing considerations, it is clear that there is a need for an Oahu feasibility study of recycling water reclaimed from sewage. The transport of pollution parameters which cannot be extrapolated from experience elsewhere must be assessed in direct relation to Hawaiian soils. There is a need to determine how reclaimed water might be used on land to lessen the draft on groundwaters without contaminating such waters and to evaluate the economics of reclaiming the recycling water now being wasted and discharged into the ocean.

## Objectives of Study

The general objectives of the study are implicit for study. Specific objectives are to:

1. Evaluate by field lysimeters and pilot plots, and augment by laboratory studies, the feasibility of utilizing water recalimed from sewage for irrigation under Hawaiian conditions.
2. Assess the probable effects of surface-applied reclaimed water on groundwater quality, particularly in terms of potential viral transmission and long-term buildup of dissolved solids.
3. Evaluate the effects of various water quality parameters on the soil, percolation, and vegetative growth when grassland or sugarcane is irrigated with sewage effluents.
4. Explore any problem in sugarcane culture, either in technology or in crop quality that might be involved in the irrigation of sugarcane with water reclaimed from sewage.

## Nature and Rationale of Study

The project was designed initially to study the field application and the effects of secondary, primary, and tertiary treated effluent over a period of three to six years, depending upon the success of each research step. The research plan called for the project to begin with the application of secondary sewage effluent to grassland and to plots of sugarcane over a period of several crop cycles and to monitor the effects of runoff and percolation and then, if successful in terms of safety to groundwater quality and acceptability to grass and sugarcane culture, to proceed to the application of primary effluent to the same culture types during the fourth year. Finally, during the fifth and sixth years, experiments would be conducted with tertiary effluent. The project phases using secondary effluent were scheduled to be completed within three years. Since the initiation of the project, two highly pertinent articles of legislation have been signed into law (Federal PL 92-500 and Hawaii's Department of Health *Public Health Regulations*, chap. 38) which specify that sewage receive a minimum of secondary treatment before being used for irrigation, thus, limiting the scope of study.

Some limited irrigation with treated sewage effluents with or without dilution is already being practiced in Hawaii where the overlying strata protect groundwater or where the underlying water is brackish. Therefore, the first logical phase of study was to determine whether the extension of local practices and the adoption of the minimum (secondary) level of treatment commonly accepted in the conterminous U.S. is compatible with the groundwater quality objectives of Hawaii. Considering the expense and the limited present use of tertiary treatment in Hawaii, and the minimum of secondary treatment of sewage at both the state and national levels, the Project Executive Group decided to concentrate the entire research effort on the use of secondary treated effluent.

## Organization of Study

The overall responsibility and direction of the project was delegated to L. Stephen Lau, Director of the Water Resources Research Center as Principal Investigator of the project. He is assisted by an Executive Group consisting of University faculty from various departments and the staff of the Water Resources Research Center, engineers from both the Board of Water Supply and Division of Sewers, City and County of Honolulu, and agronomists and engineers from the Hawaiian Sugar Planters' Association and the Oahu Sugar Company, Ltd. The Executive Group meets on a regular basis, at least once a month, to review and discuss progress, and to conduct detailed planning and coordination of the research.

The following University staff has been responsible for the five major activity areas:

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| Paul C. Ekern | Soils and irrigation |
| Philip C.S. Loh | Virology |
| Reginald H.F. Young | Water quality analyses |
| Nathan C. Burbank, Jr. | Public health |
| Gordon L. Dugan | Data management and report preparation |

Cooperating agencies have made the following contributions in addition to providing technical advice:

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| Division of Sewers (Pearl City Treatment Plant Laboratory), City and County of Honolulu | Laboratory and field support |
| Board of Water Supply, City and County of Honolulu | Laboratory and field support |
| Hawaiian Sugar Planters' Association | Field and laboratory studies of sugarcane and soil responses |
| Oahu Sugar Company, Ltd. | Sugarcane fields for experimental studies |

Construction of facilities and instrumentation for the field studies were undertaken jointly by all cooperating agencies.

## ACKNOWLEDGMENTS

Special acknowledgment is due to all personnel contributing to and assisting in the project and to project consultant, Dr. P.H. McGauhey, professor emeritus, of the University of California, Berkeley.

## PREVIOUS PROJECT REPORTS

Pursuant to the contractual agreement and amendments, three progress reports have been submitted, prior to the final report, to the funding agencies. The three progress reports, which consist of the First Progress Report (Lau et al. 1972, Tech. Rep. No. 62); Second Progress Report (Lau et al. 1974, Tech. Rep. No. 79); and the 1975 Interim Progress Report, will be summarized briefly.

### First Progress Report, WRRC Tech. Rep. 62

The First Progress Report, covering the period from project initiation in August 1971 to July 1972, consisted of a site description and installation of field grass-sod and pan lysimeters at the Mililani Sewage Treatment Plant (STP); laboratory facilities and analytical capabilities for determining the constituents in water, waste water, and soils; development of viral culturing and assaying techniques under field conditions; and studying the application of secondary effluent to maturing sugarcane on a test plot in the Oahu Sugar Company (OSC) Field No. 240. The experimental results, for the period which commenced in January 1972, basically indicated that the grass-sod and soils of the test area were very effective in removing a high percentage of $BOD_5$, suspended solids, TOC, nitrogen, phosphorus, potassium, boron and coliforms.

## Second Progress Report, WRRC Tech. Rep. 79

The Second Progress Report, covering the period from July 1972 to July 1973, involved: continued operation, measurement, and analysis of percolates from the grass-sod and pan lysimeters started during the period of the First Progress Report; installation of a 76-cm (30-in.) deep pan lysimeter; near completion of the studies involving secondary effluent application to maturing sugarcane (OSC Field No. 240); installation of a hydrualic lysimeter kept fallow; and initiation of the thrust of the project which involved the sequential application of secondary sewage, ditch water, and combinations thereof to sugarcane in 30 test plots with uniform areas of 0.04 ha (0.1 acre) each in the newly planted (February 1973) Field No. 246. The test plots were divided into three basic irrigation schemes of 10 plots each: A, B, and C. Plots "A" were scheduled to receive only ditch water for the 2-yr culture cycle; "B" plots to receive secondary effluent for the first half of the growth cycle and ditch water thereafter; and "C" plots to have only effluent irrigation applications for the full growth cycle.

Fifty ceramic point samplers were installed in representative "A", "B", and "C" plots at depths of 23 to 30 cm (9 to 12 in.) and 46 to 53 cm (18 to 21 in.). Two 1.52-m (5-ft) deep field lysimeters were also installed in a furrow row adjacent to the test plot. Sugarcane growing on one lysimeter was irrigated with ditch water while the sugarcane on the other lysimeter received secondary effluent. Cane growth parameters were monitored periodically throughout the culture cycle. The soil within the test sites of both the grass and sugarcane areas is of the Oxisol order, Lahaina series, the general soils type on which approximately 90% of Hawaii's irrigated sugarcane is grown.

Raw sewage, secondary effluent, and leachate from the soils continued to be assayed for various physical, chemical, sanitary, viral, and other microbiological quality parameters. Analyses for pesticides and heavy metals were also performed occasionally.

The grass-sod and soils at Mililani continued to be very effective in removing $BOD_5$, TOC, nitrogen, phosphorus, potassium, boron, coliforms, and viruses as evidenced by analyses of the leachate passing through the 1.52-m (5-ft) deep grass-sod lysimeter. Nitrogen, however, was not removed effectively until after 5 months of operation, whereas, the other constituents were fairly rapidly attenuated. There appeared to be inconclusive evidence of a base exchange or similar phenomenon in the soil at least between sodium and calcium in the Field No. 240. Similar results were also found for leachate collected by the point samplers in the sugarcane fields. Virus cultures were obtained from the sewage effluent, however, only one positive virus culture was identified from leachate passing through the 1.52-m (5-ft) deep lysimeter.

## 1975 Interim Progress Report

The 1975 Interim Progress Report consisted of the major findings from data collected over a period exceeding 3 yrs (August 1971 to December 1974). Essentially, the report was based primarily on the first two progress reports (Tech. Rep. Nos. 62 and 79) and on the project related technical paper "Land Disposal of Sewage in Hawaii--A Reality?" presented to the 47th Annual Conference of the Water Pollution Control Federation in Denver, Colorado, 6-11 October 1974 (Dugan et al. 1974).

During the period from the "Second Progress Report" (WRRC TR 79, July 1972 to July 1973) until the completion of the reporting period for the "1975 Progress Interim Report" (December 1974), the status of the activities included continued monitoring of the grass-sod lysimeter; discontinuance of the operation of the pan lysimeters; completion of the studies in OSC Field No. 240; continued water quality and viral monitoring; and continued sequential secondary effluent and ditch water application and the collection of the leachate for quality analysis from the lysimeters and ceramic points in the test plots of OSC Field No. 246.

At the end of the interim report period, water quality studies on grass-sod, bare soil, and sugarcane lysimeters were essentially completed, and irrigation and water quality sampling and analysis for the Field 246 test plots, were to be terminated, depending on the weather and sugarcane moisture content, after one additional irrigation cycle. Marker virus experiments were being continued in order to obtain a better understanding of the virus removal mechanism from irrigation waters in the plant-soil-water system.

Percolate pans, which were placed at various depths in an in situ soil column, collected very limited amounts of leachate, even when heavy irrigation applications were applied directly above the lysimeters in an 46-cm (18-in.) by 76-cm (30-in.) diameter metal ring installed within the overlying soil directly above the lysimeters. The results suggest that a dense subsoil exists in the area which resists vertical percolation and, thus, promotes lateral soil water movement.

Cane growth in Field No. 240 test plots was estimated to be nearly 40% greater than that for the unanticipated water-short adjacent sugarcane fields. Although the single plot could not be considered adequate to measure sugarcane growth and sugar yield, chemical analysis of sugarcane samples indicated that the sugar purity difference was approximately 1% (14% vs. 15%) with the ditch water irrigated fields having the higher value. It should be noted, however, that the Field No. 240 test plot study was not designed to ascertain sugar yields.

As of July 1974, the value of secondary effluent at sugarcane field sites was estimated to be equivalent to $78.29 per mil gal in terms of the value of both water and fertilizers.

Virus results showed that human enteric viruses survived secondary treatment at the Mililani STP even after chlorination. Fifty-eight percent of the analyzed chlorinated effluent samples yielded viruses at concentrations ranging from 2 to 750 PFU/ℓ. The viruses isolated over a nearly 2-yr period were predominately poliovirus types 1, 2, and 3, ECHO virus type 7, and coxsackie viruses B-4 and B-5.

With one possible exception, viruses were not isolated in the leachate samples (sample volume primarily 76 to 95 ℓ [20 to 25 gal]) collected over a period of about 18 months, from the 1.5-m (5-ft) deep grass-sod and sugarcane lysimeters which were irrigated regularly with effluent. The results to date from test soil profiles indicate that the chances of the presence of virus in the leachates are remote. These same results also suggest that the test soils in the lysimeters are highly effective in removing viruses from the applied secondary effluent. In addition, no positive fecal coliform test results were obtained for the bottom leachate samples.

The behavior of viruses in the field soil was studied in a series of marker virus experiments in the five field lysimeters as described in the section: bare soil (I and II), grass sod, and sugarcane (D and E). Marker viruses introduced at extremely high concentrations (nine orders of magnitude higher than normally expected in secondary sewage effluent) on the soil surface of the lysimeters were recovered at depths down to 117 cm (46 in.) on the first day on two occasions although they were generally only detected in the first few inches during the first two to three days.

It should be noted that these experiments represented a highly artifical condition in comparison to the application of secondary effluent irrigation being studied in the field.

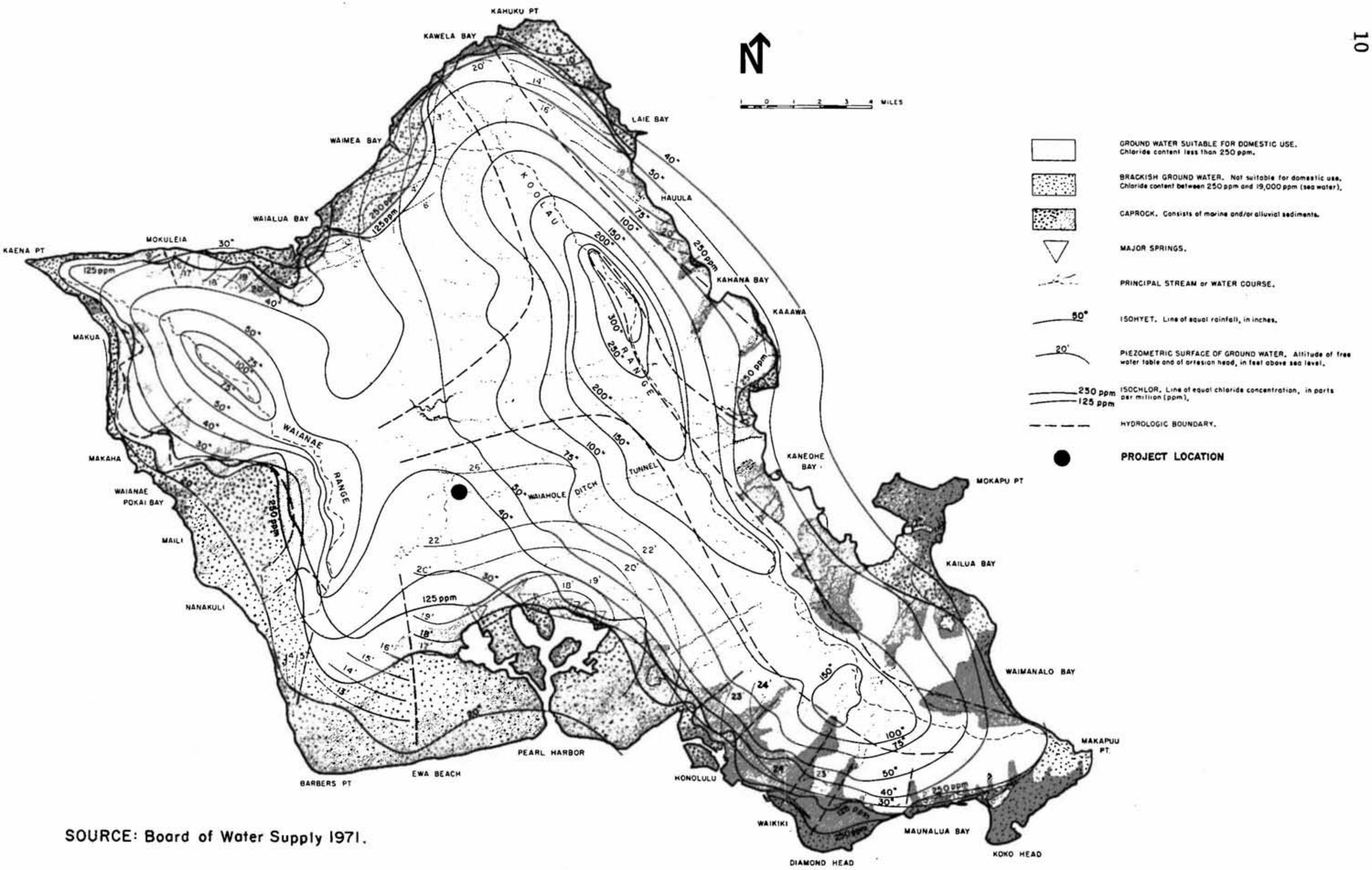
All available data indicated that the chances of virus-caused diseases occurring under test conditions are extremely remote. However, the field worker should follow every normal precaution, such as, the maintenance of their poliovirus immunizations and the exercise of standard hygienic practices.

## FIELD INVESTIGATIONS

The project site area (Fig. 1) is located near the Mililani Sewage Treatment Plant (STP) which received during 1975 approximately 3217 $m^3$/day (0.85 mgd) of essentially domestic sewage from the nearby expanding Mililani Town development. In operation since 1969, the sewage treatment plant presently utilizes the Rapid Bloc activated sludge process that achieves a suspended solids and $BOD_5$ removal rate that averages approximately 90% (Table A-1, App. A). In the fall of 1973, a primary sedimentation tank was added and an anaerobic digester replaced the aerobic digester.

The location of the project site, situated at an elevation approaching 152 m (500 ft), was chosen not only because of its close proximity to the Mililani STP, but because the sugarcane on adjacent fields are grown on soils similar to that on which approximately 90% of the sugarcane under irrigation on Oahu is grown. The predominate Oxisol is the Lahaina silty clay, a Tropeptic haplustox, which was developed on a thick deposit of Koolau lava. These soils are compacted readily by conventional sugarcane tillage operations to high bulk densities (1.3 to 1.4) which considerably reduce their infiltration capacity. The general area, as can be observed in Figure 1, receives an average annual rainfall of approximately 102 cm (40 in.), primarily from northeast tradewind showers and winter cyclonic storms.

The research activities are grouped into three major areas: soils and irrigation, viral analysis, and water quality analysis. Inasmuch as progress and findings at various sequential stages have been presented in three technical reports (Lau et al 1972, 1974, 1975) and at national and local meetings (Dugan et al. 1974; Young, Ekern, and Lau 1972; Young et al.



SOURCE: Board of Water Supply 1971.

FIGURE 1. GENERAL HYDROLOGIC AND GEOLOGIC CHARACTERISTICS OF OAHU

1974), only a summarization of the past information will be presented as appropriate for the final report study.

At the initiation of the study, effort was directed primarily at measuring rainfall and solar radiation, determining evapotranspiration and percolation, characterizing transported irrigation water and Mililani STP raw sewage and secondary effluent, monitoring ongoing turf irrigation with secondary effluent at the Mililani STP grounds, conducting field lysimeter and soil studies, perfecting viral assay techniques, and applying effluent to 5 rows of sugarcane crop in the test plot of Oahu Sugar Company's (OSC) Field No. 240, which was midway through its normal 2-yr growth cycle.

Under normal fertilization practices, various forms of nitrogen, phosphorus, and potassium for the 2-yr sugarcane crop, are applied during the first 10 months of the growth cycle. Of all the factors that are important to the overall assessment of the feasibility of sugarcane irrigation by treated sewage effluent, nitrogen is considered to be the one of the most critical of all factors due to its potential effect on cane growth and sugar yield. Nitrogen application to sugarcane after the first 10 months of the growth cycle is traditionally considered to reduce sugar yield. Thus, monitoring of the nitrogen application rates and the concentration in the soil water is of prime interest, not only because of its possible effect on total sugar yield, but also its danger to children's health in the form of methemoglobinemia when nitrate builds up in potable groundwater supplies to concentrations of >10 mg/ℓ as N.

Monitoring of the chemical constituent concentrations in Field No. 240 was conducted by collecting percolate samples from 29 porous ceramic points installed in both furrows and ridges of the irrigated field at depths varying from 23 to 84 cm (9 to 33 in.). Soil water samples were withdrawn under 0.67-bar (9.7-psi) or 0.68 kg/cm$^2$ suction on the points during irrigation. It is obvious that for an overall assessment of the potential effects of secondary sewage effluent being used as an irrigation source for sugarcane culture, it would be best conducted over at least the complete 2-yr sugarcane growth cycle; however, there were no sugarcane fields within a practical distance of the Mililani STP that were scheduled for replanting for approximately 17 months after the initiation of the project.

Effluent irrigation of the pilot plot in Field No. 240, in its second year of growth with normal fertilization completed, nonetheless, afforded the opportunity to perfect lab and field techniques as well as to monitor changes in the constituent concentrations within the plant root zone, however, the single plot could not reliably measure the effects on cane growth and sugar yield. The secondary effluent was transported 3.22 km (2 miles) to Field No. 240 from the Mililani STP in 8327-ℓ (2200-gal) lots by a tank truck. Adjacent furrows and ridges, in fields receiving normal irrigation water, were also monitored by using ceramic points.

Test plots that were established in January 1973 cooperatively with the Oahu Sugar Company (OSC) and the Hawaiian Sugar Planters' Association (HSPA) in OSC Field No. 246 afforded the opportunity to conduct, for the approximately 2-yr sugarcane growth cycle, irrigation with sequential applications of both ditch water and secondary effluent to a newly planted sugarcane field within approximately 1.6 km (1 mile) of the Mililani STP and about 3.22 km (2 miles) from Field No. 240. The soil of Field No. 246 is of the same general type as in Field No. 240. A detailed soil analysis from five samples collected in the test plots of Field No. 246 is shown in Table 1. However, the inherent field variability (coef of variation ±10%) of soil chemical and physical properties precludes detection unless very significant quantitative changes occur.

TABLE 1. SOIL ANALYSIS, OSC FIELD NO. 246
(Sampled 26 January 1973)

| TEST PLOT | DEPTH | pH | P* | K | Ca | NITROGEN AVAILABLE | NITROGEN MINERALIZABLE |
|---|---|---|---|---|---|---|---|
| | in.† | | lb/acre-ft‡ | | | | |
| 9A | 0-12 | 5.9 | 135 | 290 | 4300 | 25 | 50 |
| 21B | 0-12 | 5.8 | 160 | 330 | 4250 | 25 | 60 |
| 29C | 0-12 | 6.9 | 175 | 205 | 6100 | 25 | 60 |
| 14A | 0-12 | 5.7 | 185 | 315 | 3950 | 20 | 55 |
| 25C | 0-12 | 6.0 | 100 | 130 | 3950 | 25 | 55 |
| AVERAGE | | 6.1 | 151 | 254 | 4510 | 24 | 56 |

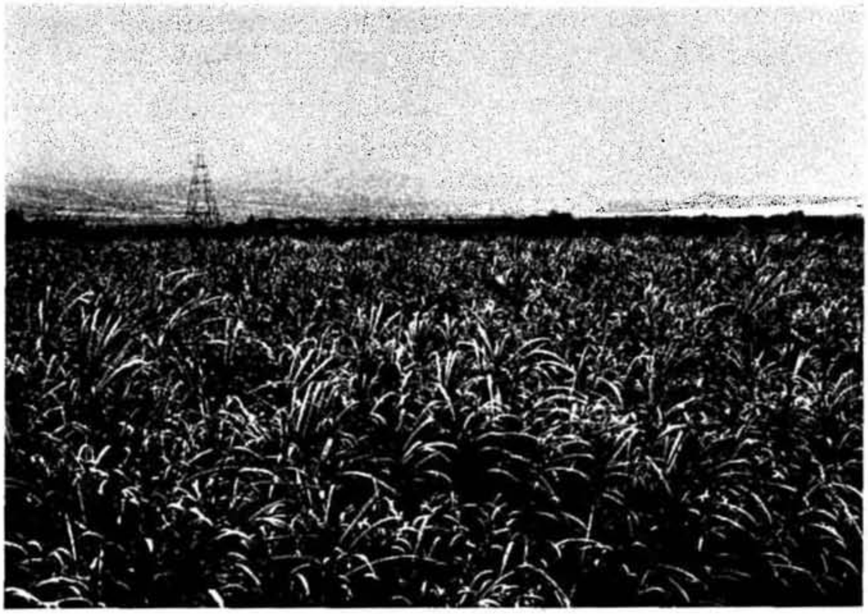
NOTE: Soil analysis performed by the Hawaiian Sugar Planters' Association, Honolulu, Hawaii; K and Ca extracted in 1N $NH_4OAc$, available N and mineralizable N in 0.5N $K_2SO_4$; P extracted in 0.5N $NaHCO_3$.

*$NaHCO_3$-P.

†in. x 2.54 = cm.

‡lb/acre-ft x 0.367 = g/m$^3$.

Photograph No. 1. NEWLY PLANTED PROJECT SUGARCANE IN OAHU SUGAR COMPANY FIELD NO. 246



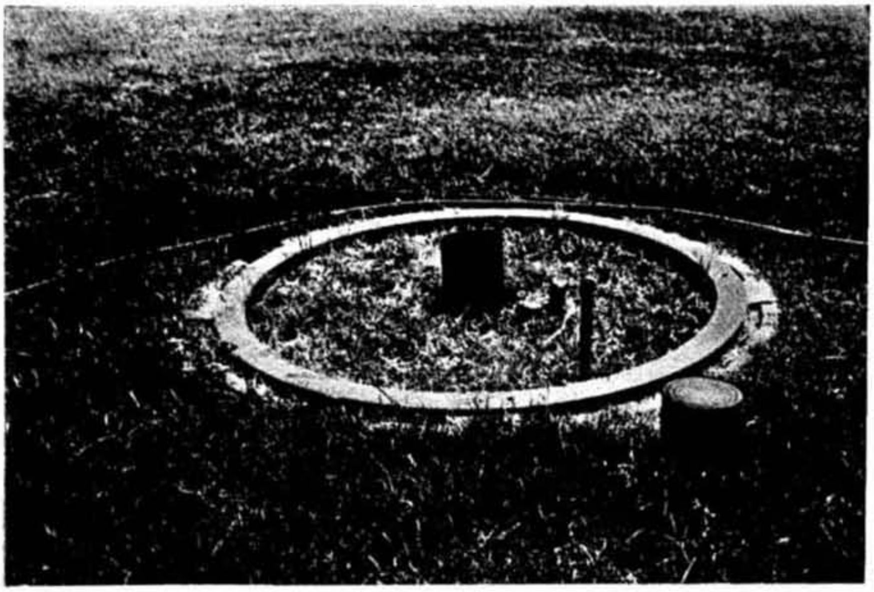
Photograph No. 2. MATURE PROJECT SUGARCANE ON OAHU SUGAR COMPANY FIELD NO. 246. CANE GROWTH ABOUT 25 MONTHS JUST BEFORE HARVEST.

Photographs by P.C. Ekern

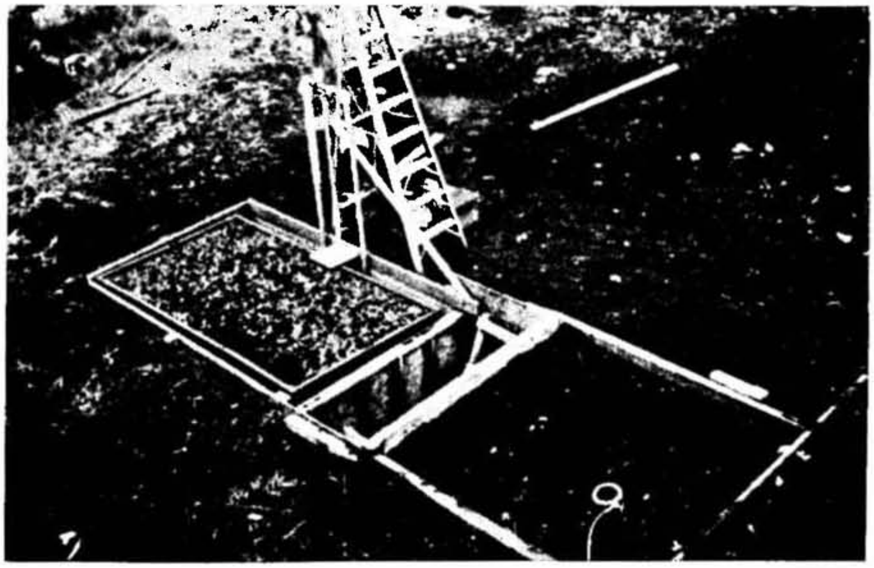
Photograph No. 3.
MATURE PROJECT SUGARCANE ON OAHU SUGAR COMPANY FIELD NO. 246

Photograph No. 4.
TRANSPORT AND DISTRIBUTION SYSTEMS FOR THE IRRIGATION WATER: PVC PIPE FOR SEWAGE EFFLUENT AND ALUMINUM FLUME FOR DITCH WATER.

Photographs by P.C. Ekern



Photograph No. 5. CYLINDRICAL HYDRAULIC LYSIMETER FOR BERMUDAGRASS TESTING



Photograph No. 6. RECTANGULAR HYDRAULIC LYSIMETER FOR BARE SOIL TESTING (BACKGROUND)

Photographs by P.C. Ekern

Photograph No. 7.
HARVESTED PROJECT SUGARCANE IN OAHU SUGAR COMPANY FIELD NO. 246

Photograph No. 8.
SPECIALLY ARRANGED HAND HARVESTING FOR THE PROJECT SUGARCANE ON OAHU SUGAR COMPANY FIELD NO. 246.

Photograph No. 9.
A PORTION OF THE HARVESTED PROJECT SUGARCANE IN OAHU SUGAR COMPANY FIELD NO. 246

Photographs by P.C. Ekern

Thirty test plots, laid out in Field No. 246 in widths of 10 sugarcane rows 16.8-m wide x 24.4-m long (55-ft wide x 80-ft long), resulted in a total area of 408.76 $m^2$ (4400 $ft^2$) per plot or about 0.04 ha (0.1 acre). The 1.62-ha (4-acre) triangular field containing all test plots is shown in Figure 2.

The planting of sugarcane variety H59-3775 in Field No. 246 occurred on 8 to 9 February 1973 and was scheduled for harvest in November 1974; however, a sugarcane workers strike during the spring of 1974 resulted in a postponement of harvesting until March 1975. At the time of planting, treble superphosphate was applied to all plots at an application rate of approximately 170.39 kg/ha (152 lb/acre) as P. This application and subsequent applications of urea and muriate of potash in various quantities to the different plots are shown in Table 2.

TABLE 2. ACTUAL CHEMICAL FERTILIZER APPLICATION ON TEST PLOTS, OSC FIELD NO. 246

| TEST PLOT SECTION | 8-9 FEB. 1973 | 27 FEB. 1974 | | 9 MAY 1973 | | 20 JUNE 1973 | | 8 AUG. 1973 | | TOTAL FERTILIZER APPLICATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P[*] | N[†] | K[‡] | N[†] | K[‡] | N[†] | K[‡] | N[†] | K[‡] | P[*] | N[†] | K[‡] |
| | lb/acre[§] | | | | | | | | | | | |
| A | 152 | 95 | 47 | 100 | 50 | 110 | 65 | 75 | 66 | 152 | 380 | 228 |
| B | 152 | 95 | 47 | 80 | 50 | 40 | 22 | | | 152 | 215 | 119 |
| C | 152 | 95 | 47 | 40 | 17 | | | | | 152 | 135 | 64 |

[*] As treble super phosphate; applied mechanically with initial seeding.
[†] As urea; applied by hand.
[‡] As muriate of potash; applied by hand.
[§] lb/acre x 1.121 = kg/ha.

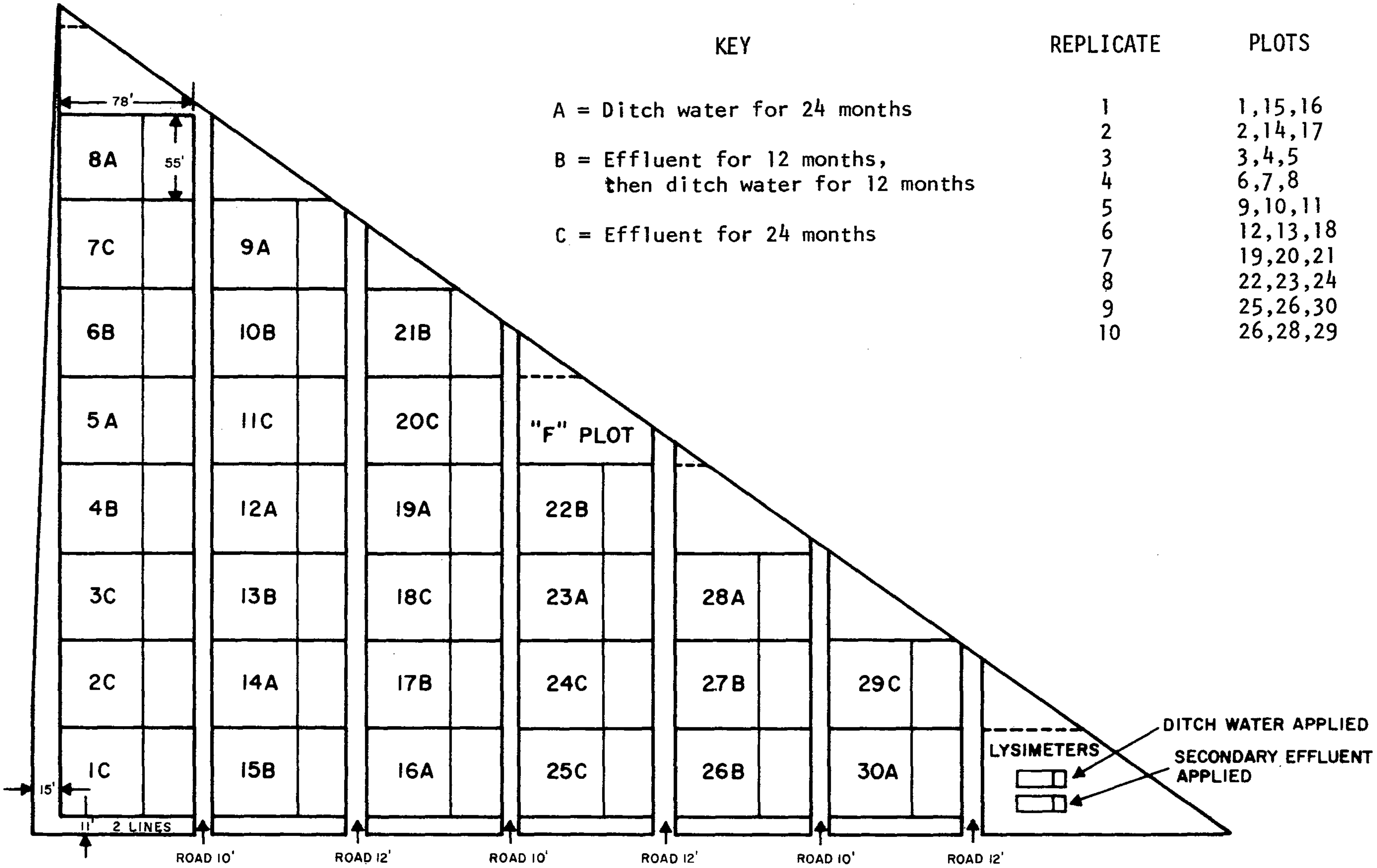
Ditch water application to all test plots was initiated on 15 February 1973 and was later repeated on 27 February, 2 and 14 March, and 4 April 1973. After the 4 April 1973 irrigation, only "A" plots received ditch water, "B" plots received effluent through 1973 and ditch water in 1974 and "C" plots received only effluent after 4 April 1973. The actual quantity of ditch water applied to the furrows, due to the method of application by the use of flumes with no flow control, is difficult to determine to a high degree of accuracy, however, by rough measurements it is estimated to average, including rainfall, approximately 13.97 cm (5.5 in.) every 2 weeks. This quantity of application, which is considered in the optimum range for sugarcane growth in central Oahu, is nearly one-third more than the irrigation water being applied to the water-short adjacent sugarcane fields.

Secondary effluent was pumped from the Mililani STP to the test plots through 1524.0 m (5000 ft) of 7.6 cm (3 in.) PVC pipe at a rate of approximately 7.89 ℓ/sec (125 gpm) with a static lift of approximately 30.5 m (100 ft). The secondary effluent, after being delivered to the test plot area, is distributed to the furrows of the test plots through PVC pipes with 2.54-cm (1-in.) openings at each furrow. The application rate for satisfactory advance time in the furrows of the effluent irrigated plots was 1.26 ℓ/sec (20 gpm) per plot. To supply this required three 4542-ℓ (1200-gal) interconnected storage reservoirs and a booster pump which were installed at the test plot site. The ditch water irrigation of the "B" plots during 1974 was also done through the booster pump and the pipe distribution system, rather than through the flumes used for the "C" plots, so that the water application could be metered more precisely.

Secondary effluent applications to the "B" and "C" plots were initiated on 13 April 1973 and followed with due consideration given to soil moisture stresses and periods of heavy precipitation. Soil tension was maintained at less than 0.5 bar (7 psi) at 45.72 cm (18 in.) below the bottom of the furrow. Four days were needed, with the available manpower and equipment, to complete both the ditch water and secondary effluent irrigation to all 30 test plots. Replicate plot series, however, were irrigated sequentially so that the interval between irrigation was nearly identical. Not only the physical factors, but also the changing nitrogen concentration in the secondary effluent caused difficulty in determining both the hydraulic and nutrient loads for the replicate test plots.

In order to monitor the chemical constituents in the soil water, a total of 50 ceramic point samplers (similar to those used in the Field No. 240 test plot) were installed in test plots 10, 11, 19, 20, and 21 of Field No. 246. The point samplers were placed at one of two separate depths--just above the tillage pan and approximately 15.24 cm (6 in.) below the tillage pan. The tillage pan produced by plowing averages approximately 22.86 cm (9 in.) below the bottom of the furrow. The sampling less than 0.5-bar suction (7 psi) from these point samplers commenced in April 1973.

Two 1.52 x 2.74-m (5 x 9-ft) metal field lysimeters, 1.52-m (5 ft) deep, were installed along furrow lines adjacent to the test plots in Field No. 246 as shown in Figure 2. A plan view and cross section of the 2 lysim-



KEY

A = Ditch water for 24 months

B = Effluent for 12 months,
then ditch water for 12 months

C = Effluent for 24 months

| REPLICATE | PLOTS |
|---|---|
| 1 | 1,15,16 |
| 2 | 2,14,17 |
| 3 | 3,4,5 |
| 4 | 6,7,8 |
| 5 | 9,10,11 |
| 6 | 12,13,18 |
| 7 | 19,20,21 |
| 8 | 22,23,24 |
| 9 | 25,26,30 |
| 10 | 26,28,29 |

FIGURE 2. TEST PLOT LAYOUT FOR IRRIGATION AND FERTILIZATION PRACTICES, OSC FIELD NO. 246

eters are illustrated in Figure 3. The lysimeter designated "D" refers to ditch water application and "E" refers to secondary effluent application. Percolate samples were pumped from a collection well at the bottom of the lysimeter. Both lysimeters have sugarcane stalks growing along their lengths which in turn are aligned with the furrows they intersect. Also shown in Figure 3 inside the pit at the head of each lysimeter, are nine 91.44-cm (36-in.) long horizontally positioned ceramic-point samplers that are set at 22.86-cm (9-in.), 45.72-cm (18-in.), and 60.96-cm (24-in.) depths. The 91.44-cm (36-in.) horizontal samplers are thus able to collect leachate soil water samples under 0.5-bar suction (7 psi) from not only the intersected furrow, but also from the adjacent furrows on each side of the lysimeters. The horizontal samplers placed at 45.72-cm (18-in.) and 60.96 cm (24-in.) depths collected soil water from undisturbed soil. Analysis of leachate collected from the lysimeters and ceramic point samplers began in the latter part of June 1973.

Lysimeters D and E complement a nearly 1.22-m (4-ft) diameter x 1.52-m (5-ft) deep hydraulic stainless steel lysimeter, illustrated in Figure 4, that was installed at the Mililani STP grounds in the first year of the study. The top of the hydraulic lysimeter, which has a Bermudagrass-sod growing on repacked soil and positioned level with the surrounding grass-covered ground surface is supported by water-filled tubes that are connected to a gage and recorder to provide a continuous record of the lysimeter's weight. This design provides an opportunity to determine both water or secondary effluent application and evapotranspiration losses. Percolate passing through the hydraulic lysimeter was collected at the bottom or at various depths through ceramic point samplers. The grass-sod lysimeter, which was operated and monitored continuously since January 1972, received secondary effluent when the surrounding area was irrigated in addition to receiving effluent during certain experimental program phases.

A bare soil (fallow) lysimeter, identical in size to lysimeters D and E (Fig. 3), except that it was equipped with an hydraulic device similar to that shown for the grass-sod lysimeter (Fig. 4), was operated from August 1973 through February 1975, with an interruption during 1 to 17 April 1974 when an electric transformer station was constructed at the original bare soil lysimeter site. Porous PVC (PORVIC) tubes, 1.22-m (4-ft) long, were set at 10.16-, 22.86-, 45.72-, and 60.96-cm (4-, 9-, 18-, and 24-in.) depths with-

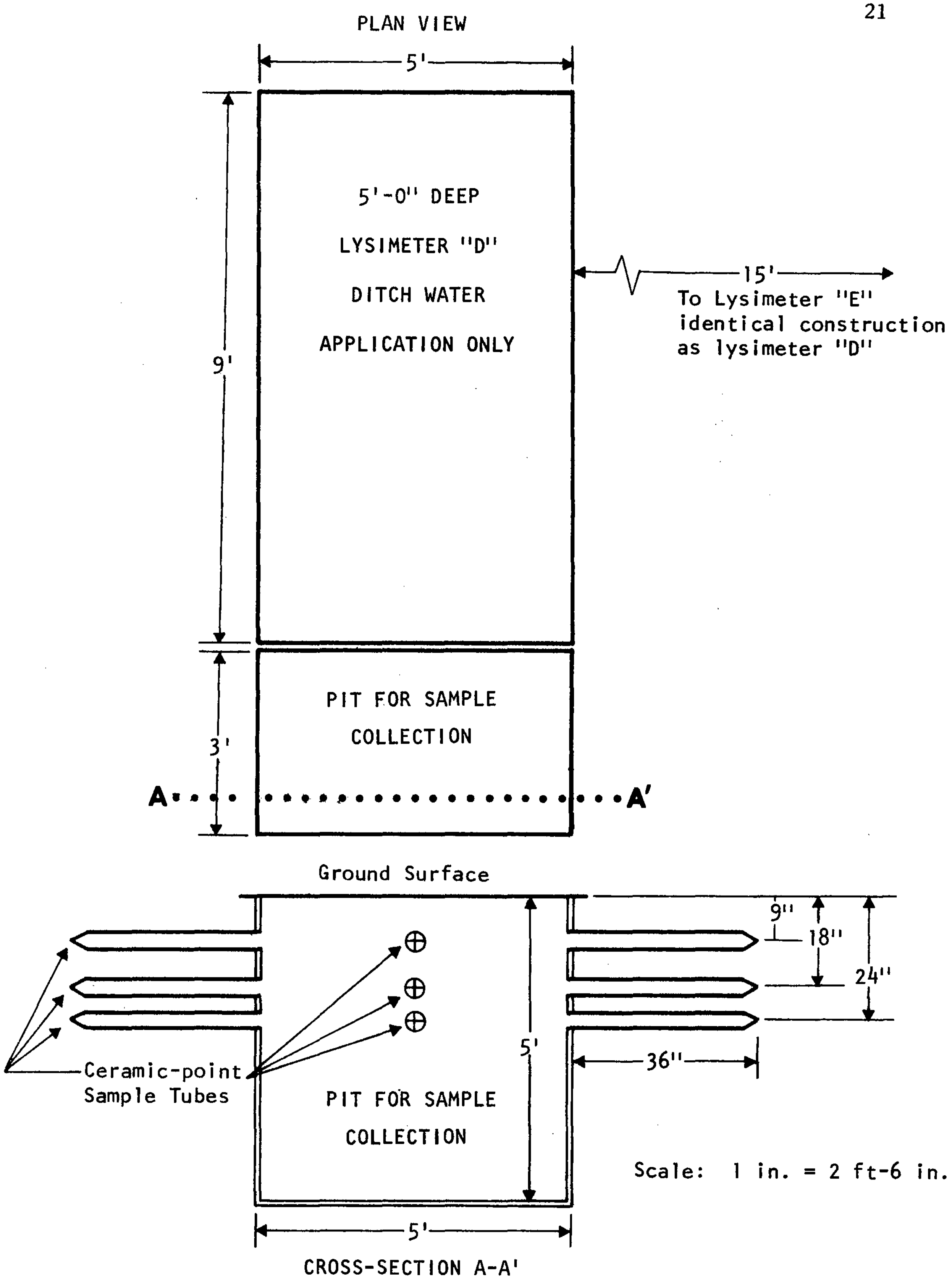


FIGURE 3. PLAN AND CROSS-SECTION VIEWS OF 5-FT DEEP LYSIMETERS INSTALLED IN THE TEST PLOTS OF OSC SUGARCANE FIELD NO. 246

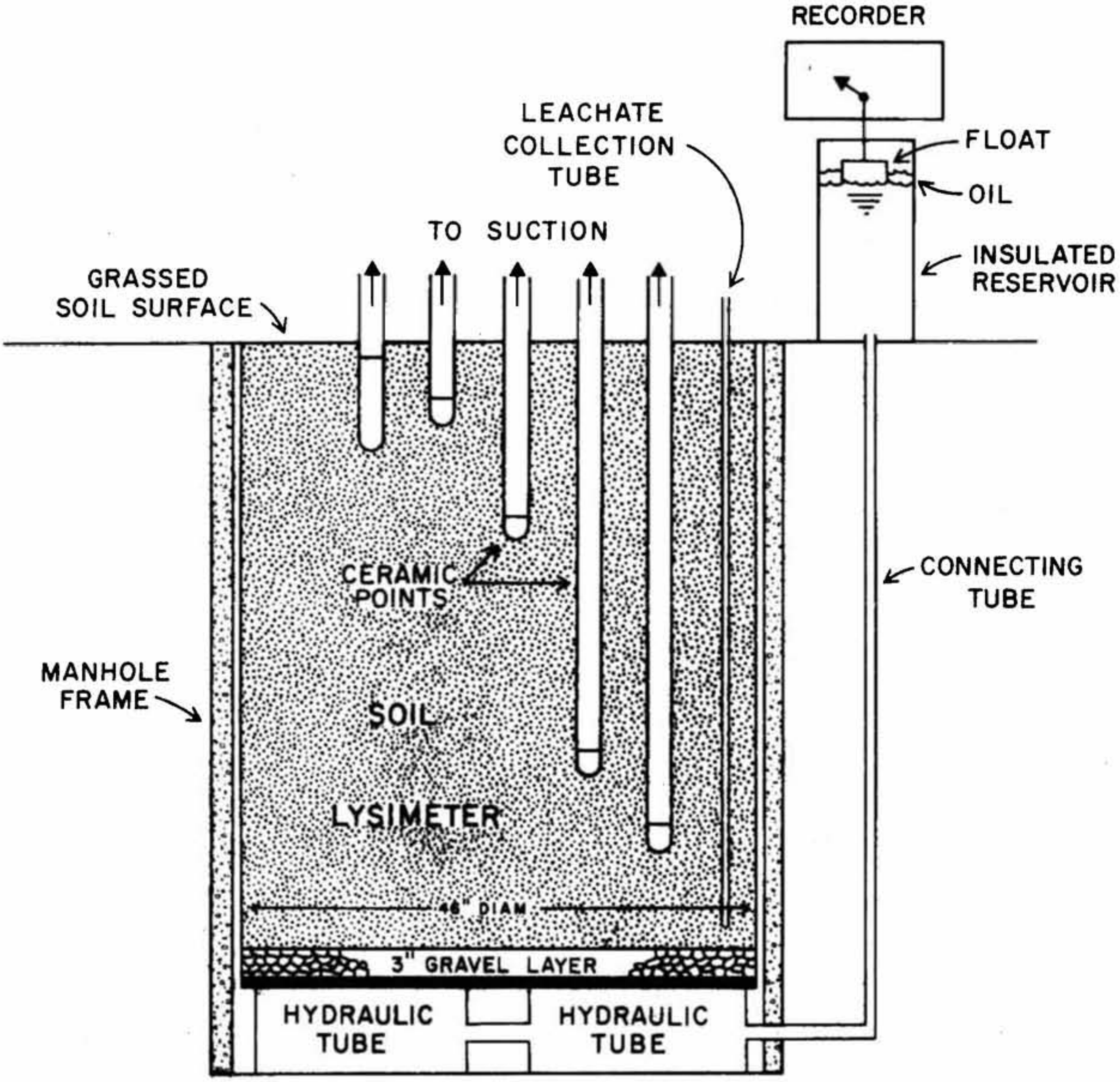


FIGURE 4. DIAGRAM OF THE 5-FT DEEP SOD LYSIMETER

in the lysimeters. Through these tubes, soil water samples as great as 1 ℓ/min (0.26 gal/min) were removed under 0.1-bar (1.45-psi) suction to aid in viral transmission studies. Measurements were made of both the water and chemical budgets when irrigation with secondary effluent was applied. Similar porous tubes were set horizontally into undisturbed soil from the pit at the head of the lysimeter. The site of the second phase of operation was approximately 46 m (150 ft) from the original site. The bare soil was operated to not only ascertain the water budget but also the leachate composition when irrigation with secondary effluent was applied to bare soil. Leachate from the ceramic points and bottom of the lysimeters was pumped out on a regular basis for characterization.

Periodic sugarcane growth parameter analyses were scheduled to be conducted throughout the sugarcane culture cycle. Crop logs, which include analysis of moisture, plant nutrients, and sugar, performed on samples from the sheath and blade, were conducted during the entire sugarcane growth cycle until harvest. Stand density was monitored periodically during the early stages of crop growth. Leaf punch samples for leaf nitrogen status were taken monthly during periods when crop log samples were not obtained.

The laboratory activities conducted for the project can be classified into the following general categories of analyses: standard water and sewage quality analyses which include major cations (calcium, magnesium, sodium, and potassium) and anions (carbonate, bicarbonate, sulfate, chloride, and nitrate), pH, total dissolved solids, conductivity, suspended solids, biochemical oxygen demand, total organic carbon, total phosphate, nitrogen series, silica dioxide, boron, grease, and fecal and total coliforms, pesticides, heavy metals, soils, and enteric viruses.

Pesticides, heavy metals, and soil chemical constituent analyses were performed on an infrequent basis, while the standard water and sewage quality and viruses analyses have been conducted on a fairly intense regular basis. The standard water and sewage quality analyses are in accordance with well-established laboratory procedures (APHA, AWWA, WPCF 1971; Strickland and Parsons 1972).

## VIRAL STUDIES

Viral studies were conducted to accomplish the following project objectives:

1. To determine the concentration and the identification of human enteric viruses in the Mililani STP raw sewage and treated effluent
2. To assess the efficiency of the present sewage treatment process in removing viruses found in the raw sewage
3. To determine whether viruses present in the recycled sewage effluent can percolate through the soil and potentially contaminate the underground water source
4. To determine the fate of viruses in the effluent used to irrigate sugarcane and evaluate the hazard they may represent to the field workers and possibly to the surrounding communities.

Viral studies for the project required the development of special assay techniques and a complete virus laboratory. The established virus laboratory represents the first facility of its kind in Hawaii and is one of the few similar facilities in the nation.

## Materials and Methods

CELLS AND MEDIA. African green monkey kidney cells, either primary, secondary or tertiary passaged (AGMK) of an established line (BGM) as well as the human diploid cells, WI-38, were used for virus isolation and growth. The mouse L-cells were used to plaque and identify reoviruses while the established rhesus monkey kidney cells (LLC-$MK_2$) was used in many of the enterovirus identification tests. All cell lines were grown in Eagle's basal medium using either Hank's or Earle's salt and supplemented with 5 to 10% fetal calf serum.

VIRUS AND VIRAL ASSAY. Stock pools of poliovirus type 1, originally isolated from a case in Hawaii and prepared in BGM cells and purified by isopycnic banding in CsCl, were used to evaluate the various viral concentration methods used. The Sabin type 1 attenuated poliovirus strain was used as a control in the test to determine the genetic temperature marker (T) of the poliovirus isolates. Viral growth was quantified by using either the 50% tissue culture infectious dose ($TCID_{50}$) method under liquid overlay or as plaque forming units (PFU) under agar overlay. The isolated enteroviruses were identified by the neutralization test using the Lim-Benyesh-Melnick pooled antisera as described and supplied by the NIH (1972). Reovirus was identified using the fluorescent antibody technique (Spendlove et al. 1963).

WATER SAMPLES AND SAMPLING SITES. The sewage effluent from the Mililani STP was used throughout the study; however, comparative sewage samples were obtained from the Wahiawa STP (secondary treatment-activated sludge with chlorination) and Pearl City STP (primary treatment with chlorination). The sewage samples were collected by the grab method. Soil water percolates were obtained from the grass-sod lysimeter (Fig. 4) on the Mililani STP grounds, lysimeter E (Fig. 3) in the test plots of OSC Field No. 246, and bare soil lysimeter (Fig. 3). All water samples were transported back to the laboratory and immediately processed or stored overnight at 4°C. Water samples were clarified initially by filtration through an AP-25 fiberglass pad (Millipore Corp.) before they were concentrated and the final concentrates were freed of bacteria by filtration through a 10% calf serum or 3% beef extract washed, 0.45-μ membrane filter (Millipore Corp.).

## Methods of Sample Concentration

The relative paucity of information regarding viruses in sewage has been due to the limitations of the available techniques to efficiently concentrate water-borne viruses which are diluted in large volumes of water. Based on previous published reports, the following methods to concentrate viruses were selected (App. B):

| Method | Source |
|---|---|
| Polyelectrolyte-60 (PE-60) (Batch) | Sewage effluent |
| Polymer two-phase | Sewage effluent |
| PE-60 (Sandwich) | Soil percolates |
| Membrane adsorption | Soil percolates |

The above methods were modified for the project and were used primarily for the isolation of human enteroviruses. Other methods employed were the protamine sulfate and $Al(OH)_3$ (aluminum hydroxide) methods which were used to preferentially isolate reovirus and adenovirus from sewage samples.

## Results

EVALUATION OF CONCENTRATION METHODS. The efficiency of the concentration methods used in this study was evaluated by adding $10^3$-$10^5$ PFU/mℓ of poliovirus type 1 to a known volume of Mililani STP sewage effluent and the sample concentrated by the selected methods. The resulting concentrate was assayed for virus and the virus recovery efficiency determined.

The results (Table 3) show that the efficiencies of the various methods to remove the added type 1 poliovirus from the sample and to recover them in the final concentrate varied were comparable to those obtained by other laboratories. As has been the experience of most other investigators (Hill, Akin, and Benton 1971; Berg 1973), none of the concentration methods approached 100% efficiency of virus recovery under field conditions, indicating that much improvement is still needed in this area. Although the polymer two-phase method resulted in the highest recovery efficiency (68%), it was severely limited for practical reasons to only 4 to 6 ℓ of sample. The protamine sulfate had been reported to be selective for the larger viruses (reovirus and adenovirus) rather than the smaller enteroviruses. Our results indicate that the efficiency of the protamine sulfate method may be dependent on the strain or perhaps the past history of the enterovirus as the method was ineffective in concentrating our laboratory strain of type 1 poliovirus but was relatively effective in concentrating a recent isolate of type 1 poliovirus. The $Al(OH)_3$ method became cumbersome as the volume of the sample was increased over 3.785 ℓ (1 gal). Technically, the PE-60 (Batch) method was the most feasible and volumes up to 18.93 ℓ (5 gal) of sample could be easily processed. However, the PE-60 lot obtained from Monsanto varied greatly in their efficiency to adsorb virus and, at

TABLE 3. VIRAL CONCENTRATION METHODS AND THEIR RELATIVE EFFICIENCIES

| METHOD | SUSPENDING MEDIUM | TOTAL VOLUME | STRAIN OF TYPE 1 POLIOVIRUS ADDED | % OF VIRUS REMOVED | % OF VIRUS RECOVERED |
|---|---|---|---|---|---|
| PE-60 (Batch) | Chlorinated Effluent | 1 ℓ | Laboratory Strain | 42 | 36 |
| Two-Phase | " | " | Laboratory Strain | 79 | 68 |
| Protamine | " | " | Laboratory Strain | 10 | 3 |
| Sulfate | " | " | Field Isolate | 66 | 60 |
| $Al(OH)_3$ | " | " | Laboratory Strain | 97 | 44 |
| Membrane Adsorption | Soil Percolate | 5 gal | Laboratory Strain | 92 | 40 |
| PE-60 (Sandwich) | " | " | Laboratory Strain | 41 | 35 |

NOTE: Concentration used $10^3$-$10^5$ PFU/mℓ.

best, only 36% of the added poliovirus was recovered. Both the membrane adsorption and PE-60 (Sandwich) methods are limited to processing only clean waters and up to 94.63 ℓ (25 gal) of soil percolates were processed by these methods with the expectation of approximately 35 to 40% efficiency of virus recovery.

VIRAL ASSESSMENT. To determine the concentration of human enteric viruses in raw sewage and the effectiveness of the sewage treatment processes in reducing the concentration, 1.89 ℓ to 18.93 ℓ (0.5 to 5.0 gal) of either the raw, activated sludge treated or the final chlorinated effluent from Mililani STP were concentrated and assayed for enteric viruses for a period of over 2 yr. It was found (Table 4) that 11/11 (100%) of the raw sewage tested positive for virus at concentrations ranging from 43 to 19,000 PFU/ℓ, while 13/17 (76%) of the activated sludge treated effluent tested were positive at concentrations ranging from 7 to 5,222 PFU/ℓ. In the final chlorinated effluent, 31/53 (58%) of the samples tested were positive for viruses at concentrations ranging from 2 to 750 PFU/ℓ. These results show that the raw, domestic sewage always contains infectious human viruses and often at a relatively high concentration. Furthermore, it should be noted that although sewage treatment at the STP effectively reduces this concentration of viruses, the final treated sewage effluent still contains infectious viruses in 58% of the samples assayed with a concentration as high as 750 PFU/ℓ. The consistent isolations of human enteric viruses from raw sewages and their persistence although at reduced concentrations after the raw sewage had undergone standard secondary sewage

TABLE 4. VIRAL ISOLATES AND SOIL PERCOLATE FROM MILILANI STP SAMPLES

| SOURCE OF SAMPLES | NO. OF SAMPLES TESTED | LITERS OF SAMPLE ASSAYED | NO. AND % OF SAMPLES POSITIVE FOR VIRUS | RANGE OF VIRUS CONCENTRATION (PFU/ℓ) |
|---|---|---|---|---|
| Raw Sewage | 11 | 1-6 | 11 (100%) | 27-19,000 |
| Unchlorinated Effluent | 17 | 2-16 | 13 (76%) | 7-5,222 |
| Chlorinated Effluent | 53 | 5-20 | 31 (58%) | 2-750 |
| 5-ft Lysimeter Soil Percolate | 35 | 5-75 | 1 (2.9%) | * |

*Not tested.

treatment with final chlorination have also been reported by other investigators (Shuval et al. 1969; Berg 1973).

IDENTIFICATION OF VIRAL ISOLATES. The viruses isolated from the Mililani STP sewage samples were identified and correlated with the method of concentration, the date of isolation, and the source of sewage (Table 5). The results showed that over the 2-yr study period, the viruses most frequently isolated were poliovirus types 1, 2, and 3, as well as coxsackies B-4, B-5, and ECHO-7. From the present data, it was noted that the various methods of virus concentration employed were not inherently selective for any given type of virus. Different types of viruses were isolated by all of the concentration methods used and in certain experiments the same virus was isolated when two or more methods were used on the same sample.

Twenty-six of the enteroviruses isolated were identified as polioviruses and it is of public health significance to determine whether these isolates belong to either the attenuated (vaccine strain) or the virulent strains. One of the most stable genetic markers for poliovirus virulence is temperature (T). Virulent poliovirus has been found to grow effectively at both 37°C and 40°C (T+), whereas the attenuated strain grows well at 37°C but is inhibited at 40°C (T-). The T marker property of all the poliovirus isolates was determined and compared with the attenuated Sabin strain of poliovirus type 1. The isolates were considered T- when growth at 40°C was not greater than 1 $\log_{10}$ $TCID_{50}$ (tissue culture infectious dose) less than at 37°C, and were considered T+ when the difference between the growth at 37°C and 40°C was not greater than 1 $\log_{10}$ $TCID_{50}$. Of the 26 poliovirus isolates tested, only 3 isolates (type 1) were considered T+ or indicative of the virulent strain. It is apparent that most of the poliovirus isolates are of the attenuated strain and are the result of immunization practices. The presence of the wild strain indicates that the virus either is present endemically or has been introduced into the community. In any case, virulent poliovirus is still present and represents a potential public health problem.

It is interesting to note that ECHO-7 virus was isolated exclusively over a 3-mo span indicating that the Mililani community underwent an epidemic of ECHO-7 virus infection during this period. However, since only a small percentage of people infected with ECHO-7 virus will develop clinical symptoms, the community was probably unaware of its presence. On the

TABLE 5. VIRUSES IDENTIFIED IN MILILANI STP SEWAGE EFFLUENT

| DATE | METHOD | RAW SEWAGE | UNCHLORINATED EFFLUENT | CHLORINATED EFFLUENT |
|---|---|---|---|---|
| 07-05-72 | PE-60 | ECHO-1 | ............. | ............. |
| 07-18-72 | PE-60 | Coxsackie B-4 | Reo | ............. |
| 08-02-72 | Two Phase | Polio-1 | ............. | ............. |
| 08-29-72 | PE-60 | ............. | Coxsackie B-5 | ............. |
| 09-05-72 | Two Phase | ............. | Coxsackie B-5 | ............. |
| 09-12-72 | PE-60 | ............. | Polio-3 | ............. |
| 10-26-72 | ............. | ............. | ............. | Coxsackie B-5 |
| 11-21-72 | Two Phase | ............. | ............. | Coxsackie B-5 |
| 12-05-72 | ............. | ............. | ............. | Coxsackie B-5 |
| 12-07-72 | ............. | ............. | ............. | ECHO-7 |
| 12-12-72 | Two Phase | ............. | ............. | ECHO-7 |
|  | PE-60 | ............. | ............. | ECHO-7 |
| 12-18-72 | Two Phase | ............. | ............. | ECHO-7 |
|  | PE-60 | ............. | ............. | ECHO-7 |
| 01-03-73 | Two Phase | ............. | ............. | ECHO-7 |
|  | PE-60 | ............. | ............. | ECHO-7 |
| 01-09-73 | PE-60 | ............. | ............. | ECHO-7 |
| 01-16-73 | PE-60 | ............. | ............. | ECHO-7 |
| 02-13-73 | ............. | ............. | ............. | ECHO-1 |
| 02-20-73 | Two Phase | ............. | ............. | ECHO-7 |
|  | PE-60 | ............. | ............. | ECHO-27 |
| 03-27-73 | Two Phase | Coxsackie A-16 | ............. | ............. |
| 04-19-73 | Two Phase | Polio-1 | ............. | ............. |
| 05-10-73 | Two Phase | Coxsackie B-5 | ............. | ............. |
| 05-15-73 | Two Phase | ............. | Polio-3 | ............. |
| 05-22-73 | PE-60 | ............. | Polio-2 | Reo |
| 05-23-73 | Two Phase | ............. | Coxsackie B-5 | ............. |
| 06-01-73 | Prot. Sulfate | ............. | ECHO-1 | ............. |
| 07-17-73 | $Al(OH)_3$ | ............. | ............. | Reo |
| 08-14-73 | $Al(OH)_3$ | ............. | ............. | Polio-2, -3 |
| 09-11-73 | PE-60 | ............. | ............. | Polio-2 |
| 09-27-73 | $Al(OH)_3$ | ............. | ............. | Coxsackie B-4 |
| 10-02-73 | Two Phase | ............. | ............. | ECHO-15 |
| 12-11-73 | Two Phase | Coxsackie B-4 | ............. | ............. |
|  | Prot. Sulfate | Coxsackie B-5 | ............. | ............. |
| 12-18-73 | Two Phase | Coxsackie B-4 | ............. | ............. |
|  | Prot. Sulfate | ............. | ............. | Polio-1 |
| 02-06-74 | Prot. Sulfate | ............. | Coxsackie B-4 | ............. |
|  | Two Phase | ............. | Coxsackie B-5 | ............. |
|  | PE-60 | ............. | ............. | Coxsackie B-4 |
| 02-13-74 | Prot. Sulfate | ............. | Coxsackie B-5 | ............. |
|  | PE-60 | ............. | ............. | Polio-1 |
| 02-20-74 | Prot. Sulfate | ............. | ............. | Polio-3 |
|  | PE-60 | ............. | ............. | Polio-3 |
| 02-27-73 | Two Phase | ............. | ............. | Polio-3 |
|  | PE-60 | ............. | ............. | Polio-3 |
| 03-20-74 | PE-60 | ............. | ............. | Polio-2 |
| 04-03-74 | PE-60 | ............. | ............. | Polio-1 |
| 04-29-74 | Two Phase | Polio-1, -3 | ............. | ............. |
| 07-13-74 | Two Phase | ............. | ............. | Polio-1 |
| 08-06-74 | PE-60 | ............. | ............. | Polio-1 |
| 08-29-74 | Two Phase | ............. | ............. | Polio-1 |

other hand, polioviruses and coxsackie B-4 and B-5 viruses appear to be endemic in Mililani, as these viruses were isolated from the sewage throughout the testing period.

STP SAMPLE COMPARISON. Since Mililani STP processes sewage from a small, strictly residential community, the question was raised whether the results obtained were typical of all other sewage treatment plants in the state. Sewage samples from two other sewage treatment plants which serve much larger residential communities, including industrial and commercial land uses were obtained and assayed for viruses.

The Wahiawa STP employed settling, activated sludge, and chlorination while the Pearl City STP employed only settling and chlorination. As was found for the Mililani STP, 100% of the raw sewage samples tested from both the Wahiawa and Mililani STPs were positive for virus (Table 6).

TABLE 6. VIRAL ISOLATES FROM OTHER SEWAGE TREATMENT PLANTS

| SOURCE OF SAMPLE | NO. OF SAMPLES TESTED | NO. OF POSITIVE SAMPLES | TYPES OF VIRUS IDENTIFIED | RANGE OF VIRUS CONCENTRATION (PFU/ℓ) |
|---|---|---|---|---|
| A. Wahiawa STP | | | | |
| 1. Raw Sewage | 2 | 2 | ECHO-15,<br>Polio-1,<br>Coxsackie B-5 | 50-118 |
| 2. Chlorinated Effluent | 9 | 2 | Polio-3, -2 | * |
| B. Pearl City STP | | | | |
| 1. Unchlorinated Effluent | 2 | 2 | Coxsackie B-2, | 5-268 |
| 2. Chlorinated Effluent | 2 | 2 | ECHO-15,<br>Coxsackie B-4,<br>Coxsackie B-5,<br>Polio-3 | 25-34 |

*Not tested.

Furthermore, the sewage treatment processes of both plants were not capable of completely destroying the viruses in raw sewage. It was noted that the kinds and concentrations of viruses isolated were similar to that found at the Mililani STP and indicate that the wastes were primarily of human origin.

PERCOLATION OF SEWAGE-BORNE VIRUSES THROUGH THE SOIL. Since viruses were shown to be present in the chlorinated effluents which were used to irrigate the sod and sugarcane lysimeters, the possibility existed that these sewage-borne viruses might percolate through the soil and eventually contaminate the underground water sources. To test this possibility, chlorinated effluent was applied to the 1.5-m (5-ft) deep sugarcane lysimeter E and sod lysimeter. At different times during a 2-yr period, percolate lysimeter samples in quantities ranging from 18.93 ℓ to 94.63 ℓ (5 to 25 gal) were collected, concentrated, and assayed for virus. Only one of 28 percolated samples obtained from the sod lysimeter was positive for virus, while none of the 7 percolate samples obtained from lysimeter E yielded viruses. The possibility that the single virus isolated may represent a laboratory contaminant cannot be ruled out. However, the identification of this isolate, coxsackie B-5, as one of the predominant viruses found in the Mililani sewage, and the fact that this virus was not being used in the laboratory argues against this. Although it was not possible to determine the probability of virus movement through the soil profile, the results indicate that the viruses in the sewage effluent are retained effectively by the 1.5-m (5-ft) deep soil lysimeter.

SURVIVAL OF THE SEWAGE-BORNE VIRUSES IN SUGARCANE FIELDS. Since viruses were found in the sewage effluents used to irrigate the sugarcane, the important question on the fate and extent of viruses present in the cane field was examined. Briefly, 2 to 100 g of surface soil samples were obtained from the effluent-irrigated cane field and were treated in the laboratory with borate buffer plus 10% calf serum (final pH 9-10) in order to elute the viruses adsorbed to the surface soil. Of 30 different soil samples assayed, only one soil sample which was obtained immediately after irrigation with the effluent was positive for virus (poliovirus type 1). This extremely low frequency of virus recovery from the soil was found to be due in part to the inefficient elution of virus from the soil, an efficiency which became poorer as the size of the soil sample increased (see following Corollary Studies section). Recognizing the limitations in sampling and processing of soil samples, it is difficult at present to make any generalization as to the extent of virus contamination of the soil in the irrigated cane field. It is clear, however, that sewage-borne viruses are applied to the sugarcane field, but that these viruses are not accumulated at the soil surface in an infectious form which can be easily dissociated from the soil.

**COROLLARY STUDIES USING TYPE I POLIOVIRUS AS A MARKER.** The results of the field studies (Percolation of Sewage-Borne Viruses; Survival of Sewage-Borne Viruses) have yielded no evidence as to the extent and the possible mechanism of virus-soil interactions. In order to obtain a clearer understanding of the interaction of viruses with soil, poliovirus type 1 was added to the Lahaina type soils and the fate of the virus followed. It should be clearly understood that these experiments using added poliovirus as a marker are not directly analogous to natural field conditions. This is especially true with the extremely high concentrations of virus added, a concentration one would never expect to approach under natural field conditions but that was used in these experiments in order to facilitate dections but that was used in these experiments in order to facilitate detection of virus. Nevertheless, similar mechanisms of virus soil interactions are very likely to operate whether under natural or artificially created field conditions. Information obtained from these experiments, therefore, can provide useful data of the mechanisms and virus-soil interactions in operation and, when extrapolated, provide some reasonable explanation of the fate of enteroviruses in the soil under normal irrigation practices.

probability of virus movement through the soil profile under field conditions, poliovirus at concentrations ranging from $10^7$ to $10^{10}$ PFU was added to 3.79 $\ell$ to 204.39 $\ell$ (1 to 54 gal) of Mililani chlorinated effluent and either dripped or poured onto the surface of the sod lysimeter, bare soil lysimeter, and the undisturbed soil plot, respectively. Additional water was added daily and the water passing through the soil profile was collected by using a suction pump attached to ceramic points at various depths. The results (Table 7) show that the maximum depth at which poliovirus was detected was 117 cm (46 in.) in the sod lysimeter 91 cm (36 in.) in the bare soil lysimeter, and 38 cm (15 in.) in the undisturbed soil profile. These results indicate that virus movement through the soil profile is not extensive and that naturally packed soil appears to be a better retardant of virus movement than repacked soil.

**The Virus-Soil Interaction Mechanism.** The field study (p. 37) indicated that virus movement through the soil was being retarded effectively.

TABLE 7. POLIOVIRUS MOVEMENT AND SURVIVABILITY IN LAHAINA SOILS: MARKER EXPERIMENT

| TEST SITE | ENVIRONMENTAL CONDITIONS | SURFACE FOLIAGE | SURFACE MOISTURE | SUN-LIGHT | TEMPERA-TURE | VIRUS RECOVERY FROM SOIL PERCOLATES MAXIMUM DEPTH | VIRUS RECOVERY FROM SOIL SURFACE MAXIMUM DURATION |
|---|---|---|---|---|---|---|---|
| Sod Lysimeter | Field | Short grass | Wet-Dry | Direct | 10-40°C | 46 in. | 9 days |
| Bare Soil Lysimeter | Field | None | Wet-Dry | Direct | 10-40°C | 36 in. | 7 days |
| Undisturbed Soil Plot | Field | None | Wet-Dry | Direct | 10-40°C | 15 in. | 8 days |
| Lysimeter E | Field | Tall cane plant, thick underbrush | Wet-Dry | None | 10-20°C | * | 61 days |
| Laboratory | Refrigeration | None | Damp | None | 4°C | * | 108 days |

*Not tested.

However, it was not possible to determine whether virus movement was being retarded by the sieving or adsorptive capacity of the soil. To differentiate between these two mechanisms, Lahaina type soil samples taken from the test field site were returned to the laboratory. Initially, a thin soil column measuring 47 mm in diameter and 6 to 12 mm deep (20 g of soil) was made in a Millipore filtre apparatus and wetted with water. To this was added $10^4$ to $10^6$ PFU of the poliovirus in 10 to 20 mℓ of water which was allowed to percolate by gravity through the soil column. The filtrate was assayed for virus and found to contain approximately 1% of the added virus. The thinness of the soil column precluded efficient sieving of virus and indicated that the soil was an effective adsorbent of viruses. To reaffirm more conclusively that the soil was an efficient virus adsorbent, $10^4$ to $10^6$ PFU of poliovirus in 20 to 100 mℓ of water were added to a flask containing 20 to 40 g of soil and mixed well for 15 to 60 min at room temperature. The entire mixture was then centrifuged at 10,000 rpm for 10 min to pellet the soil particles and the supernatant assayed for virus. Again, less than 1% of the added virus was detected in supernatant indicating that greater than 99% of the virus was adsorbed to the soil particles. Based on these results, it is concluded that the primary mechanism by which soil retards virus movement is by adsorption of viruses. It is of interest to note that the Lahaina type soil is comprised of a high concentration of iron oxide which, in its purified form, is an excellent adsorbent of viruses.

Since poliovirus was shown to adsorb to soil, two obvious questions arise. First, can the soil lose its adsorptive capacity especially after prolonged treatment with sewage effluent and, secondly, can viruses already adsorbed to the soil be readily eluted in an infectious form? Experiments dealing with both questions are presently being made.

Preliminary experiments on the first question employing three thin soil columns pretreated for 1 hr with water and Mililani chlorinated effluent on 10% calf serum indicated however, that while pretreatment of the soil column with either water or sewage effluent did not interfere with its adsorptive capacity for virus, pretreatment with 10% calf serum reduced virus adsorption by 32%. The early data suggest that some kind of concentrated proteinaceous material can interfere with the virus adsorptive capacity of the Lahaina type soils. While pretreatment of the soil with serum proteins is an artificially created condition, proteinaceous material is present in sewage effluents (Table 8).

TABLE 8. EFFICIENCY OF ELUANTS TO ELUTE SOIL-ADSORBED POLIOVIRUS

| ELUANT | FINAL pH | % OF ADDED POLIOVIRUS RECOVERED IN ELUATE |
|---|---|---|
| Water | 6.6 | <1 |
| Chlorinated Effluent | 7.7 | <1 |
| Borate Buffer | 8.9 | 25 |
| Borate Buffer + 10% Calf Serum | 9.3 | 43 |
| Borate Buffer + 10% Calf Serum | 10.4 | 45 |

To determine whether prolonged treatment of this soil with sewage effluent would appreciably reduce the soil's adsorptive capacity, soil samples were obtained from OSC Field No. 246 which had been irrigated with sewage effluent for at least 6 months. These soil samples retained their ability to effectively adsorb viruses, indicating that under normal field conditions of irrigation with sewage effluent, the capacity of Lahaina type soils to adsorb virus was not impaired appreciably.

In relation to the second question on the elution of infectious virus from the soil, preliminary experiments indicated that both unbuffered water and Mililani chlorinated effluents did not elute virus from the soil. It was found that a high pH of greater than 8 was required to efficiently elute virus. The data indicated that the bond between virus and soil was fairly stable and, since sewage effluents normally rarely attain a pH of 8 or greater, it does not appear likely that any extensive virus elution would result due to sewage-soil interactions. However, the long term effects of sewage effluent interactions on the soil-virus complex cannot be answered by these experiments.

Virus Survival Under Field Conditions. Another pressing question, concerning sewage-borne viruses in irrigation water, is the expected duration of their survival under field conditions. In an attempt to answer this question, 1.89 to 18.93 ℓ (0.5 to 5.0 gal) of water containing $10^6$ to $10^{10}$ PFU of poliovirus were sprinkled over a 0.91 x 1.5 m (3 x 5 ft) surface area of the test plot site. Five grams of top soil were collected at different time intervals and the virus that was complexed to these soil samples were eluted by 15-min treatments with 10 mℓ of borate buffer plus 10% calf serum at a final pH of 9 to 10. The resulting eluates were centrifuged for 10 min at 10,000 rpm to pellet the soil particles and the pH of the supernatant was readjusted to 7 to 7.5 with 0.6 N HCl. This supernatant was then filtered through a 0.45-μ membrane filter (Millipore, type HA) to remove contaminating bacteria and fungi and assayed for virus. The results (Table 7) show that infectious virus was recovered 61 days after seeding lysimeter E, but only 7, 8, and 9 days after seeding the bare soil lysimeter, undisturbed soil plot, and sod lysimeter, respectively. In a separate experiment, poliovirus was added to Lahaina soil and stored in a refrigerator. After 108 days, infectious virus was recovered readily on the last test day from this soil sample. These results clearly show that survival of viruses in the soil is dependent on the environmental conditions which are known to be fatal to poliovirus, namely high temperature, ultraviolet light (sunlight), and dessication. Thus, poliovirus survived longest in the refrigerator which was kept cold (4°C), humidified, and free of ultraviolet light. Even under field conditions (lysimeter E) when the soil was always moist, relatively cool, and hidden from the sunlight by the tall sugarcane canopy and the thick underbrush, poliovirus survived for at least 61 days. On the other hand, when the soil was exposed directly to the elements, such as sunlight, dessication, and periods of high temperature, perhaps 40°C, poliovirus survival time was reduced drastically to 7 to 9 days post seeding.

Survival of Soil-Bound Virus Following Cane Field Burning. Prior to cane harvesting, the entire field is burned to eliminate the leafy plant parts and the fallen trash. To determine whether this procedure can be relied upon to purify the soil of any residual viruses, 7 identical aluminum cans, measuring 6.35 cm (2.5 in.) in diameter and 4.44 cm (1.75 in.) in depth, were filled with soil taken from the cane field and $2 \times 10^7$ PFU of type 1 poliovirus was added to each of these 7 soil samples. One of these soil samples was kept as a control, while the remaining 6 cans of soil samples were placed in the ridges and furrows of 3 different irrigation ditches in field lysimeter E. The cans were carefully placed to ensure that the level of the soil in the can was equal to that of the ground. The burning of the cane in field lysimeter E was started within 10 min of emplacing the soil sample containers and the entire field was completely burned out in 30 min. Five minutes after the burn, the soil in the cane field was barely warm and the soil samples were recovered and returned to the laboratory. Equal aliquots of soil sub-samples were taken from the center of each can and the adsorbed virus eluted as described previously. All recoveries were compared with the recovery obtained from the control soil sample. The results (Table 9) show that the field burning procedure inactivated from 0 to 93% of the poliovirus added to the soil samples. As was expected, the virus in the soil samples which were closer to the surface (ridge samples) appeared to be destroyed more effectively by the burn-

TABLE 9. EFFECT OF BURNING FIELD ON SOIL-BOUND POLIOVIRUS: MARKER EXPERIMENTS

| FIELD NO. 246 SITE OF SOIL-BOUND VIRUS | VIRUS RECOVERED PFU/mℓ x $10^3$ | PERCENT VIRUS INACTIVATED |
|---|---|---|
| Unexposed Soil (control) | 216 | 0 |
| Furrow of Irrigation Ditch #20 | 230 | 0 |
| Ridge of Irrigation Ditch #20 | 14 | 93 |
| Furrow of Irrigation Ditch #18 | 112 | 48 |
| Ridge of Irrigation Ditch #18 | 136 | 37 |
| Furrow of Irrigation Ditch #16 | 100 | 54 |
| Ridge of Irrigation Ditch #16 | 62 | 71 |

ing procedure than the virus in the soil samples planted in the deeper furrows of the irrigation ditches. These results indicate that the burning procedure will inactivate soil-bound virus in the cane field, but that the extent of virus inactivation was variable and not excessively effective.

## CROP AND SOIL RESPONSES TO EFFLUENT-IRRIGATION IN THE TEST PLOTS

The major study objectives of the OSC Field No. 246 test plots were: to determine whether satisfactory cane and sugar yields can be produced by using sewage effluent for sugarcane irrigation, and to determine the possible changes in the soil properties when sewage effluent is used to irrigate sugarcane. It should be understood that the findings are related to the soil type, cane variety, and weather conditions encountered in this experiment and may not necessarily be transferable to other situations if these factors are changed.

### Fertilization Programs

In addition to the portion of the crop cycle to which sewage effluent was applied in the three different types of test plots A, B, and C, each type had to be fertilized (with commercial fertilizers) on a different schedule because of the nutrient content of the effluent. After considering present plantation practices, results of soil analysis and nutrient levels in the effluent, the fertilization schedule that was agreed on is presented in Table 10. The amounts of commercial fertilizers applied at planting was considered necessary to obtain a rapid and uniform start for the crop. In the fertilization program, N is the most critical element under most conditions because it has the greatest influence on cane tonnage, and cane and juice quality. The extra 28.03 kg/ha (25 lb/acre) N scheduled for the C plots was necessary to keep water application equal in all plots. Usually, there is no significant adverse effect from applying phosphorus or potassium in quantities greater than that which is adequate for good cane growth. The amounts of P and K applied in all plots is greater than that normally required for good growth as judged by the soil analyses. Soil analysis from 5 samples collected in the test plots of Field 246 in January 1973 is shown in Table 10.

TABLE 10. SCHEDULED APPLICATION OF NUTRIENTS BY COMMERCIAL FERTILIZERS AND SEWAGE EFFLUENT TO TEST PLOTS, OSC FIELD NO. 246

| TREAT-MENT CODE | CROP AGE (mo) 0 | | | 2 | | 4 | | 6 | | TOTAL | | | FERTILIZER AND EFFLUENT TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COMMERCIAL FERTILIZERS | | | | | | | | | | | | | | |
| | $P_2O_5$ | N | $K_2O$ | N | $K_2O$ | N | $K_1O$ | N | $K_2O$ | N | $P_2O_5$ | $K_2O$ | N | $P_2O_5$ | $K_2O$ |
| | lb/acre | | | | | | | | | | | | | | |
| A | 350 | 95 | 114 | 100 | 120 | 110 | 156 | 70 | 90 | 375 | 350 | 480 | 375 | 350 | 480 |
| B | 350 | 95 | 114 | 40 | 72 | 40 | 54 | | | 175 | 350 | 240 | 375 | 550 | 480 |
| C | 350 | 95 | 114 | | | | | | | 95 | 350 | 114 | 400 | 655 | 480 |

NOTE: $P_2O_5$ as treble superphosphate (applied mechanically with initial planting);
N as urea (hand applied);
$K_2O$ as muriate of potash (hand applied).

Median, minimum, and maximum levels of N, P, K in the secondary treated effluent for the period January to July 1972 were 10.8, 5.7, 21.9 mg/ℓ N; 10.11, 6.68, 11.25 mg/ℓ P; and 9.5, 5.8, 11.4 mg/ℓ K. Using the median value for each nutrient, calculations show that the effluent would be roughly equivalent to a 11-23-11 (N, $P_2O_5$, and $K_2O$, respectively) fertilizer. However, as shown in Table 11, the N level in the effluent during the months when it was used for irrigating Field 246 plots was much higher, and P and K levels slightly higher, than in the earlier samples. The effluent approximated a 20-25-12 (as N, $P_2O_5$, and $K_2O$, respectively) fertilizer. Heavy rain-rainfall reduced irrigation, thus also reducing the total N application to the C plots. The curves in Appendix C show the application dates and the cumulative amounts applied for N, $P_2O_5$, and $K_2O$, respectively (points for nutrients applied via effluent represent monthly totals) for each of the treatments. Total amounts of various nutrients and other elements or compounds, applied in each treatment are shown in Table 11.

The increase in the N content of the effluent to nearly twice the expected level could not be corrected. Furthermore, the initial starter fertilization, once applied, could not be rescinded. Additional K was applied to the "A" plots at the final application in an attempt to raise the K values from the crop logs, hence the final K applications to the "A" plots exceeded those for the "B" and "C" plots. Moreover the K estimations had been predicated on 10.16-cm (4-in.) rounds, and 9.40-cm (3.7-in.) rounds were actually applied.

TABLE 11. ACTUAL TOTAL APPLICATION OF NUTRIENTS, $SiO_2$, AND Na SUPPLIED FROM COMMERICAL FERTILIZERS, SEWAGE EFFLUENT, AND/OR WAIAHOLE DITCH WATER TO TEST PLOTS, OSC FIELD 246.

| ELEMENT or COMPOUND | TREATMENT* A | B | C |
|---|---|---|---|
| | lb/acre† | | |
| N‡ | 380 | 508 | 622 |
| P‡ | 153 | 312 | 420 |
| K | 498 | 394 | 374 |
| Ca | 320 | 347 | 364 |
| Mg | 154 | 142 | 195 |
| $SO_4$ | 270 | 706 | 1066 |
| $SiO_2$ | 925 | 1311 | 1811 |
| Na | 308 | 867 | 1352 |
| Cl | 578 | 958 | 1312 |

*Treatment A = Ditch water, 24 mo.
B = Effluent, 12 mo. followed by Ditch water, 12 mo.
C = Effluent, 24 mo.

†lb/acre x 1.121 = kg/ha.

‡Insignificant quantities of N and $P_2O_5$ contained in Waiahole Ditch water not included.

## Sugarcane Sampling Procedures

One of the major components of yield is the number of millable stalks per unit of land area. For this reason, shoot and/or stalk counts were made at 2.1, 4.0, and 6.2 months. Each census consisted of counting the total number of shoots and/or stalks in the premarked final harvest area (approximately .008 ha or 0.02 acre) of each plot.

When the cane was large enough (about 4 months of age for this test), crop log sampling was begun. Collecting and analyzing of these samples continued to within one week of harvest. A crop log sample is obtained by collecting 5 representative stalks, in this case, from each plot. Then the leaf blades (a 15.24-cm or 6-in. section from the middle of the blade) and the leaf sheath of leaves 3, 4, 5, and 6 (counting down from the top) are separated out. All analyses are then made on the leaf sheaths, except N (leaf blade) and the Amplified Phosphorus Index (which is derived by a formula using leaf sheath P, moisture, and total sugar content, and the fifth mature internode P content). Unless otherwise specified, all nutrient levels or indices are expressed on a sugar-free, dry-weight basis.

The amount of nutrient in the harvested cane is estimated by collecting an approximately 90.8-kg (200-lb) subsample of the hand-cut cane from the final harvest area after the field is burned to destroy the leafy trash. This subsample is then run through an ensilage chopper. The chopped cane is thoroughly mixed and an approximately 0.91.kg (2-lb) subsample is collected and analyzed for nutrient concentration. Nutrient concentration times the weight of gross cane per acre gives the weight of nutrient per acre in the above ground portion of the crop.

## Soil Sampling Procedure

Soil samples were collected and analyzed prior to planting and after harvesting the test area. For the initial soil sampling, 5 soil samples (0- to 30.48-cm or 0- to 12-in. depth), each from 1/5 of the general experiment area (corresponding approximately to plots 9A, 14A, 21B, 25C, and 29C in Fig. 2) were collected on 26 January 1973. Each sample was a composite of 4 subsamples. On 3 and 4 April 1975, after the irrigation furrows were reshaped by OSC's reshaping machine, a sample was collected from each plot. The samples were obtained with a soil auger by extracting a 5.08-cm (2-in.) diameter coil core to a 30.48-cm (12-in.) depth from halfway up the reshaped furrow bank. Each sample was a composite of 3 such soil columns, one from each of 3 furrows in the final harvest plot area. A preliminary sampling was made on 6 March 1975, by collecting soil from the 0- to 7.62- or 10.16-cm (0- to 3- or 4-in.) depth in the bottom of an old furrow (before reshaping) in each plot.

The gross cane weight per acre, expressed as tons cane per acre (TCA), at harvest is determined by slash-cutting the cane around the perimeter of the premarked final harvest plot. This is done after burning the leafy trash. Cane attached to stools within the harvest plot is then cut at ground level and all of the cane in the plot is weighed by a hydraulic scale in a grab mechanism mounted on a tractor.

The cane quality expressed as yield of sugar per ton of cane (YD/C), and juice quality, the percent of soluble solids (sucrose) in the cane, expressed as % purity or just purity, are determined by taking a subsample of chopped cane (same cane as used for nutrient content determinations) and extracting the juice from it. The pol (sucrose) is measured by a saccharimeter and soluble solids by a refractometer. Purity is then calculated by (pol/soluble solids) x 100. The cane weight, pol value, and purity value are then all subjected to a series of standard formulae which ultimately produce an estimated tons sugar per acre (ETSA) figure.

In Hawaii's sugar industry, the nutrient content of plant and soil samples are reported as the elemental form. However, because the fertilizer industry reports and labels the nutrient content of their fertilizer products on an oxide basis, the sugar industry uses this basis for reporting fertilization rates. The basis used in practice, for the respective analyses, will be used in this report. The following conversion factors are appropriate for converting the oxide form to the elemental form: $P_2O_5$ x 0.436, $K_2O$ x 0.830, CaO x 0.715, $SiO_2$ x 0.467, MgO x 0.603, and $SO_4$ x 0.334.

## RESULTS AND DISCUSSION OF CROP AND SOIL RESPONSES

### Crop Development

The shoot census taken at 2.1 and 4.0 months after planting showed no significant differences among treatments. However, the later census revealed that "B" plots contained 16% more shoots than "A" plots (significantly different at the 5% probability level), and about 8% more than "C" plots. Normally, many more shoots are produced than survive beyond the leaf canopy "close-in" stage. Millable stalk counts made at 6.2 months, after close-in and the normal stabilization of stalk population, revealed that the plots receiving A, B, or C treatments contained approximately 29,600, 30,400, and 30,500 stalks/acre. These small differences were not significant and all plots contained an adequate number of stalks to produce high yields.

Standard crop log samples were collected by OSC personnel starting at a crop age of 4.2 mo and continuing until harvest (24.6 mo). These samples normally were analyzed for the water, K, P, Ca, Mg, and total sugar content in the leaf sheaths, weight of the sheaths, N in the leaf blade, and P in the stalk. The mean value for sheath moisture, leaf blade N, sheath P, sheath K-$H_2O$ in each treatment on the various sampling dates are plotted in Figures 5, 6, 7, and 8, respectively.

Moisture content in the leaf sheath and N level in the leaf blade normally move up and down together, although not always by the same magnitude. Sheath moisture was about normal for sugarcane irrigated on an optional schedule for the first 15 mo. The moisture level started to decline by the 12.1-mo sampling and continued through the 15.2-mo sampling. This was expected of cane of this age coming into the warmer and drier season of the year, although it may have been just a little early. Normally, the sheath moisture would continue to decline slowly with age throughout the summer. However, the 5 August samples taken at 17.9 mo showed that moisture levels had returned to approximately what they had been at 12.1 mo. Moisture differences among treatments were not significantly different until 17.9 mo, when the moisture for cane in the C plots was greater than that in the A and B plots. At crop ages 20.9, 23.9, and 24.6 mo, sheath moisture content for C plots was significantly greater than that for the A but not the B plots. The higher moisture values were due to more N in the cane produced by the continuing supply of N from sewage effluent. At several other samplings (five replicates only) between 17.9 mo and harvest, none of the differences were significant.

The linear moisture-time line in Figure 9 shows the desired rate of reduction for sheath moisture as the harvesting age (25 mo) is approached. Mean sheath moisture values, for each treatment plotted above this line, show that during this interval moisture levels were always considerably higher than desired because of higher than normal rainfall (Table 12) and extra applied N. This graph alone would indicate the juice quality would be considerably below that desired.

By 4.2 mo, 218.60, 313.88, and 269.04 kg N/ha (195, 280, and 240 lb N/acre, respectively) had been applied to A, B, and C plots, repectively. Leaf blade N content was in the same order at the 4.2-crop log sampling. The differences between B and A were significant. By the 15.2-mo sampling 425.98, 569.47, and 586.28 kg N/ha (380, 508, and 523 lb N/acre, respectively) had been

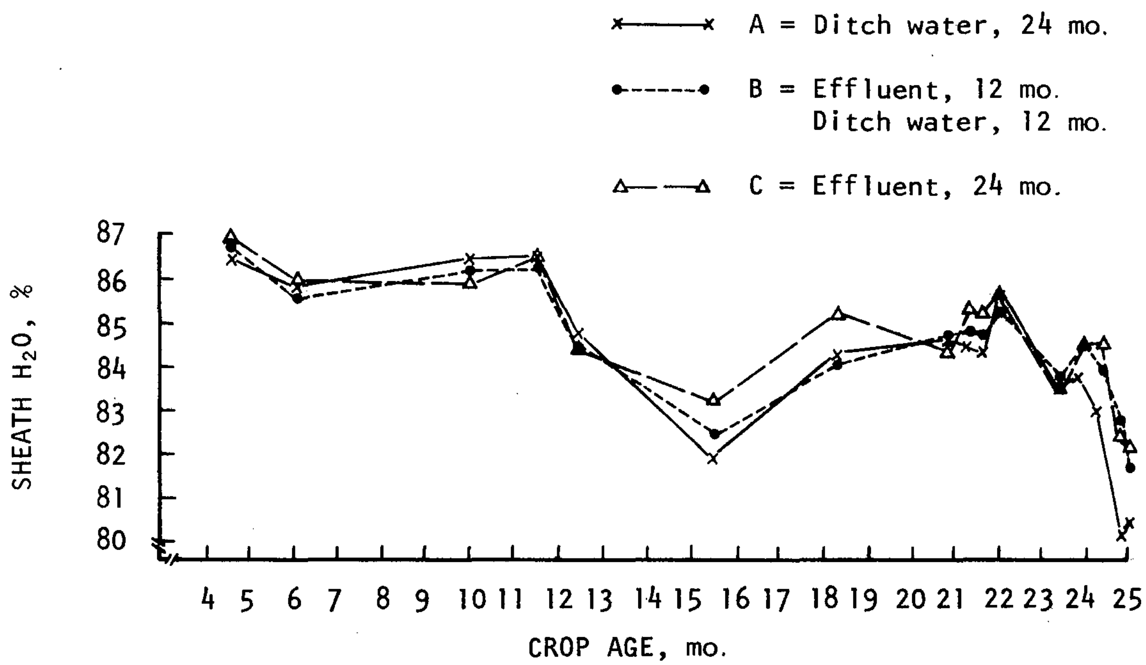


FIGURE 5. EFFECT OF SEWAGE EFFLUENT ON SHEATH MOISTURE OF SUGARCANE, OSC FIELD 246

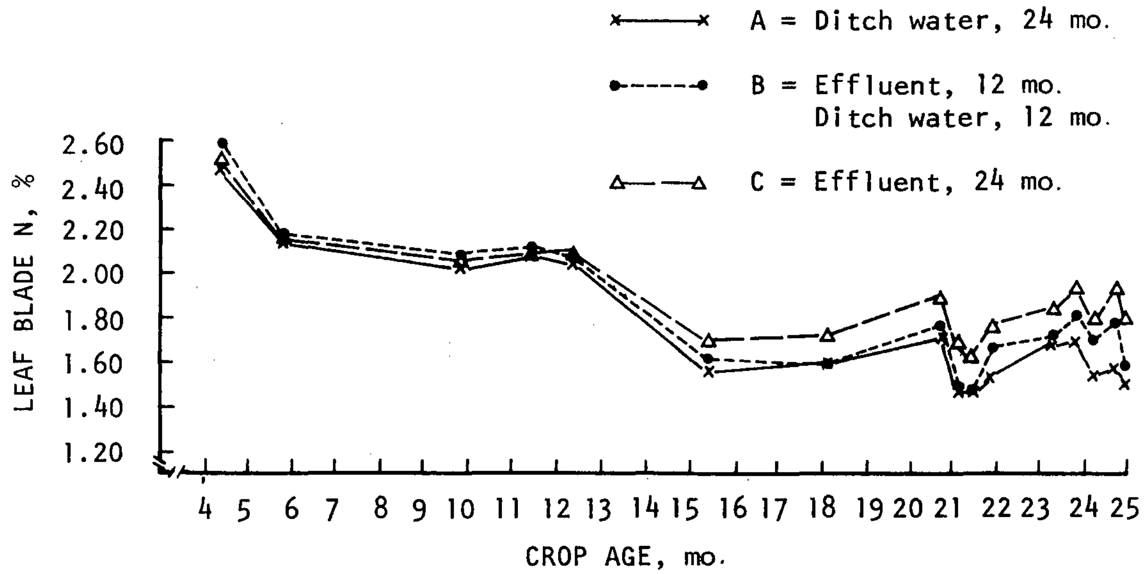


FIGURE 6. EFFECT OF SEWAGE EFFLUENT ON LEAF BLADE N OF SUGARCANE, OSC FIELD 246

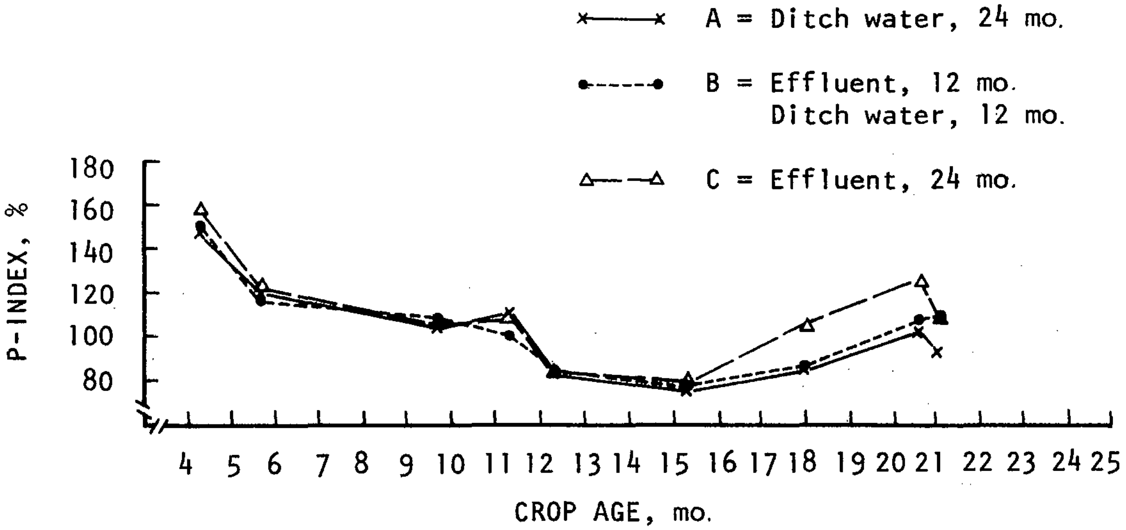


FIGURE 7. EFFECT OF SEWAGE EFFLUENT ON THE P-INDEX OF SUGARCANE, OSC FIELD 246

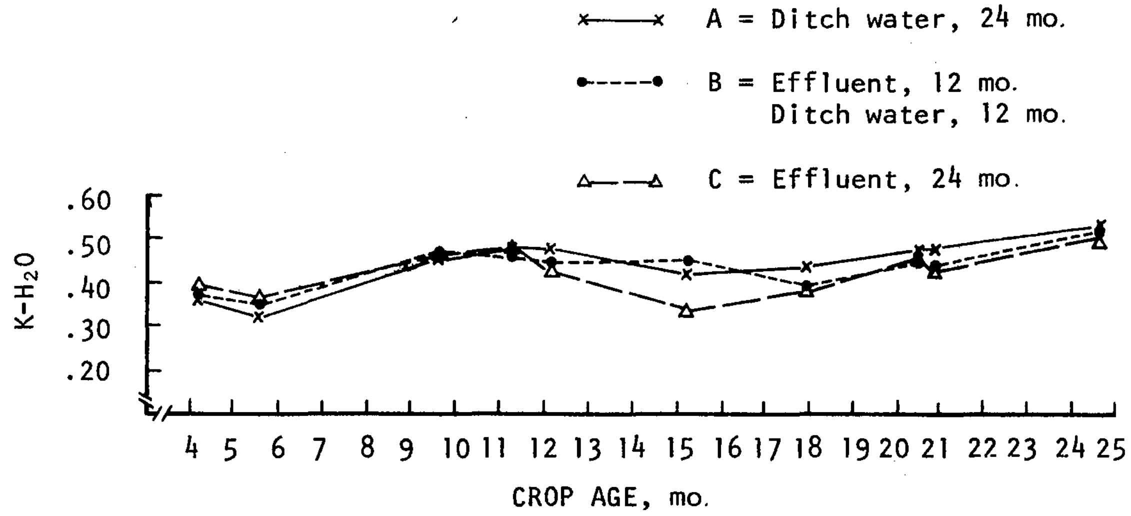


FIGURE 8. EFFECT OF SEWAGE EFFLUENT ON THE K-$H_2O$ VALUES OF SUGARCANE, OSC FIELD 246

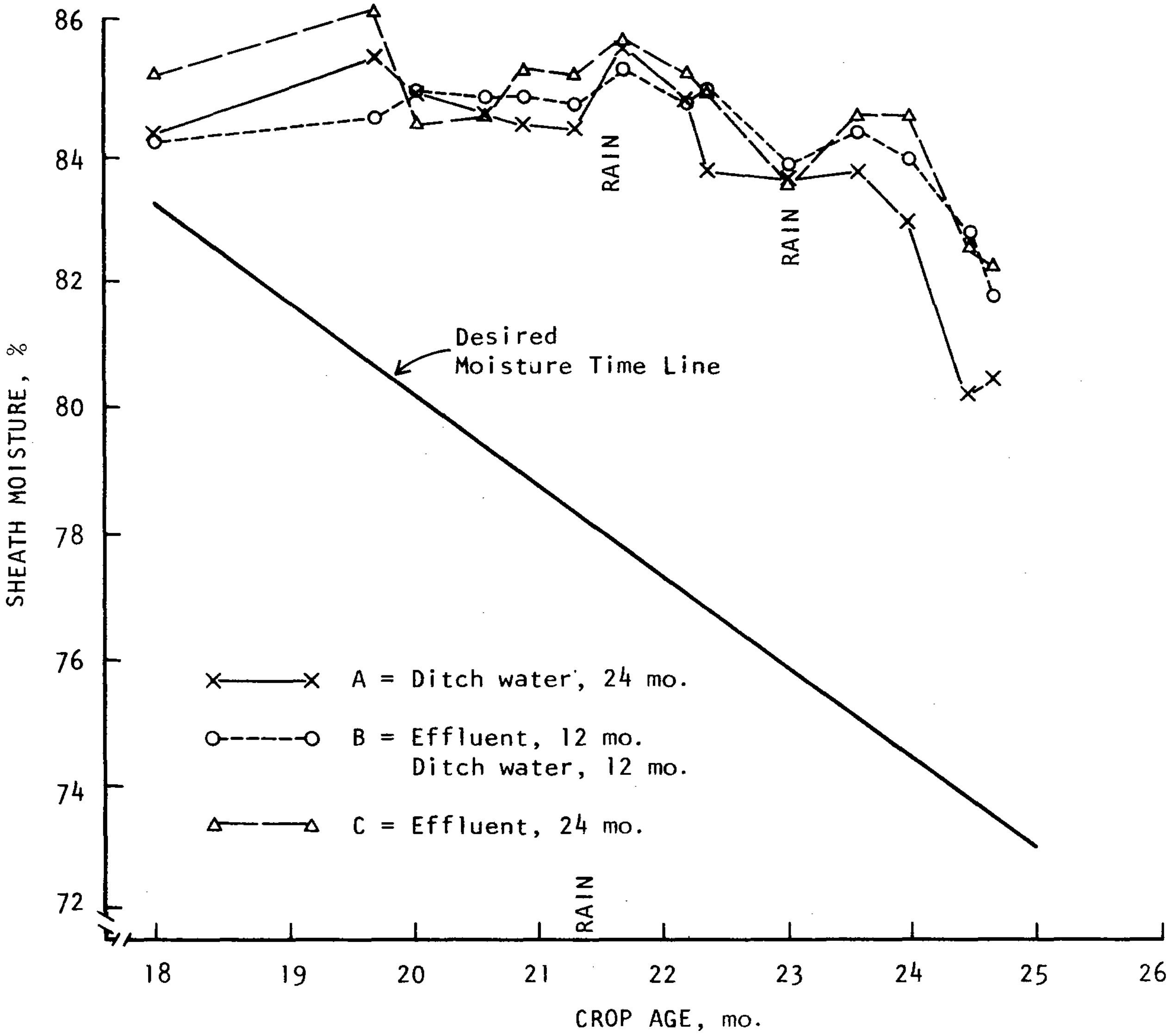


FIGURE 9. COMPARISON OF SHEATH MOISTURE- AND THE DESIRED MOISTURE-TIME LINES FOR SUGAR CANE, OSC FIELD 246

TABLE 12. MONTHLY RAINFALL AT MILILANI SEWAGE TREATMENT PLANT AND OAHU SUGAR COMPANY FIELD NO. 246

| DATE | MILILANI STP 1973 | MILILANI STP 1974 | MILILANI STP 1975 | OAHU SUGAR CO. FIELD 246 1923-73 | OAHU SUGAR CO. FIELD 246 1973 | OAHU SUGAR CO. FIELD 246 1974 | OAHU SUGAR CO. FIELD 246 1975 |
|---|---|---|---|---|---|---|---|
| | in. | | | | | | |
| January | 0.93 | 8.69 | 7.71 | 5.6 | 0.87 | 8.82 | 1.19 |
| February | 0.63 | 4.34 | 5.90 | 4.1 | 1.27 | 4.57 | 6.16 |
| March | 1.69 | 5.79 | | 4.6 | 2.34 | 7.27 | |
| April | 1.13 | 4.23 | | 3.2 | 1.27 | 5.93 | |
| May | 1.60 | 2.84 | | 1.9 | 2.04 | 3.74 | |
| June | 0.58 | 0.97 | | 1.3 | 1.16 | 2.08 | |
| July | 0.93 | 2.47 | | 1.5 | 1.24 | 1.81 | |
| August | 0.89 | 0.31 | | 1.8 | 1.27 | 0.37 | |
| September | 0.99 | 8.78 | | 1.6 | 1.70 | 8.52 | |
| October | 2.51 | 2.81 | | 3.3 | 3.42 | 3.07 | |
| November | 3.14 | 4.31 | | 3.9 | 3.46 | 5.31 | |
| December | 5.98 | 1.20 | | 5.4 | 6.48 | 1.95 | |
| Total | 21.00 | 46.74 | 13.61 | 38.2 | 26.52 | 53.44 | 7.35 |

applied to A, B, and C plots, respectively, and the leaf-N levels were in the same order (1.55, 1.60, and 1.68% N). The leaf-N values for A and C were significantly different. From this age on, leaf-N levels were always in the order of A, B, and C (lowest to highest). Usually, only the values for treatments A and C were significantly different from each other. As with the sheath moisture values, leaf-N values (especially for cane irrigated with effluent) were higher than desired during the last 4 months of the crop.

According to Clements (1959), the critical K-$H_2O$ value (K% tissue moisture) is 0.425. Using this criteria, the K content was deficient in cane in all treatments at the 4.2- and 5.6-mo sampling (Fig. 8). By 15.2 months the A, B, and C plots had received 616.5, 510.0, and 414.8 kg $K_2O$/acre, respectively (550, 455, and 370 lb $K_2O$/acre, respectively). In the 15.2- and 17.9-mo samples, the K-$H_2O$ values were low in cane receiving treatment C and low for B in the 15.2-mo samples. Low K-$H_2O$ values have been observed frequently when high moisture levels are maintained in sugarcane irrigated by drip irrigation. Because of the high moisture content of the cane in this experiment, it is not certain whether the low K-$H_2O$ values observed at various times in this test were low enough to cause any yield reduction.

The results of crop log analysis for P (P-index and amplified P index) indicated that at no time was there a deficient level of P in the plant, with the exception of a borderline case at 15.2 mo indicated by the P index only. The only time there was a significant difference in the P index among treatments was at the 17.9- and 20.9-mo samplings. The P index revealed that cane in all treatments was adequate at this time. However, in the former sampling, C treatment produced significantly higher P index values than the other two treatments, while in later samplings, treatments B and C produced higher sheath P values than did A. The soil type involved in this experiment is capable of fixing large amounts of P, therefore the large differences in applied P 414.77, 171.51, and 470.82 kg/ha (153, 312, and 420 lb/acre for A, B, and C, respectively) did not produce differences of comparable magnitude in P index values for the various treatments.

The analysis of crop log samples for Ca content indicated that Ca was never low for any of the treatments. In the samples collected at 9.6, 15.2, and 17.9 mo, the Ca content in cane from the various treatments did show some significant differences, but the actual differences were relatively small.

The crop log Mg index was similar to that of Ca in that the levels were always adequate.

## Nutrient Content of Cane

The nutrient content of the aboveground portion of the cane plant after the trash was burned is shown in Table 13. Although the treatment effect was not significant in many cases, numerically the content of each nutrient measured increased as more sewage effluent (and consequently more of each nutrient) was applied, except for K. Because of the differential in K applied as commercial fertilizer, more K was applied to the A plots than to the B or C plots. It can be seen in the table that the K content in the plants was very similar among treatments. Both percentage-wise and in absolute terms, the greatest effect of sewage effluent on nutrient concent in the plant was for N. Although 687.17 kg/ha (613 lb/acre) more $P_2O_5$ was applied to the C plots than to the A plots, the nutrient content only increased by 11 kg/ha (10.2 lb/acre). Nevertheless, this 11 kg/ha represents a 33% increase which is a significant amount. In fact, the P content increased as effluent application increased in each treatment and C>B>A were all significant at the 5% level. The Mg content was not significantly different between cane in A and B plots but values for each of these were significantly lower than for C plots.

TABLE 13. EFFECT OF SEWAGE EFFLUENT ON NUTRIENT CONTENT OF ABOVEGROUND PORTION OF THE SUGARCANE AT HARVEST, OSC FIELD NO. 246

| TREATMENT CODE | TCA | MEAN NUTRIENT CONTENT | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | N | P | K | Ca | Si | Mg | S |
| | lb/acre | | | | | | | |
| A | 138.1 | 109.6 | 31.0 | 260.5 | 26.5 | 131.4 | 48.4 | 52.6 |
| B | 144.6 | 151.4 | 36.7 | 261.1 | 29.9 | 154.7 | 53.9 | 66.8 |
| C | 152.9 | 225.3 | 41.2 | 247.8 | 34.6 | 162.5 | 60.5 | 73.2 |
| Statistical Summary: | | | | | | | | |
| A vs. B | * | * | * | n.s. | n.s. | * | n.s. | * |
| A vs. C | * | * | * | n.s. | n.s. | * | * | * |
| B vs. C | * | * | * | n.s. | n.s. | n.s. | * | † |

*Difference significant at 5% probability level.
†Difference significant at 10% probability level.
n.s. = Difference nonsignificant.

## Nutrient Content of Soil

The nutrient content in the soil at the beginning of the test is presented in Table 1. The values indicate an adequate supply of P and Ca, but a relatively low content of K and a very low content of N with respect to sugarcane production.

"Comparable" samples, i.e., samples taken from the 0- to 12-in. depth, that were taken after the furrows were reshaped in 1975 (Table 14) indicate that changes were produced by the addition of sewage effluent and by the growing of sugarcane. Comparing Treatment A values in Table 14 with values in Table 1, it appears that the combination of the growing crop and the ferlization program for Treatment A has resulted in the reduction of soil P content and an increase in the soil K level. Mineralizable N data indicate virtually no effect.

TABLE 14. EFFECT OF SEWAGE EFFLUENT ON NUTRIENT CONTENT OF THE SOIL IN OSC FIELD NO. 246

| TREATMENT CODE | MEAN NUTRIENT CONTENT | | | | | | | | pH |
|---|---|---|---|---|---|---|---|---|---|
| | AVAIL. N | MIN.N | P | K | Ca | Si | Mg | S | |
| | lb/acre | | | | | | | | |
| A | 54 | 57 | 128.5 | 406.5 | 4128 | 215.5 | 831.0 | 20.3 | 6.06 |
| B | 65 | 79 | 174.0 | 529.5 | 4125 | 203.5 | 958.5 | 28.1 | 5.92 |
| C | 65 | 92 | 224.0 | 441.5 | 3945 | 221.0 | 974.0 | 24.8 | 5.84 |
| Statistical Summary: | | | | | | | | | |
| A vs. B | n.s. | n.s. | * | * | n.s. | n.s. | * | n.s. | n.s. |
| A vs. C | n.s. | n.s. | * | n.s. | n.s. | n.s. | * | n.s. | n.s. |
| B vs. C | n.s. | n.s. | * | † | n.s. | n.s. | n.s. | n.s. | n.s. |

NOTE: Samples collected 3-4 April 1975.
*Difference significant at 5% probability level.
†Difference significant at 10% probability level.
n.s. = Difference nonsignificant.

Application of sewage effluent (B and C plots) has resulted in significantly higher soil P levels as compared to plots irrigated with ditch water and only commercial fertilizers (A plots). The more effluent applied, the more P applied, and the higher the soil P content. Also, the Mg content of the soil was raised by applying sewage effluent, but the differences in the B and C plots were not significant. There was a tendency for the soil K levels to increase with the addition of effluent (the effect was significant for B plots) even though the total (commerical fertilizers plus effluent) K applied was less in plots irrigated with effluent.

Table 15 contains the results of the nutrient analyses of soil samples taken from the top 7.6 to 10.2 m (3 to 4 in.) of soil in the bottom of the furrows immediately after harvesting the cane. The values are expressed as ppm since the sample was not taken to the 0.30-m (1-ft) depth. The main point brought out by data in this table is that the effects of effluent application on the soil nutrient level are apparently greatest at the initial point of contact between effluent and soil. Therefore, by examining this area, it might be possible to detect changes that would be missed in the more conventional type sampling. It might indicate the changes which would occur to a greater portion of the soil profile, if the effluent were applied year after year. In this regard, P and pH levels should be monitored closely in future tests.

TABLE 15. EFFECT OF SEWAGE EFFLUENT ON NUTRIENT CONTENT OF 3-4 IN. SOIL SURFACE OF IRRIGATION FURROWS, OSC FIELD NO. 246

| TREATMENT CODE | MEAN NUTRIENT CONTENT | | | | | | | | pH |
|---|---|---|---|---|---|---|---|---|---|
| | AVAIL. N | MIN.N | P | K | Ca | Si | Mg | S | |
| | lb/acre | | | | | | | | |
| A | 10.6 | 23.0 | 59.0 | 347.5 | 1266 | 67.8 | 338.5 | 10 | 5.99 |
| B | 13.3 | 27.9 | 128.4 | 228.0 | 1252 | 43.4 | 356.5 | 11 | 5.64 |
| C | 18.3 | 29.4 | 198.5 | 229.5 | 1089 | 41.6 | 344.5 | 13 | 5.47 |
| Statistical Summary: | | | | | | | | | |
| A vs. B | * | * | * | * | n.s. | * | n.s. | n.s. | * |
| A vs. C | * | * | * | * | n.s. | * | n.s. | n.s. | * |
| B vs. C | * | n.s. | * | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |

NOTE: Samples collected 6 March 1975.
*Difference significant at 5% probability level.
n.s. = Difference nonsignificant.

## Cane and Sugar Yields

The test area was burned on 5 March 1975 when the crop was 24.93 mo old. Hand-harvesting of the center 4 lines by 12.19 m (40 ft) began the following day and was completed on 7 March. Ideal weather conditions prevailed at harvest time.

Tons cane per acre (TCA), yield percent cane (YD/C), and estimated tons sugar per acre (ETSA) for each treatment are shown in Table 16. As expected, the more sewage effluent (and therefore, N) applied the more cane produced. The additional cane tonnage was 6.5 and 14.8 for application of effluent for the first year and the entire crop cycle, respectively. Cane tonnages for each treatment were significantly different from each other.

Compared to the quality (expressed as YD/C) of the cane irrigated with surface water, effluent only reduced the quality when applied for the entire crop cycle. This was caused by the N contained in the effluent. The YD/C figure for Treatment C was significantly lower (1% probability level) than for Treatments A or B. Inasmuch as plant moisture and N levels are the predominant factors controlling cane and juice quality, and as shown earlier, Treatment B usually had moisture and N levels intermediate to A and C during the 7 mo prior to harvest, it was expected that cane quality for Treatment B would be intermediate to Treatments A and C.

TABLE 16. EFFECT OF SEWAGE EFFLUENT ON CANE YIELD, CANE QUALITY, AND SUGAR YIELD IN OSC FIELD NO. 246

| CODE | TREATMENT | TCA | YD/C | ETSA |
|---|---|---|---|---|
| A | Ditch water, 2 yr | 138.1 | 12.2 | 16.8 |
| B | Effluent 1st year, followed by ditch water 2d year | 144.6 | 12.3 | 17.8 |
| C | Effluent, 2 yr | 152.9 | 10.3 | 15.8 |
| Statistical Summary: | | | | |
| | A vs. B | * | n.s. | n.s. |
| | A vs. C | † | † | n.s. |
| | B vs. C | † | † | * |

*Difference significant at 5% probability level.
†Difference significant at 1% probability level.
n.s. = Difference nonsignificant.

In the case of Treatment B, the increase in TCA due to the addition of effluent was translated directly into increased sugar production (1.0 ETSA increase). This was because neither cane quality nor juice quality (purity) was lowered by the addition of effluent in the first year of the crop, if it was followed by surface water irrigation for the second year of the crop cycle. However, if the irrigation with sewage effluent was continued through the second year, the large drop in juice and cane quality more than offset the increase in TCA. The net result was lower ETSA. The 1.0 ETSA differences between Treatments A and B or A and C were not significant from a statistical standpoint, even at the 10% probability level. The 2.0 ETSA difference between B and C was significant at the 5% level. However, from an economical standpoint, a "real" 1.0 ETSA difference would be very important. To be able to statistically detect such a difference, the treatments would have to be replicated more times or the variability between replications would have to be reduced. In this test, the coefficient of variability was quite low for TCA, but relatively high for YD/C and ETSA.

Yields from small plots which are hand harvested are biased upward. The amount of the bias depends, among other factors, on the size of the plot. It is not uncommon for yield results obtained from conventional harvesting and milling methods to be about 80% of those obtained from small plot harvests. Nevertheless, the yields look satisfactory to good.

Based on these preliminary test results, it appears that sugar yields would not be decreased by applying sewage effluent for the first year only, but could quite likely be decreased by applying the effluent during the entire crop cycle. Effects from applying sewage effluent to sugarcane might be altered significantly if the variety, soil type, or weather conditions were different, or if a chemical ripener were applied. Variety 59-3775 which was grown in this test is known for its superior cane and juice quality and its ability to withstand high N applications.

Although rainfall was considerably above normal for the year and slightly above normal (Table 12) for the 6-mo period preceding harvest (which would promote lower juice quality), the lower-than-normal temperatures (Table 17) during the latter period tended to counterbalance the rainfall effect.

TABLE 17. MONTHLY TEMPERATURE, OSC FIELD NO. 246

| YEAR | MONTH | MAX. | MIN. | MEAN | RANGE |
|---|---|---|---|---|---|
| | | °F | | | |
| 1956-1970 | JAN. | 76.7 | 60.0 | -- | -- |
| | FEB. | 76.7 | 59.5 | -- | -- |
| | MAR. | 78.4 | 59.6 | -- | -- |
| | APR. | 79.3 | 61.3 | -- | -- |
| | MAY | 81.9 | 63.1 | -- | -- |
| | JUNE | 83.4 | 64.9 | -- | -- |
| | JULY | 83.7 | 65.9 | -- | -- |
| | AUG. | 84.7 | 66.5 | -- | -- |
| | SEPT. | 84.9 | 65.7 | -- | -- |
| | OCT. | 83.3 | 65.4 | -- | -- |
| | NOV. | 80.2 | 64.2 | -- | -- |
| | DEC. | 77.7 | 62.1 | -- | -- |
| 1973 | JAN. | 71.3 | 57.2 | 64.3 | 14.1 |
| | FEB. | 68.8 | 57.4 | 63.1 | 11.4 |
| | MAR. | 70.6 | 62.3 | 66.5 | 8.3 |
| | APR. | 72.7 | 61.1 | 66.9 | 11.6 |
| | MAY | 72.8 | 63.1 | 68.0 | 9.7 |
| | JUNE | 75.3 | 64.3 | 69.8 | 11.0 |
| | JULY | 75.9 | 65.9 | 70.9 | 10.0 |
| | AUG. | 77.6 | 65.0 | 71.3 | 12.6 |
| 1973 | SEPT. | 78.6 | 64.7 | 71.7 | 13.9 |
| | OCT. | 75.0 | 64.5 | 69.8 | 10.5 |
| | NOV. | 72.0 | 62.8 | 67.4 | 9.2 |
| | DEC. | 74.1 | 59.9 | 67.0 | 14.2 |
| 1974 | JAN. | 75.8 | 63.5 | 69.7 | 12.3 |
| | FEB. | 70.8 | 59.5 | 65.2 | 11.3 |
| | MAR. | 67.3 | 60.3 | 63.8 | 7.0 |
| | APR. | 72.4 | 62.5 | 67.6 | 9.9 |
| | MAY | 73.9 | 62.8 | 68.4 | 11.1 |
| | JUNE | 76.1 | 63.3 | 69.7 | 12.8 |
| | JULY | 76.4 | 63.3 | 69.9 | 13.1 |
| | AUG. | 77.9 | 65.0 | 71.5 | 12.9 |
| | SEPT. | 78.0 | 63.7 | 70.9 | 14.3 |
| | OCT. | 72.8 | 64.3 | 68.6 | 8.5 |
| | NOV. | 69.9 | 61.7 | 65.8 | 8.2 |
| | DEC. | 68.2 | 60.7 | 64.5 | 7.5 |
| 1975 | JAN. | 65.6 | 57.4 | 61.5 | 8.2 |
| | FEB. | 65.6 | 57.0 | 60.8 | 7.6 |
| | MAR. (1-7) | 77.2 | 62.8 | 70.0 | 14.4 |

NOTE: °F-32 x .555 = °C.

## EVALUATION OF WATER QUALITY PARAMETERS

### Treatment Plant Effluent

Selected median water quality constituent values, from 218 grab samples of Mililani STP secondary effluent obtained between April 1973 through December 1974, are shown in Table 18. Although some secondary effluent quality data have been reported previously for the project (Lau et al. 1972,

TABLE 18. MEDIAN CONSTITUENT VALUES OF SECONDARY SEWAGE EFFLUENT, MILILANI STP, CENTRAL OAHU, HAWAII

| DATE | NO. OF SAMPLES | TOTAL N | $PO_4$-P | K | Na | Ca | Mg | $SO_4$ | $SiO_2$ | Cl | TDS | COND. µmhos/cm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MEDIAN mg/ℓ | | | | | | | | | | |
| 1973 | | | | | | | | | | | | |
| APR. | 8 | 17.4 | -- | 10.8 | 55 | 14 | 7 | 43 | 63 | 49 | -- | 400 |
| MAY | 10 | 23.2 | 12.55 | 10.6 | 55 | 8 | 9 | 42 | 64 | 55 | -- | 420 |
| JUNE | 13 | 20.7 | 11.16 | 9.5 | 58 | 16 | 4 | 52 | 67 | 48 | 354 | 420 |
| JULY | 13 | 18.1 | 10.74 | 9.7 | 48 | 14 | 4 | 43 | 64 | 54 | 327 | 370 |
| AUG. | 11 | 20.3 | 9.95 | 10.0 | 48 | 12 | 1 | 38 | 70 | 66 | 290 | 345 |
| SEPT. | 9 | 19.6 | 10.57 | 9.0 | 50 | 17 | 5 | 38 | 66 | 45 | 198 | 410 |
| OCT. | 10 | 23.2 | 10.83 | 9.6 | 50 | 17 | 7 | 38 | 67 | 48 | 311 | 400 |
| NOV. | 14 | 22.2 | 12.67 | 11.2 | 50 | 7 | 12 | 46 | 71 | 48 | 353 | 420 |
| DEC. | 17 | 20.9 | 13.22 | 9.4 | 63 | 10 | 10 | 40 | 73 | 50 | 311 | 480 |
| 1974 | | | | | | | | | | | | |
| JAN. | 7 | 24.7 | 14.27 | 10.0 | 61 | 11 | 10 | 42 | 70 | 48 | 232 | 500 |
| FEB. | 13 | 17.3 | 13.54 | 10.4 | 59 | 10 | 9 | 35 | 75 | 48 | 324 | 440 |
| MAR. | 6 | 20.1 | 12.82 | 9.8 | 57 | 10 | 9 | 36 | 74 | 50 | 315 | 455 |
| APR. | 10 | 24.6 | 10.82 | 9.6 | 62 | 9 | 9 | 41 | 74 | 48 | 337 | 520 |
| MAY | 12 | 26.7 | 11.15 | 10.2 | 53 | 10 | 8 | 40 | 74 | 46 | 383 | 580 |
| JUNE | 12 | 19.3 | 10.31 | 10.2 | 54 | 8 | 9 | 44 | 73 | 52 | 360 | 485 |
| JULY | 12 | 16.8 | 10.97 | 10.6 | 57 | 8 | 10 | 49 | 73 | -- | 353 | 505 |
| AUG. | 13 | 13.3 | 8.47 | 9.2 | 53 | 8 | 10 | -- | 72 | 53 | -- | 415 |
| SEPT. | 5 | 13.3 | 9.72 | 9.7 | 49 | 8 | 9 | -- | 72 | 50 | 326 | 450 |
| OCT. | 8 | 16.1 | 8.87 | 9.1 | 50 | 8 | 9 | -- | 72 | 51 | 354 | 465 |
| NOV. | 7 | 17.8 | 9.70 | 10.3 | 50 | 8 | 10 | -- | 71 | 52 | 325 | 420 |
| DEC. | 8 | 20.8 | 10.37 | 8.6 | 51 | 10 | 10 | -- | 80 | 55 | 335 | 540 |
| | | MEDIAN OF MEDIANS | | | | | | | | | | |
| APR. 73-DEC. 74 | | 20.1 | 10.83 | 9.7 | 54 | 10 | 9 | 42 | 72 | 50 | 327 | 440 |

1974), the time period for Table 18 was chosen to coincide with the test plot studies in Field No. 246.

In addition to the numerous grab sample values, 8 sets of composited samples were collected between October 1971 and January 1975 for comparison with the grab samples. All the composited samples, shown in Appendix A-1, except for the October 1971 set, were collected over a 16-hr period. The composited samples were quite comparable, thus indicating that the grab samples were not unduly influenced by anomalies due to time of collection.

## Irrigation Water Quality Standards

Numerous parameters have been advanced to evaluate suitability of a water supply for irrigation such as soil type, drainability, type of crops, and chemical composition of the water. For the conterminous U.S. temperate zones, total dissolved solids, electrical conductivity, chlorides, sodium percentage, and boron have been the chemical parameters that have been used traditionally. As may be noted in Table 18, total dissolved solids, electrical conductivity, and chlorides of the effluent are considerably less than the mainland-established limiting values for sensitive crops of <700 mg/ℓ, <1000 μmhos/cm, and 175 mg/ℓ, respectively. The percentage of sodium in comparison to the total major cations (calcium, magnesium, sodium, and potassium) on an equivalent basis was nearly 62%, which is slightly greater than the <60% established for sensitive crops, However, the sodium level satisfies another commonly used criterion, the sodium adsorption ratio (SAR). It should be noted that the SAR is not deleterious to soil structure, especially for these aggregated soils. The median concentration of boron, during a 7-mo period at the beginning of the project (Lau et al. 1972), was 0.39 mg/ℓ which is less than the <0.5 mg/ℓ value set for sensitive crops. Due to the low concentration of boron, its analysis on a regular basis was discontinued. Pesticides and heavy metal concentrations were either below the level of concern or the level of detectability as shown on Appendix Tables B-1 and B-3.

## Rainfall and Evaporation

Rainfall is monitored extensively at numerous locations on sugarcane plantations for purposes of irrigation management. The quantity of rainfall, measured at a rain gage located adjacent to the Mililani STP control building from January 1972 through February 1975 is presented in Table 19. As can be observed in Table 19, rainfall for 1973 was nearly one-half of the 101.6-cm (40-in.) approximate annual average; however, the rainfall amount for 1972 was about average, and the 118.72 cm (46.74 in.) for 1974 was slightly above average.

Pan evaporation data, collected at OSC Field No. 245 (approximately one mile from both the Mililani STP and OSC Field No. 246 test plots), are presented in Table 20. The total quantity of evaporation for 1973 and the resulting corresponding values for 1974 were not recorded for several weeks due to pan overflow from excessive rainfall and the sugar plantation employees strike during March and part of April.

# TABLE 19. PAN EVAPORATION RATES, OSC FIELD NO. 245, CENTRAL OAHU

| DATE[1] | EVAPORATION | |
|---|---|---|
| | TOTAL in. | MONTHLY in./day |
| 1973 | | |
| Jan. 1-4 | 0.618 | |
| 5-11 | 0.986 | |
| 12-18 | 1.391 | |
| 19-25 | 1.522 | |
| 26-31 | 1.233 | 0.185 |
| Feb. 1 | 0.206 | |
| 2-8 | 1.408 | |
| 9-15 | 1.498 | |
| 16-22 | 1.497 | |
| 23-28 | 1.408 | 0.215 |
| Mar. 1 | 0.235 | |
| 2-8 | 1.724 | |
| 9-15 | 1.708 | |
| 16-22 | 1.492 | |
| 23-29 | 1.785 | |
| 30-31 | 0.425 | 0.238 |
| Apr. 1-5 | 1.062 | |
| 6-12 | 1.508 | |
| 13-18 | 1.666 | |
| 19-26 | 1.714 | |
| 27-30 | 1.130 | 0.236 |
| May 1-3 | 0.848 | |
| 4-10 | 2.009 | |
| 11-17 | 1.874 | |
| 18-24 | 2.046 | |
| 25-31 | 1.732 | 0.274 |
| June 1-7 | 1.764 | |
| 8-14 | 1.974 | |
| 15-21 | 1.956 | |
| 22-28 | 1.669 | |
| 29-30 | 0.415 | 0.251 |
| July 1-5 | 1.036 | |
| 6-12 | 1.898 | |
| 13-19 | 1.958 | |
| 20-26 | 1.998 | |
| 27-31 | 1.591 | 0.274 |
| Aug. 1-2 | 0.637 | |
| 3-9 | 2.167 | |
| 10-16 | 1.888 | |
| 17-23 | 1.462 | |
| 24-30 | 1.799 | |
| 31 | 0.240 | 0.264 |
| Sept. 1-6 | 1.439 | |
| 7-13 | 1.834 | |
| 14-20 | 1.808 | |
| 21-27 | 1.598 | |
| 28-30 | 0.771 | 0.248 |
| Oct. 1-4 | 1.029 | |
| 5-11 | 1.545 | |
| 12-18 | 1.852 | |
| 19-25 | 1.312 | |
| 26-31 | 1.527 | 0.234 |
| Nov. 1 | 0.255 | |
| 2-8 | 0.720 | |
| 9-15 | 1.272 | |
| 16-20 | 0.673 | |
| 21-29 | 1.250 | |
| 30 | 0.201 | 0.146 |
| Dec. 1-6 | 1.209 | |
| 7-13 | 1.372 | |
| 14-20 | 1.078 | |
| 21-27 | 0.810 | |
| 28-31 | -- [2] | 0.166 |
| 1973 TOTAL EVAPORATION | 82.732 | |
| 1973 AVERAGE EVAPORATION RATE | | 0.227 |
| 1974 | | |
| Jan. 1-17 | -- [2] | |
| 18-24 | 1.204 | |
| 25-31 | -- [2] | 0.172 |
| Feb. 1-7 | 1.305 | |
| 8-14 | 1.214 | |
| 15-21 | 1.317 | |
| 22-28 | 1.284 | 0.183 |
| Mar. 1-31 | -- [3] | |
| Apr. 1-25 | -- [3] | |
| 26-30 | 1.065 | 0.213 |
| May 1-2 | 0.426 | |
| 3-9 | 1.696 | |
| 10-16 | 1.216 | |
| 17-23 | 1.340 | |
| 24-30 | -- [2] | |
| 31 | 0.268 | 0.206 |
| June 1-6 | 1.606 | |
| 7-13 | 1.784 | |
| 14-20 | 1.374 | |
| 21-27 | 1.894 | |
| 28-30 | -- [2] | 0.247 |
| July 1-4 | -- [2] | |
| 5-11 | 1.824 | |
| 12-18 | 1.548 | |
| 19-25 | 1.500 | |
| 26-31 | 1.286 | 0.199 |
| Aug. 1 | 0.214 | |
| 2-8 | 1.684 | |
| 9-15 | 1.446 | |
| 16-22 | 1.850 | |
| 23-29 | 1.496 | |
| 30-31 | -- [2] | 0.231 |
| Sept. 1-5 | -- [2] | |
| 6-12 | 2.090 | |
| 13-26 | -- [2] | |
| 27-30 | 0.445 | 0.231 |
| Oct. 1-3 | 0.333 | |
| 4-10 | 1.480 | |
| 11-17 | 1.126 | |
| 18-28 | -- [2] | |
| 29-30 | 0.380 | |
| 31 | 0.163 | 0.174 |
| Nov. 1-7 | 1.143 | |
| 8-14 | 1.060 | |
| 15-21 | -- [2] | |
| 22-26 | 0.538 | |
| 27-30 | 0.426 | 0.138 |
| Dec. 1-5 | 0.532 | |
| 6-12 | 1.317 | |
| 13-19 | 1.476 | |
| 20-26 | 0.880 | |
| 27-31 | 0.643 | 0.156 |
| 1974 TOTAL EVAPORATION | 45.873 | |
| 1974 AVERAGE EVAPORATION RATE | | 0.196 |
| 1975 | | |
| Jan. 1-2 | 0.237 | |
| 3-9 | 0.784 | |
| 10-12 | -- [2] | |
| 13-16 | 0.490 | |
| 17-23 | 0.758 | |
| 24-30 | 1.731 | |
| 31 | -- [2] | 0.149 |
| Feb. 1-2 | -- [2] | |
| 3-6 | 0.622 | |
| 7-13 | 0.936 | |
| 14-20 | 1.277 | |
| 21-27 | 1.173 | |
| 28 | 0.176 | 0.161 |
| Mar. 1-6 | 1.056 | |
| 7-13 | 1.572 | |
| 14-20 | 1.607 | |
| 21-26 | 1.282 | |
| 27-31 | -- [2] | 0.212 |
| 1975 TOTAL EVAPORATION | 13.721 | |
| 1975 AVERAGE EVAPORATION RATE | | 0.174 |

NOTE: Evaporation data obtained from the Hawaiian Sugar Planters' Association, Climatological Section, Experimental Station. Collection site located approximately 0.1-mi from both the Mililani STP and OSC Field No. 246 Test Plots.

[1] Inasmuch as evaporation data are recorded at approximately 7:30 A.M., the date is assumed to be representative of the evaporation for the previous day.

[2] Pan overflowed due to excessive rainfall during the month.

[3] Data not collected.

TABLE 20. MONTHLY RAINFALL, MILILANI STP

| DATE | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|
| | in. | | | |
| JANUARY | 8.38 | 0.93 | 8.69 | 7.67 |
| FEBRUARY | 5.17 | 0.63 | 4.34 | 5.90 |
| MARCH | 2.67 | 1.69 | 5.79 | 2.33 |
| APRIL | 7.90 | 1.13 | 4.23 | |
| MAY | 0.27 | 1.60 | 2.84 | |
| JUNE | 1.03 | 0.58 | 0.97 | |
| JULY | 0.84 | 0.93 | 2.47 | |
| AUGUST | 0.92 | 0.89 | 0.31 | |
| SEPTEMBER | 2.78 | 0.99 | 8.78 | |
| OCTOBER | 3.27 | 2.51 | 2.81 | |
| NOVEMBER | 2.22 | 3.14 | 4.31 | |
| DECEMBER | 3.39 | 5.98 | 1.20 | |
| TOTAL | 38.84 | 21.00 | 46.74 | |

NOTE: 1 in. x 2.54 = cm.

## Quality of Sod Lysimeter Leachate

The constituent changes in secondary effluent passing through the 5-ft (1.5 m) deep grass-sod lysimeter and accompanying water balance, since its installation in January 1972, shown in Figure 4, has been reported previously in detail up to July 1973 (Lau et al. 1972, 1974). The constituent values of the grass-sod lysimeter percolate from its inception in January 1972 to February 1975 are tabulated in Appendix Table B-4 and the monthly water balance from July 1972 through February 1975 are shown in Appendix Table B-5. The combination of soil and turf in the sod lysimeter removed nearly all detectable levels of total nitrogen and phosphate, between 90 and 95% of the suspended solids and total organic carbon, nearly 90% of the potassium and approximately 70% of the silica dioxide from the applied effluent. The reduction in the silica dioxide concentration of the leachate from that of the secondary effluent suggests resilication of the soil profile and a reversal of the natural tropical soil genesis patterns (Roy et al. 1971; Tenorio et al. 1970). Total nitrogen, however, was not removed effectively until after four months of operation. These results, with the exception of nitrogen, were as expected. Other parameters such as total dissolved solids, chloride and electrical conductivity appeared to be essentially uneffected. Calcium, magnesium and sulfate increased considerably from applied effluent to the percolate, thus indicating base exchange or similar phenomena. The evapotranspiration from the grass-sod lysimeter, which was determined hydraulically by actual weight differences, proved to be within a few percent of the values measured by the pan evaporation method.

As previously indicated, there is considerable concern over nitrogen, particularly the oxidizable forms of nitrite and nitrate which are essentially found in nature only in the soluble form, except for saltpeter deposits. Anion sorption can play a major role in sulfate and nitrate balances of tropical soils, however, the relatively low content of amorphous material in the Lahaina soils minimizes the importance of the sorption in the nitrate balance. Consequently, the nitrite and nitrate forms have the potential of being transported to the groundwater zone. In an attempt to quantify the apparent nitrogen deficiency, an inventory was made of the known nitrogen input and output for the lysimeter. The readily measured inputs were the applied secondary effluent and precipitation, and the outputs were the percolate and the Bermudagrass clippings. A summation of the inputs and outputs over a period of several months still leaves an "unaccounted nitrogen loss" of 39% (Lau et al. 1974). Even assigning a liberal estimate of 25% of the total nitrogen being removed in grass clippings to the roots and that portion of organic and ammonia being sorbed in the soil system (both of which would be expected to be in a reasonable steady-state), the unaccounted loss is still approximately 24%. It is assumed, at this time, that the major portion of the unaccounted nitrogen loss can be attributed to bacterial nitrification-denitrification, which can result from the alternately wet-dry operation of the lysimeter, and/or possibly through ammonia gas loss, depending on the pH of the soil water.

## OSC Field No. 240 Leachate Water Quality

With the exception of nitrogen and sulfate, the chemical constituent results from percolate collected in the point samplers from the 5 test rows of Field No. 240, between June 1972 to June 1973 as shown in the analyses of composite leachate samples (App. Table B-4) produced the same general trends for most chemical constituents as was observed for the 5-ft (1.5-m) deep grass-sod lysimeter during the same time period. Chloride and sodium remained in the same range as the applied secondary effluent; total organic carbon decreased from a median of 24 mg/ℓ in the applied secondary effluent to a value of approximately 8 mg/ℓ, and calcium increased from a median value of 10 mg/ℓ in the secondary effluent to greater than 70 mg/ℓ in the point sampler leachate. The calcium values increased considerably higher than the 145% increase in the grass-sod lysimeter. This sharp increase may be attributed possibly to the large amount of calcium-bearing coral used for an airplane runway at this particular site during World War II.

Electrical conductivity of the point sampler leachate ranged from 50 to 200 μmhos/cm higher than in the applied effluent, whereas, the conductivity level was changed very little in passage through the grass-sod lysimeter. This may be in part a reflection of the high quantity of calcium leaching or base exchange. Sulfate decreased from approximately 50 mg/ℓ in the applied secondary effluent to about 20 mg/ℓ in the point sampler leachate as compared to the sod lysimeter where the concentration of sulfate increased from 48 mg/ℓ applied effluent to 75 mg/ℓ percolate during the same 1-yr period.

Potassium in the leachate from the point samplers, with some fluctuations, remained less than 1 mg/ℓ to slightly greater than 3 mg/ℓ after the first two months of operation, compared to a median of 10 mg/ℓ for applied secondary effluent, which is essentially the same reaction that occurred in the grass-sod lysimeter. Silica dioxide also exhibited the same general trend as potassium in both the point samplers and the grass-sod lysimeter. The concentration of silica dioxide in the point samplers ranged from 10 to 30 mg/ℓ compared to a median value of 70 mg/ℓ for the applied secondary effluent.

Nitrogen was extensively monitored in the 5 test rows of Field No. 240. Inasmuch as nitrate was the predominant nitrogen form in the leachate, it was used to monitor the individual point samplers where the sample volume was minimal. Determinations for other forms of nitrogen that comprise total nitrogen were perfomed on a composite of the individual samples remaining after nitrate analysis.

The sugarcane crop in Field No. 240 had already received the scheduled plantation fertilizer application of 356 kg/ha (318 lb/acre) prior to the initiation of secondary effluent application. The total nitrogen concentration in the applied effluent ranged from median monthly values of nearly 8 mg/ℓ to over 20 mg/ℓ as N with a total 396-cm (156-in.) hydraulic depth which resulted in an additional nitrogen load of 518 kg/ha (462 lb/acre) over a 1-yr period. The additional nitrogen from secondary effluent resulted in a nearly uniform nitrate concentration increase in the point sampler leachate that reached, after eight months of application, maximum median values which ranged from approximately 10 to 15 mg/ℓ as nitrogen. However, as shown in Table 20, this coincided with a period of unusually low seasonal rainfall. The nitrogen concentration from the leachate in adjacent rows receiving normal irrigation ditch water was generally less than 1.0 mg/ℓ. These results tentatively indicate that sugarcane is not nearly as effective a nitrogen sink as bermudagrass.

## Quality of Bare Soil Leachate

As previously stated the bare soil lysimeter was operated in two phases: August 1973 to April 1974 and then relocated approximately 46 m (150 ft) to a new location due to the construction of an electric transformer station at the original bare soil lysimeter site. Operation of the relocated bare soil lysimeter commenced on 17 April 1974 and continued through February 1975.

In both cases the lysimeter was carefully repacked with soil at about the same density and position as the soil material excavated to construct the lysimeter. Although the two lysimeter locations were only separated by approximately 46 m, they were recently managed in significantly different ways. Both sites had been planted in pineapple for several decades, however, the first site had its top soil reshaped, without further cultivation, during the construction of the Mililani STP in 1968, whereas, the second site had been in cultivated pineapple until approximately the last two years. Thus, the second site had at least two additional 2-yr growing cycles than the first site, which results in a more recent nitrogen fertilizer application. Pineapple cultivation usually requires a higher nitrogen fertilizer application than sugarcane.

The various water quality constituent parameters from individual bare soil lysimeter percolate samples are tabulated in Appendix Table B-7. Essentially the same general applied secondary effluent-percolate removal performance occurred in the bare soil lysimeter as was observed in the grass-sod lysimeter except for nitrogen. The median monthly nitrogen and phosphorus values for Phases I and II are shown in Table 21. In addition the

TABLE 21. HYDRAULIC AND NUTRIENT ASPECTS OF BARE SOIL LYSIMETER, NEAR MILILANI STP

| | DATE | RAINFALL[1] | APPLIED EFFLUENT | | | | | EVAPORATION[3] | PERCOLATE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TOTAL N | | $PO_4$-P | | | | TOTAL N | | $PO_4$-P | |
| | | in./mo | in./mo | mg/ℓ[2] | lb/ acre-mo | mg/ℓ | lb/ acre-mo | acre-mo | in./mo | mg/ℓ | lb/ acre-mo | mg/ℓ | lb/ acre-mo |
| PHASE I | 1973 | | | | | | | | | | | | |
| | Aug. | 0.89 | -- | 0.7[4] | -- | --[4] | -- | -- | -- | 13.7 | -- | 0.05 | -- |
| | Sept. | 0.99 | -- | 0.7[4] | -- | --[4] | -- | -- | -- | -- | -- | -- | -- |
| | Oct. | 2.51 | -- | 0.7[4] | -- | --[4] | -- | -- | -- | -- | -- | -- | -- |
| | Nov. | 3.14 | -- | 22.2 | -- | 12.67 | -- | -- | -- | 9.9 | -- | 0.05 | -- |
| | Dec. | 5.98 | -- | 20.9 | -- | 13.22 | -- | -- | -- | 19.4 | -- | ND* | -- |
| | 1974 | | | | | | | | | | | | |
| | Jan. | 8.69 | -- | 24.7 | -- | 14.27 | -- | -- | -- | 22.6 | -- | ND* | -- |
| | Feb. | 4.34 | -- | 17.3 | -- | 13.54 | -- | -- | -- | -- | -- | -- | -- |
| | Mar. | 5.79 | -- | 20.1 | -- | 12.82 | -- | -- | -- | -- | -- | -- | -- |
| | Apr. (1-16) | 0.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PHASE II Lysimeter relocated | Apr. (17-30) | 3.43 | 5.5 | 24.6 | 30.7 | 10.82 | 13.5 | -- | 2.64 | 11.8 | 7.1 | 0.02 | -- |
| | May | 2.84 | 11.0 | 26.7 | 66.6 | 11.15 | 27.8 | 4.32 | 9.36 | 12.5 | 26.5 | ND* | 0.00 |
| | June | 0.97 | 10.0 | 19.3 | 43.7 | 10.31 | 23.4 | 4.03 | 5.99 | 17.5[5] | 23.8 | 0.01[5] | 0.01 |
| | July | 2.47 | 10.0 | 16.8 | 38.1 | 10.97 | 24.9 | 4.61 | 8.90 | 22.5 | 45.4 | 0.01 | 0.02 |
| | Aug. | 0.31 | 11.0 | 13.3 | 33.2 | 8.47 | 21.1 | 4.32 | 6.93 | 18.5 | 29.1 | 0.01 | 0.02 |
| | Sept. | 8.78 | 3.0 | 13.3 | 9.0 | 9.72 | 6.6 | 3.49 | 7.35 | 28.0 | 46.6 | 0.01 | 0.02 |
| | Oct. | 2.81 | 7.25 | 16.1 | 26.5 | 8.87 | 14.6 | 3.39 | 7.06 | 31.9 | 51.0 | 0.01 | 0.02 |
| | Nov. | 4.31 | 0.6 | 17.8 | 2.4 | 9.70 | 1.3 | 2.46 | 4.10 | 25.0 | 23.2 | 0.01 | 0.01 |
| | Dec. | 1.20 | 2.0 | 20.8 | 9.4 | 10.37 | 4.7 | 2.03 | 1.17 | 29.0 | 7.7 | 0.01[5] | 0.00 |
| | 1975 | | | | | | | | | | | | |
| | Jan. | 7.67 | 0.0 | -- | 0.0 | -- | 0.0 | 2.05 | 5.63 | 29.0[6] | 37.0 | ND* | 0.00 |
| | Feb. | 5.90 | 0.0 | -- | 0.0 | -- | 0.0 | 2.10 | 4.59 | 29.0[6] | 30.2 | ND* | 0.00 |
| | TOTAL | | | -- | 259.6 | -- | 137.9 | | | -- | 327.6 | -- | 0.10 |

*ND = none detected.

[1] Chemical composition of rainfall neglected.

[2] Median values.

[3] Hydraulically measured by weight difference of lysimeter.

[4] Tap water.

[5] Interpolated value.

[6] Assume concentration to be equal to December 1974 value.

hydraulic loading aspects for Phase II is also presented, thus, total nitrogen and phosphate monthly loading rates could be determined.

Tap water, with very little nitrogen and phosphorus concentrations, was used as the applied liquid during the initial three months of the Phase I operation. The percolate quality results indicated that nitrogen was being leached out while very little phosphate was emitted from the lysimeter. The monthly nitrogen and phosphate input and output rates for Phase II operation indicate that approximately 118 kg (260 lb) of nitrogen were applied while nearly 149 kg (328 lb) were removed in the percolate, thus, illustrating nitrogen leaching is still occurring. During this same time period, essentially 100% of the nearly 63 kg (138 lb) of phosphate was not recovered in the percolate. It is obvious that before meaningful nitrogen related results from the operation of the bare soil lysimeter can be obtained the lysimeter will have to be operated for a sufficiently (undetermined) long time period to leach out the excess residual entrained nitrogen.

## OSC Field No. 246 Test Plot, Water Quality Parameters

Of all the monitored chemical constituents passing through the soil profiles under the varied hydraulic and nutrient loading and meteorological conditions encountered in the OSC Field No. 246 test plots and lysimeters, nitrogen appears to be of prominent importance. Nitrogen's prominance is due to a combination of attributes which include: its use as a major component of most fertilizers; its reported adverse effect on matured sugarcane; being essentially soluble in the oxidized forms (nitrite and nitrate); its relationship to the disease of infants, methomoglobinemia, in nitrate concentrations exceeding 10 mg/ℓ as N; and its potential role in the eutrophication of bodies of water receiving nitrogen loads.

As previously indicated, the studies in the test plots of Field 246 can be segregated basically into 2 categories: lysimeters D and E, and 30 test plots.

The monthly hydraulic and nitrogen values for lysimeters D and E are tabulated in Table 22. The individual chemical constituents analyzed for lysimeters D and E are presented in Appendix Tables B-8 and B-9, respectively. For the 18-mo period, the approximately 254 cm (100 in.) of secondary effluent application to lysimeter E and 224 cm (88 in.) of ditch water application to lysimeter D, together with 155 cm (61 in.) of rainfall on both lysimeters, produced evapotranspiration losses of about 239 and 229 cm (94 and 90 in.), respectively, with percolation through the 5-ft (1.5-m) soil profiles of 170 and 150 cm (67 and 59 in.), respectively. The chemical constituents analyzed for applied ditch water are tabulated in Appendix Table B-10. On an annual basis, August 1973 through July 1974, the evapotranspiration loss was 143 cm (56.4 in.) and 159 cm (62.5 in.), respectively, for lysimeters E and D. Although these values have an evaporation difference of 8%, they are considered to be within a reasonable range for the period of time and conditions under review. Soil moisture differences within the lysimeters may alter these values, however, this source of potential error decreases as the length of monitoring time increases.

The effective pore volume of the soil, defined in this study as the volume of water that will drain freely from a thoroughly wetted volume of soil under natural gravity conditions is approximately 15%. Thus, the 5-ft (1.5-m) deep lysimeters should have a theoretical complete free soil water change for approximately each 23 cm (9 in.) of percolate. On this assumption, the

## TABLE 22. HYDRAULIC AND NITROGEN ASPECTS OF LYSIMETERS D AND E, OSC FIELD NO. 246

| DATE | MONTHLY RAINFALL in. | N-FERT. APPL. lb/acre | APPL. SECOND. EFFL. |  |  | LEACHATE |  |  | EVAPO-TRANS-PIRATION in./mo |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | TOTAL N |  |  | TOTAL N |  |  |
|  |  |  | QUANTITY in./mo | mg/ℓ | lb/ acre-mo | QUANTITY in./mo | mg/ℓ | lb/ acre-mo |  |
| LYSIMETER D |  |  |  |  |  |  |  |  |  |
| 1973 |  |  |  |  |  |  |  |  |  |
| May 30 | 0.58 | 100 | 8.14 | 0.1 | 0.2 | 2.15 | 12.7 | 6.2 | 6.57 |
| July | 0.93 |  | 7.40 | 0.2 | 0.4 | 1.30 | 7.2 | 2.1 | 7.08 |
| Aug. 15 | 0.89 | 150 | 8.14 | 0.3 | 0.6 | 0.00 | 27.0[1] | 0.0 | 9.03 |
| Sept. | 0.99 |  | 8.88 | 0.2 | 0.4 | 0.19 | 46.7 | 2.0 | 9.68 |
| Oct. | 2.51 |  | 7.77 | 0.2 | 0.4 | 1.78 | 41.5 | 16.7 | 8.50 |
| Nov. | 3.14 |  | 4.07 | 0.2 | 0.2 | 2.89 | 11.6 | 7.6 | 4.32 |
| Dec. | 5.98 |  | 4.44 | 0.2 | 0.2 | 4.89 | 1.1 | 1.2 | 5.53 |
| 1974 |  |  |  |  |  |  |  |  |  |
| Jan. | 8.69 |  | 0.00 | 0.2 | 0.0 | 10.00 | 0.8 | 1.8 | -1.31[2] |
| Feb. | 4.34 |  | 4.44 | 0.1 | 0.1 | 4.81 | 0.4 | 0.4 | 3.97 |
| Mar. | 5.79 |  | 0.00 | 0.1 | 0.0 | 4.03 | 0.1 | 0.1 | 1.76 |
| Apr. | 4.23 |  | 4.44 | 0.1 | 0.1 | 4.21 | 0.2 | 0.2 | 4.46 |
| May | 2.84 |  | 5.55 | 0.1 | 0.1 | 3.02 | 0.1 | 0.1 | 5.37 |
| June | 0.97 |  | 2.22 | 0.7 | 0.4 | 0.89 | 0.1 | 0.1 | 2.30 |
| July | 2.47 |  | 8.12 | 0.1 | 0.2 | 1.69 | 0.2 | 0.1 | 8.90 |
| Aug. | 0.31 |  | 7.40 | 0.3 | 0.5 | 3.41 | 0.1 | 0.1 | 4.30 |
| Sept. | 8.78 |  | 3.70 | 0.1 | 0.1 | 8.38 | 0.1 | 0.2 | 4.10 |
| Oct. | 2.81 |  | 0.00 | 0.1 | 0.0 | 1.86 | 0.3 | 0.1 | 0.95 |
| Nov. | 4.31 |  | 3.70 | 0.6 | 0.5 | 3.56 | 0.1 | 0.1 | 4.45 |
| TOTAL | 60.56 |  | 88.41 |  | 4.4 | 59.06 |  | 39.1 | 89.91 |
| LYSIMETER E |  |  |  |  |  |  |  |  |  |
| 1973 |  |  |  |  |  |  |  |  |  |
| June | 0.58 | 100 | 8.14 | 20.7 | 39.4 | 3.85 | 12.1 | 10.6 | 4.87 |
| July | 0.93 |  | 15.75 | 18.1 | 63.1 | 6.57 | 8.0 | 11.9 | 10.11 |
| Aug. 15 | 0.89 | 75 | 9.63 | 20.3 | 47.5 | 3.94 | 12.6 | 11.2 | 6.57 |
| Sept. | 0.99 |  | 8.88 | 19.6 | 39.4 | 1.48 | 20.3 | 6.8 | 8.39 |
| Oct. | 2.51 |  | 7.77 | 23.2 | 40.8 | 4.45 | 23.3 | 23.5 | 5.83 |
| Nov. | 3.14 |  | 4.44 | 22.2 | 22.3 | 2.59 | 20.4 | 12.0 | 4.99 |
| Dec. | 5.98 |  | 4.44 | 20.9 | 21.0 | 7.93 | 18.1 | 32.5 | 2.49 |
| 1974 |  |  |  |  |  |  |  |  |  |
| Jan. | 8.69 |  | 0.00 | 24.7 | 0.0 | 8.13 | 16.1 | 29.6 | 0.56 |
| Feb. | 4.34 |  | 4.44 | 17.3 | 17.4 | 4.65 | 4.5 | 4.7 | 4.13 |
| Mar. | 5.79 |  | 0.00 | 20.1 | 0.0 | 3.97 | 1.0 | 0.9 | 1.82 |
| Apr. | 4.23 |  | 4.44 | 24.6 | 24.7 | 3.22 | 0.5 | 0.4 | 5.45 |
| May | 2.84 |  | 8.88 | 26.7 | 53.7 | 2.40 | 0.6 | 0.3 | 9.32 |
| June | 0.97 |  | 4.44 | 19.3 | 19.4 | 2.90 | 1.3 | 0.9 | 2.51 |
| July | 2.47 |  | 4.44 | 16.8 | 16.9 | 2.56 | 1.7 | 1.0 | 4.35 |
| Aug. | 0.31 |  | 11.10 | 13.3 | 33.5 | 0.70 | 0.8 | 0.1 | 10.71 |
| Sept. | 8.78 |  | 0.00 | 13.3 | 0.0 | 2.50 | 0.6 | 0.3 | 6.28 |
| Oct. | 2.81 |  | 0.00 | 16.1 | 0.0 | 2.60 | 0.7 | 0.4 | 0.21 |
| Nov. | 4.31 |  | 3.70 | 17.8 | 14.9 | 2.13 | 1.0 | 0.5 | 5.88 |
| TOTAL | 60.56 |  | 100.48 |  | 454.0 | 66.57 |  | 147.6 | 94.47 |

NOTE: Leachate collected by means of ceramic point samplers.

[1] Interpolated between two adjacent months.

[2] Negative value results from apparent changes in moisture content which were not utilized in the determinations of the evaporation rate for Lysimeters D and E.

18-mo operation of lysimeters D and E shown in Table 22 would represent approximately 7 effective pore volumes.

The correlation between the change in leachate nitrogen concentration as compared to the number of effective pore volumes passed through the soil column is not apparent. A significant portion of the applied nitrogen under normal plantation practices is taken up by the sugarcane crop and a portion of the ammonia and organic nitrogen is sorbed into the soil system. These latter nitrogen forms are, under certain conditions, biologically converted to the oxidizable nitrogen forms (nitrite and nitrate) which are considered in nature only to be found in soluble form. Nitrogen gas loss from the soil system through the nitrification-denitrification process, or possibly by means of direct ammonia gas loss at higher basic pH values, is difficult to determine quantitatively except by means of a nitrogen inventory. Another complicating factor could be nitrogen fixation by soil bacteria. In this study nitrate comprises at least 95% of the oxidizable nitrogen in lysimeter leachates.

In an attempt to estimate the fate of nitrogen through the lysimeter soil profile, a nitrogen inventory, shown in Table 23, was made for both lysimeters D and E using results from Table 22 and an assumed nitrogen concentration of 0.4 mg/ℓ for rainfall. The "unaccounted for" nitrogen (N), as can be observed in Table 24, of 293 and 123 kg/ha (261 and 110 lb/acre), respectively, for lysimeters E and D, has important implications for future consideration of secondary effluent as an irrigation source.

Of the 290 kg/ha (259 lb/acre) of nitrogen applied to lysimeter D for the 18-mo period used in Table 23, 44 kg/ha (39 lb/acre) of leachate essentially escaped the root zone and 123 kg/ha (110 lb/acre) is assumed to be in the sugarcane, based on Table 13, for Plots A, which was irrigated with sewage effluent. The 44 kg/ha of nitrogen in the leachate or approximately 15% of the applied total, which is primarily in the nitrate form at concentrations above 1 mg/ℓ, has the potential of eventually reaching the groundwater zone. This compares to the 166 kg/ha (148 lb/acre) of leachate from lysimeter E on 23% of the nitrogen input. Based on the results of Table 13, for Plots C, 252 kg/ha (225 lb/acre) is assumed to be in the sugarcane. Under actual practices the high input would undoubtedly be reduced through dilution and/or reduction in the quantity of fertilizer applied. The "unaccounted for" nitrogen of 293 and 123 kg/ha (261 and 110 lb/acre) for lysimeters D and

TABLE 23. NITROGEN INVENTORY FROM JUNE 1973 THROUGH NOVEMBER 1974 FOR LYSIMETERS D AND E, OSC FIELD NO. 246

| | | |
|---|---|---|
| LYSIMETER D | INPUT N: | |
| | Fertilizer | 250 lb/acre |
| | Ditch Water | 4 " |
| | Rainfall[1] | 5 " |
| | Total Input N | 259 lb/acre |
| | OUTPUT N: | |
| | Leachate | 39 lb/acre |
| | Harvested Sugarcane[2] | 110 " |
| | Total Output N | 149 lb/acre |
| | ΔN | 110 lb/acre |
| LYSIMETER E | INPUT N: | |
| | Fertilizer | 175 lb/acre |
| | Secondary Effluent | 454 " |
| | Rainfall[1] | 5 " |
| | Total Input N | 634 lb/acre |
| | OUTPUT N: | |
| | Leachate | 148 lb/acre |
| | Harvested Sugarcane[3] | 225 " |
| | Total Output N | 373 lb/acre |
| | ΔN | 261 lb/acre |

NOTE: Values rounded off to the nearest whole number; lb/acre x 1.121 = kg/ha.

[1] Assume total N in the rainfall to be 0.4 mg/ℓ.

[2] Assume N content to be equal to the value obtained from Plot A (Table 13).

[3] Assume N content to be equal to the value obtained from Plot C (Table 13).

TABLE 24. TOTAL DISSOLVED SOLIDS CHARACTERISTICS OF VARIOUS FIELD LYSIMETERS

| DATE | TOTAL DISSOLVED SOLIDS--MONTHLY MEDIAN | | | |
|---|---|---|---|---|
| | INPUT | PERCOLATE | | |
| | Secondary Effluent | Bare Soil Lysimeter | D Lysimeter | E Lysimeter |
| | mg/ℓ | | | |
| July 1973 | 327 | -- | 394 | 538 |
| Aug. | 290 | 336 | -- | 721 |
| Sept. | 198 | -- | 808 | 699 |
| Oct. | 311 | -- | 966 | 680 |
| Nov. | 353 | 296 | 581 | 622 |
| Dec. | 311 | 280 | 379 | 580 |
| Jan. 1974 | 232 | 284 | 398 | 450 |
| Feb. | 324 | -- | -- | 402 |
| Mar. | 315 | -- | 336 | 419 |
| Apr. | 337 | 190 | 318 | 397 |
| May | 383 | 203 | 230 | 400 |
| June | 360 | -- | 310 | 380 |
| July | 353 | -- | 365 | 415 |
| Median of monthly median values | 315 | 282 | 394 | 450 |

E, respectively, could possibly be ascribed to the sorption process in the soil system or nitrogen gas losses. As previously stated, on the basis of all available pertinent information, nitrogen in the percolate has stood out as the single most important chemical parameter that appears in quantities at concernible levels. Chloride, on the other hand, which is reflective of total salt, has been and will continue to be the single most convenient and pertinent indicator of groundwater quality in Hawaii. However, in the case of the Mililani STP effluent, chloride appears virtually independent of total dissolved solids (TDS).

A time series study of the nitrogen concentration in the percolate of Plots A, B, and C reveals high nitrogen concentration of about 20 mg/ℓ as N occurring only at the beginning followed by a gradual lowering in nitrogen concentration, as shown in Appendix Table B-11. The individual analysis of the other analyzed constituents from the percolate collected in the ceramic points in Plots A, B, and C are also shown in Appendix Table B-9. For Plots A, the percolate nitrogen was not less than the effluent irrigated plots during the first 6 to 7 months, however, it dropped thereafter to one or less mg/ℓ. It is interesting to note the coincidence of the high nitrogen period and the commercial fertilization period. In Plots C, the percolate nitrogen levelled off at about 3 mg/ℓ. In Plots B, the percolate nitrogen levelled off to one or less mg/ℓ as was the case for Plots A.

The total percolate quantity is of considerable interest not only for nitrogen considerations but also for the potential accretion of material in any intercepting subsurface water body; however, there is no precise direct measurement possible on a practical scale for the test plots A, B, and C. Nevertheless, indirect methods can be employed by correlating the measured evaporation quantities of lysimeters D and E (Table 22) with the pan evaporation rates of Table 21 together with the applied irrigation liquid and rainfall to obtain the calculated percolation quantities shown in Appendix Table B-12. From these determinations, the quantity of water calculated to percolating below the root zone (assumed to be unavailable to sugarcane) amounted to 48, 41, and 41%, of the rainfall and irrigation liquid, respectively for Plots A, B, and C.

In terms of the quantities of nitrogen, percolated below the root zone over the period February 1973 through November 1974, approximately 232, 224, and 211 kg/ha (207, 200, and 188 lb/acre), respectively were calculated to be derived from Plots A, B, and C. The unaccounted for nitrogen in the test plots using the indirect determination method is 77, 179, and 235 kg/ha (69, 160, 210 lb/acre), respectively, for Plots A, B, and C. Although the period of study for the field plots was 4 months longer than that for lysimeters D and E (Table 23), the unaccounted for nitrogen of 77 kg/ha (69 lb/acre) for Plot A compares to the unaccounted for nitrogen of 123 kg/ha (110 lb/acre) for lysimeter D (both receiving ditch water); while 235 kg/ha (210 lb/acre) for Plot A compares to the 292 kg/ha (261 lb/acre) sewage effluent.

As to the chloride in the field plot percolates, the initial concentration varies around 120 mg/ℓ with sporadic peaks up to 250 mg/ℓ. It is interesting to note that all plots produced percolate chloride at a level higher than the chloride contained in the irrigation water, namely, 15 mg/ℓ for the ditch water and 50 mg/ℓ for the effluent, and that this period coincides with the application of commercial fertilization in the form of potassium chloride to all plots. After the initial period, the percolate chloride dropped in concentration and levelled off at about 15 mg/ℓ for the ditch water irrigated plots (A) and 50 mg/ℓ for the effluent irrigated plots (C). The fact that the ultimate concentration approximately equals the concentration in the applied irrigation waters, with due consideration given to the dilution effect of percolated rainwater, is expected because of the conservative nature of chloride.

The effect of liquid passing through the soil column of the bare soil, E and D lysimeters over the period July 1973 through July 1974, as measured by TDS, is shown in Table 24. For all three lysimeters rainfall traversing through the soil diluted the concentration of the percolate. As previously mentioned, lysimeter D was irrigated with ditch water which had a median TDS concentration of 106 mg/ℓ, whereas, the bare soil and E lysimeters received secondary effluent which had a median TDS of 315 mg/ℓ. It is interesting to note that the TDS median of the percolate for the bare soil lysimeter was 282 mg/ℓ while the percolate from lysimeters E and D received a quantity and quality of fertilizers that were in the normal range for sugarcane plantation practice, while the bare soil lysimeter did not receive a fertilizer application.

The TDS concentration of the percolate of lysimeter E compared to D, 450 mg/ℓ to 394 mg/ℓ, respectively, indicated that the full strength of secondary effluent only increased the percolate TDS by about 14%. The concentration of the percolate from all lysimeters was below the desirable TDS level of 500 mg/ℓ for drinking water, as established in the 1962 U.S. Public Health Service Drinking Water Standards.

The time series of nitrogen and chloride observed in the field plots were generally confirmed in the field lysimeters (one receiving 2 years of effluent and the other 2 years of ditch water) grown with sugarcane.

It is interesting to note further that grassland can produce percolate equal to about 55% of the total combined water received from irrigation and rain for the period July 1972 through February 1975.

## MAJOR SUMMARY CONCLUSIONS

Mililani STP secondary treated and chlorinated domestic and municipal sewage effluents containing insignificant amounts of toxic chemicals represent a generally usable water supply for irrigation of sugarcane and grasslands in central Oahu.

Application of sewage effluent for the first year of a 2-yr cane crop increases the sugar yield by about 6% compared with the control plots. However, when sewage effluent was applied for the entire 2-yr crop cycle, sugar yield was reduced by about 6% and the cane quality by about 16% even though the total cane yield increased by about 11%.

There was no apparent evidence of significant surface clogging of the soil or of soil chemical properties impairment resulting from sewage effluent application for irrigating the first full cycle 2-yr sugarcane crop. Under a no-moisture stress condition, a 1 mgd supply is sufficient to irrigate 61 to 81 ha (150 to 200 acres) of sugarcane by the furrow method.

The quality of percolate from the effluent-irrigated sugarcane-cultured soil is of acceptable concentration from the standpoint of groundwater quality protection with the only possible concern for nitrogen which sporadically exceeded the 10 mg/ℓ limit for drinking water during the first 6 to 7 months of growth. However, similar exceedance occurred in the ditch water irrigated sugarcane plots and the plots irrigated with effluent during the first year and ditch water during the second year. Furthermore, there was no major difference in the total quantity of nitrogen produced in the percolate among the three different treatments. Phosphorus, potassium, suspended solids, biochemical oxygen demand, total organic carbon, and boron were removed effectively from the applied effluent by means of irrigation; however, chloride in the percolate was essentially unaffected except for a transient increase during fertilization. Both total dissolved solids and chloride in the percolates met the drinking water standards.

Human enteric viruses have been shown to be present in the majority of effluent samples examined and, hence, are applied with the effluent to the irrigated field. However, the absence of these viruses in all sugarcane and grass percolates sampled over a 2-yr period plus other project virus studies conducted, suggest strongly that the possibility of contaminating deep underground water sources is extremely remote.

Survival of poliovirus was minimal in an open field area which was exposed to direct sunlight, high temperature, and dessication. In contrast, the viability of the virus was maintained for up to 2 months for a field of mature sugarcane where the virus was protected from physical elements.

Bermudagrass, with periodic cutting and harvesting, proves to be an excellent utilizer of sewage effluent applied nitrogen and, thus, excels sugarcane from the standpoint of groundwater protection. Essentially no nitrogen was recovered from the percolate at the 5-ft depth below the grassed surface, whereas nearly 25% of the total nitrogen applied from chemical fertilizer and sewage effluent was recovered at the same depth in the sugarcane culture. Up to 100 acres of grassland may be irrigated with 1 mil gal of effluent under a no-moisture stress condition. However, fallow or bare soil has been demonstrated to be incapable of removing significant amounts of nitrogen from the applied effluent.

## MAJOR SUMMARY RECOMMENDATIONS

1. Disinfected sewage effluent of composition similar to that used in the Mililani study may be used for irrigation of sugarcane in the first year followed by irrigation with surface water in the second year. However, use of the effluent to irrigate sugarcane for the entire 2-yr crop cycle without added treatment will result in a poorer sugar yield.

2. Establishing a virus monitoring and quality control program for the treated sewage effluent before application is an essential part of a recycling by irrigation program. Furthermore, development of more effective methods of virus inactivation prior to recycling is highly recommended.

Precautionary sanitation measures for field workers should be practiced.

3. Further research on the use of effluent for irrigating sugarcane is desirable, specifically:
   a. Confirm the yield and assess long-term effects on the soil by repeating the first ratoon test plots study for a second crop cycle
   b. Test with various dilutions of sewage effluent and with chemical ripeners to improve the yield
   c. Investigate plugging of drip orifices in irrigation tubings in anticipation of extensive use in the near future.

## PROVISIONAL PRINCIPLES AND GUIDELINES FOR IRRIGATION WITH SEWAGE EFFLUENT IN HAWAII

In Hawaii the concept of water recycling from waste waters for irrigation emerged in recent years as a result of one or a combination of several major situations: (1) as an alternative to ocean disposal, (2) to augment the natural surface and subsurface water sources for irrigation supply and, hence, afford an alternative in meeting the long-term water needs to meet all domestic, agricultural, and industrial requirements.

The situations mentioned above represent opportunities as well as possible problems. Incidental to the application of effluent on land is the recharge of the groundwater. On the other hand, Hawaii's fresh groundwater sources must be protected from all possible contamination including that through application of sewage effluent on agricultural lands. Sugarcane as a cash crop and grassland as in golf courses and public parks are presently the potential high volume users of the effluent.

As the concept of water and nutrient recycling is being developed and tested, several interrelated principles have emerged and may well serve as provisional guidelines to aid consideration of waste water recycling in Hawaii. As presented here, waste water is limited to domestic and municipal sewage, and excludes agricultural and industrial waste waters.

### Effluent Quality Requirements for Irrigation

Secondary treated and chlorinated domestic and municipal sewage effluent containing insignificant amounts of toxic chemicals represents a usable water supply for irrigation because it possesses many acceptable and even desirable water quality parameters for the crops presently considered in Hawaii. Nitrogen in the effluent applied to sugarcane during the second year of growth can be undesirable from the standpoint of sugar yield. However, management techniques including dilution, post-secondary treatment, and storage of the effluent can improve their acceptability. Generally speaking, a desirable sewage effluent for the crops considered is characterized by its nutrient content with concentrations commensurate with the crop requirement, by the low concentration of total dissolved solids, boron, sodium, suspended solids, and grease, and by its acceptability for groundwater and public health protection.

From the standpoint of groundwater quality protection, the effluent should possess low concentrations of chloride and total dissolved solids. This requirement is especially important in the case of sugarcane because chemical fertilizers that are added in addition to the nutrients in the effluent to promote initial growth contribute additional leachable residue to the percolating water in the subsurface.

Toxic chemicals, such as heavy metals and pesticide residues, at this time receive national attention in the context of the safety of drinking water because many of the species and their concentration in drinking water potentially may have an effect on human health with continuous consumption of this water. Domestic sewage without the admixture of industrial waste water should be reasonably free of toxic chemicals but monitoring is a necessary and desirable requirement to assure the quality of the effluent.

Nutrient contents present in sewage effluent generally are desirable for plant growth. These include the major nutrients: nitrogen, phosphorus, and potassium, and micronutrients. Secondary effluent retains a considerable amount of the nutrients present in the raw sewage because secondary treatment processes are not designed to effectively remove nutrients. Sewage effluent, however, does not necessarily contain balanced nutrients for all plants, hence supplementary chemical fertilizers may be required, such as is the case for sugarcane. On the other hand, additions of nitrogen are not desirable after the first 10 to 12 months of the crop growth. It is only through plant yield and pathology observations that the ultimate crop response can be determined as was done in this project. Grasslands generally can utilize the sewage nutrients on a year-round basis without chemical fertilizers; however, addition of chemical fertilizers should promote more lush growth.

Nitrogen in its nitrate form, in concentrations exceeding 10 mg/ℓ as N, is undesirable in drinking water for infant health reasons (methemoglobinemia). Plants, like sugarcane, that cannot fully utilize and retain all of the applied nitrogen allow nitrogen to escape the root zone and potentially add to the underlying groundwater. This fact is demonstrated by this project. To this end, it is desirable to employ special measures to reduce the quantity of excess nitrogen and restrict its movement out of the root zone and the field.

Boron which is deleterious to sensitive crops is generally below the level of concern in secondary treated sewage effluent.

Sodium in soil water exchanges with calcium in the soil thereby causing an expansion of the clay structure and physical swelling of the soil and a reduction of the soil permeability. A level of suspended solids exceeding 10 mg/ℓ is known to result in a clogging soil surface deposit. In similar fashion, grease in irrigation water adversely affects the infiltration capacity of soils, therefore high concentrations of sodium, suspended solids, and grease in irrigation water are undesirable. Secondary sewage effluent produced by well designed and operated treatment plants should be free of excesses in suspended solids and grease.

Infiltration of brackish or salt water into sewer pipes, a phenomenon which many Hawaii sewerage systems are susceptible to because of their construction in coastal areas below the groundwater table, presents a potential problem in terms of both sodium, chloride, and salinity. Monitoring these quality parameters appears to be essential.

Consistency of the effluent quality through high performance of the sewage treatment plant operation and maintenance is also essential for successful crop growth. It is especially true for sugarcane which has a prolonged 2-yr growth period in Hawaii.

Microbiological and public health aspects are extremely significant and therefore require separate attention.

## Soils and Plants

Soils that have the desirable physical and chemical properties for selected crops, with other than sewage as irrigation water, should be the starting point in soil selection and management for sewage irrigation. These may include such factors as water holding and drainage properties, soil acidity, nutrient availability, and others.

Continued applications of sewage effluent may alter or even impair the desirable properties of good agricultural soils. The sodium-calcium relation already mentioned is an example. The nutrient content in soils, such as available nitrogen, phosphorus, and potassium, will change continuously with crop growth, fertilizer application, leaching and soil physical-chemical and microbiological environment. However, impairment of the project soil was not apparent in the soil planted with cane and subjected to effluent irrigation for up to 2 years. In this test, an apparent accretion of phosphorus and potassium in the soil was experienced. Effects of changes are apparently the greatest at the initial point of contact between the effluent and the soil such as was noted by an increase in phosphorus and a drop in acidity. Continuous monitoring during successive crops is clearly desirable to determine any long-term effects on the soil.

Adsorptive capacity of a soil has been demonstrated to be the principal factor related to virus removal from the percolating water. The Oxisol Lahaina soils which are the project soils and the soils on which most sugarcane is grown, exhibit exceptionally high virus adsorption capacity perhaps because of its high iron oxide content. The initial sorption capacity and continuous maintenance of this property for a soil subjected to effluent irrigation is absolutely essential for groundwater protection.

The project in of itself has been shown to be incapable of removing significant amounts of the effluent-applied nitrogen without crop or plant cover. Hence, from the standpoint of reducing the transmission of excess nitrogen to the groundwater, fallow or bare soil represents a rather important condition to be considered especially during the rainy season when heavy rainfall would result in rapid percolation.

Field preparation for sugarcane and golf-course fairways in Hawaii commonly utilizes heavy grading equipment. Relatively watertight or less permeable subsoil conditions that exist in nature or that can be created by land preparation of this type can result in perching of the percolating water and, hence, temporarily retaining or possibly diverting the downward path of the percolating water. Periodic field infiltration measurements are desirable.

The sugarcane variety, H59-3775, that was studied was capable of producing acceptable yields of cane, sugar, and juice quality when irrigated with undiluted effluent for the first 12 months followed by regular ditch water for the second 12 months. This treatment of supplying nutrients when needed was consistent with plantation practice for obtaining good sugar yield. Application of sewage effluent for the first year of a 2-yr cane crop appears to have no detrimental effect on the cane or sugar production and may be beneficial. Applications of sewage effluent for the entire crop cycle appear to benefit cane production, but lowers cane quality and commercial sugar production and is, therefore, undesirable.

Other cane varieties known for their superior cane and juice quality and their tolerance for nitrogen should be experimented with to determine their adaptability for effluent irrigation.

With periodic cutting, Bermudagrass [*Cynodon dactylon* (L.) Pers.] is an excellent user of sewage nutrients, including nitrogen. It is possible that other plants with similar thickly matted surface root systems could utilize equally well sewage nutrients and, hence, reduce concern for groundwater quality.

Although all crops that are grown in Hawaii for consumption may be tested for the effects of treated sewage effluent irrigation, psychological and health reasons may well exclude such crops as table vegetables that are consumed without cooking.

## Irrigation Methods and Quantity and Fertilization for Sugarcane and Grasslands

The rationale for irrigation is to maintain a no water stress condition (moisture above wilting point) for plants. The measurement of moisture by tensiometer is a recommended practice for determining when to irrigate.

In the case of irrigation with sewage effluent, an additional no-excess condition is highly desirable: no excess in application to produce surface tailwater, and deep percolation or perched lateral flow in the subsurface.

Storage or bypass measures are necessary during rainy periods when irrigation is unnecessary.

Under a no-moisture stress condition and by means of field furrow irrigation methods, a supply of 1 mgd is sufficient to irrigate 61.7 to 80.9 ha (150 to 200 acres) of sugarcane with the following schedule:

| | AVERAGE FREQUENCY | AVG. QUANTITY APPLIED IN EACH APPLICATION | TOTAL IRRIGATION WATER REQUIREMENT | | ACREAGE IRRIGATED |
|---|---|---|---|---|---|
| | | acre-in./ acre | acre-in./ acre/2 yr | gpd/ acre | per mgd |
| Effluent, 24 mo | | 4.2 | 170 | 6300 | 160 |
| Effluent, 12 mo, followed by 12 mo ditch water | Every 2 wk; irrigation omitted during rainy period | 4.2 | 130 | 4800 | 210 |

Sprinkler irrigation of grasslands appears to be a satisfactory method for effluent irrigation application. Up to 14,392 $m^3$ (140 acre-in.) of effluent may be applied to each acre of grassland per year or 1 mgd may be sufficient to irrigate about 40.47 ha (100 acres) of grassland under a no-moisture stress condition.

In effluent irrigation of sugarcane, addition of commercial fertilizers is desirable to give the cane a rapid start. All necessary phosphorus may be added at the beginning of the crop cycle and nitrogen and potassium may be totally applied during the first 6 months. It is a well known fact that nitrogen is the most critical element under most conditions in influencing cane tonnage and cane and juice quality. However, there is no significant adverse effect to the yield if phosphorus and potassium are added in excess. A 20-10-10 (N-P-K) effluent with initial commercial fertilizers added was apparently sufficient fertilization in the study reported herein.

It is highly desirable to be able to control or to have available consistent nutrient quality in the effluent. It should also be remembered that heavy rain periods not only eliminate the necessity of irrigation, but also leach out and, hence, negate partially the effluent nutrients added.

## Monitoring Methodology

The needs for monitoring include water quality on a relatively frequent basis, and soil and crop parameters on a relatively infrequent basis.

The water quality monitoring should consist of a schedule of location, frequency, and quality parameters to be assessed. The experience gained from this project helps narrow down the following essential (E) and desirable (D) schedules:

| MONITORING POINTS | | FREQUENCY | WATER QUANTITY PARAMETER GROUPING* | REMARKS |
|---|---|---|---|---|
| Sewage treatment plant effluent | (E) | Weekly<br>Monthly<br>6 mo | 1, 2<br>3, 4<br>5, 6 | |
| Leachate at bottom of root zone | (D) | Monthly | 1, 3 | Porvic points at selected locations |
| Groundwater (baseline quality) | (E) | Start of each growing cycle | 2, 5, 6 | Upgradient and downgradient from site as feasible |
| Groundwater (potable) | (D) | 3 mo | 2, 5, 6 | |
| Groundwater (brackish) | (D) | 6 mo | 2, 5, 6 | |

*1 = Nitrogen series;
2 = Viruses;
3 = Chloride, TDS, pH;
4 = Sodium, suspended solids, grease;
5 = Toxic chemicals: heavy metals (As, Pb, Cu, Zn, Cd, Hg, Ni, Cr) pesticides (chlordane, dieldrin, DDT, DDD, lindane, pentachlorophenol)
6 = Complete analysis (TDS, total hardness, suspended solids, BOD$_5$, TOC, N series, total P, Ca, Mg, Na, K, Cl, SO$_4$, CO$_3$, HCO$_3$, SiO$_2$, B, electrical conductivity, grease, fecal coliform, total coliform).

The laboratory analytic method for water quality parameter groupings 1, 3, 4, 5, and 6 should follow either the Standard Methods or EPA specifications. The Water Resources Research Center, University of Hawaii, may be consulted for parameter grouping 2.

Soil monitoring should be made before planting and after harvesting each sugarcane crop for the (1) adsorption/desorption capacity of viruses, and (2) selected physical and chemical properties, i.e., pH, N, P, K, Ca, Mg, SiO$_2$, both for the top few inches of soil and for standard depth of plantation practice.

Sugarcane monitoring should conform to standard industry tests, as conducted by the Hawaiian Sugar Planters' Association, such as the periodic leaf punch for specific parameters.

## Geohydrologic Considerations

A geohydrologic survey is essential as part of the project planning program to ascertain any probable pathway of deep percolation, groundwater occurrence and circulation, ambient water quality, water level, and groundwater recharge and discharges.

For water table aquifers which are far more susceptible to deep percolation than pressure aquifers, certain natural formations offer highly desirable protection and should be ascertained in the process of site selection: (1) a minimum 5-ft (1.5-m) thickness of high adsorptive capacity, (2) a minimum allowable depth to water table to be determined case-by-case on a geohydrologic study basis of the potable groundwater quality, and (3) water perching formations such as clay layers, ash bed, or buried soils if present.

## Disinfection of Sewage Effluent and Public Health Aspects

Human enteric viruses have been shown to be present in all raw sewage tested in the project and although in reduced concentrations are also present in the majority of the secondary treated effluent samples tested even after final chlorination. Thus, the treated sewage effluent used to irrigate sugarcane and grassland does contain infectious human viruses.

Complete inactivation using a more effective disinfection method than presently used and the improvement of the existing treatment plant operations should be held as the ultimate objectives. The development and use of more powerful disinfection methods (which may well be ozone and bromine chloride methods) are now being studied preliminarily in Hawaii.

Evidence was presented that the survival of sewage-borne viruses in the field is adversely affected by environmental conditions including direct sunlight, high temperature, and dessication. Thus, the possible health hazard posed by the presence of viruses in the sewage effluent used to irrigate sugarcane cannot be completely ignored. Fortunately, these viruses are not transmitted by physical contact but must be ingested before they can infect a person. Thus, the following precautionary measures for field workers should minimize the risk of contracting infection:

1. Post signs warning unauthorized persons from entering the sewage irrigation area
2. Thoroughly wash hands which may have come into direct or indirect contact with the effluent
3. Outer garments used when working with effluent should be washed daily.

## REFERENCES

American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1971. *Standard methods for the examination of water and wastewater.* 13th ed.

Berg, G. 1973. Reassessment of the virus problem in sewage and in surface and renovated waters. *Prog. Water Technol.* 3:87-94.

_____. 1973. Removal of viruses from sewage, effluents, and waters. *Bull. Wildlife Health Org.* 49:451-60.

City and County of Honolulu, Board of Water Supply. 1971. *2020 Plan.*

Clements, H.F. 1959. *Sugarcane nutrition and culture.* Indian Institute of Sugarcane Research, Lucknow, India.

Dugan, G.L.; Young, R.H.F.; Lau, L.S.; Ekern, P.C.; and Loh, P.C.S. 1974. Land disposal of sewage in Hawaii--A reality? Paper presented to 47th Ann. Conf., Water Pollution Control Federation, 6-11 October 1974, Denver, Colorado.

El-Swaify, S.A. 1972. Quality standard for irrigation water in the tropics. *Water Resources Seminar Series* 1:51-63, Water Resources Research Center, University of Hawaii.

England, B. 1972. Concentration of reovirus and adenovirus from sewage and effluents by protamine sulfate (salmine) treatment. *Appl. Microbiol.* 24:510-12.

Hill, W.F.; Akin, E.W.; and Benton, W.H. 1971. Detection of viruses in water: A review of methods and application. *Water Res.* 5:967-95.

Lau, L.S.; Ekern, P.C.; Loh, P.; Young, R.H.F.; and Dugan, G.L. 1972. *Water recycling of sewage effluent by irrigation: A field study on Oahu--First progress report for August 1971 to July 1972.* Tech. Rep. No. 62, Water Resources Research Center, University of Hawaii.

_____; Ekern, P.C.; Loh, P.C.S.; Young, R.H.F.; Burbank, N.C., Jr.; and Dugan, G.L. 1974. *Water recycling of sewage effluent by irrigation: A field study on Oahu--Second progress report for July 1972 to July 1973.* Tech. Rep. No. 79, Water Resources Research Center, University of Hawaii.

Melnick, J.L. 1960. Problems associated with the use of live poliovirus vaccine. *Amer. Jour. Public Health* 50:1013-35.

Research Resources Branch, National Institute of Allergy and Infectious Diseases. 1972. Procedure for using the dried Lim Benyesh-Melnick pools for typing enteroviruses. National Institute of Health.

Roy, A.C.; Ali, M.Y.; Fox, R.L.; and Silva, J.A.. 1971. Influence of calcium on phosphate solubility and availability in Hawaiian latosols. *Proceedings*, International Symposium on Soil Fertility Evaluation, New

Delhi, 1:757-65.

Shuval, H.I.; Fattal, B.; Cymbalista, S.; and Goldblum, N. 1969. The phase-separation method for the concentration and detection of viruses in water. *Water Res.* 3:225-40.

Spendlove, R.S.; Lennette, E.H.; Knight, C.O.; and Chin, J.N. 1963. Development of viral antigen and infectious virus in HeLa cells infected with reovirus. *Jour. Immunol.* 90:548.

Strickland, J.D.H., and Parson, T.R. 1972. *A practical handbook of seawater analyses.* 2d ed. Bull. No. 167, Fisheries Research Board of Canada, Ottawa.

Tenorio, P.A.; Young, R.H.F.; Burbank, N.C., Jr.; and Lau, L.S. 1970. *Identification of irrigation return water in the sub-surface, Phase III: Kahuku, Oahu and Kahului and Lahaina, Maui.* Tech. Rep. No. 44, Water Resources Research Center, University of Hawaii.

Wallis, C., and Melnick, J.L. 1967*a*. Concentration of enteroviruses on membrane filters. *Jour. Virol.* 1:472-77.

_____, and Melnick, J.L. 1967*b*. Concentration of viruses on aluminum and calcium salts. *Amer. Jour. Epidem.* 85:459-68.

_____, and Melnick, J.L. 1970. Detection of viruses in large volumes of natural waters by concentration on insoluble polyelectrolytes. *Water Res.* 4:787-96.

_____; Melnick, J.L.; and Fields, J.E. 1971. Concentration and purification of viruses by adsorption to and elution from insoluble polyelectrolytes. *Appl. Microbiol.* 21:703-9.

Water Resources Research Center. 1975. "Water recycling from sewage by irrigation: A field study on Oahu." 1975 Interim Progress Report, Water Resources Research Center, University of Hawaii.

Young, R.H.F.; Ekern, P.C.; and Lau, L.S. 1972. Wastewater reclamation by irrigation. *Jour. Water Poll. Control Fed.* 44(9):1808-14.

_____; Lau, L.S.; Dugan, G.L.; Ekern, P.C.; and Loh, P.C.S. 1974. Waste water reclamation by irrigation in Hawaii. Presented to the ASCE Water Resources Conference, 21-25 January 1974, Los Angeles, California. 28 p.

# APPENDICES

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APPENDIX TABLES

APPENDIX FIGURES

# TABLE A-1. MILILANI STP SEWAGE ANALYSES

| DATE | WASTE WATER TYPE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N KJELDAHL | NITROGEN as N NO$_2$+NO$_3$ | NITROGEN as N TOTAL | PO$_4$-P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS FECAL | COLIFORMS TOTAL | Cl$_2$ | ALK. as CaCO$_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | no./100mℓ |  | mg/ℓ |  |
| (1972) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 25 | RAW SEWAGE | -- | 548 | -- | -- | 164 | 174 | 55 | -- | 1.0 | -- | -- | -- | -- | 17 | 10.0 | 38 | 66 | 66 | 0.52 | 56.6 | -- | -- | -- | -- |
| FEB 28 |  | -- | 546 | -- | -- | 272 | 237 | 118 | 28.6 | 1.1 | 29.7 | -- | -- | -- | 21 | 9.8 | 35 | 82 | 68 | 0.45 | 56.8 | -- | -- | -- | -- |
| MAR 9 |  | -- | 514 | -- | -- | 248 | 270 | 125 | 23.5 | 1.3 | 24.8 | 18.22 | -- | -- | 32 | 11.0 | 39 | 100 | 68 | 0.65 | 34.8 | -- | -- | -- | -- |
| MAR 23 |  | -- | 594 | -- | -- | 130 | 259 | 105 | 51.6 | 1.3 | 52.9 | 22.23 | -- | -- | 35 | 9.8 | 28 | 60 | 61 | 1.02 | 39.6 | -- | -- | -- | -- |
| APR 6 |  | -- | 492 | -- | -- | 192 | 183 | 101 | 41.6 | 1.3 | 42.9 | 16.37 | -- | -- | 52 | 19.6 | 44 | 55 | 61 | 0.29 | 22.9 | -- | -- | -- | -- |
| APR 20 |  | -- | 500 | -- | -- | 168 | 310 | 127 | 25.5 | 1.1 | 26.6 | 23.22 | -- | -- | 47 | 11.0 | 45 | 100 | 73 | 1.10 | 48.7 | -- | -- | -- | -- |
| MAY 4 |  | -- | 494 | -- | -- | 312 | 298 | 95 | 57.8 | 0.7 | 58.5 | 16.26 | -- | -- | 50 | 11.4 | 43 | 109 | 52 | 1.15 | 54.8 | -- | -- | -- | -- |
| MAY 18 |  | -- | 432 | -- | -- | 164 | 172 | 70 | 49.0 | 1.0 | 50.0 | 15.74 | -- | -- | 58 | 9.0 | 40 | 105 | 57 | 0.85 | 24.2 | -- | -- | -- | -- |
| JUN 1 |  | 7.3 | 620 | 580 | -- | 280 | 248 | 68 | 36.1 | 0.1 | 36.2 | 21.90 | -- | -- | 75 | 12.3 | 48 | 86 | 62 | 0.85 | 31.6 | -- | -- | -- | -- |
| JUN 15 |  | 7.0 | 468 | 440 | 70 | 240 | 248 | 70 | 53.0 | 0.1 | 53.1 | 11.85 | 17 | 7 | 75 | 11.4 | 49 | 68 | 61 | 0.55 | 43.7 | -- | -- | -- | -- |
| JUL 13 |  | 7.4 | -- | 500 | 60 | 220 | 208 | 87 | 34.2 | 0.1 | 34.3 | 21.75 | 13 | 7 | 72 | 9.8 | 45 | 98 | 82 | -- | -- | -- | -- | -- | -- |
| AUG 10 |  | -- | 436 | -- | -- | 200 | 204 | 90 | 28.4 | 0.7 | 29.1 | 14.15 | --- | -- | 54 | 10.8 | 42 | 69 | 61 | 0.47 | -- | -- | -- | -- | -- |
| AUG 31 |  | -- | 484 | -- | -- | 288 | 204 | 88 | 38.8 | 0.2 | 39.0 | 12.30 | --- | -- | 56 | 11.0 | 44 | 69 | 59 | 0.38 | 67.0 | -- | -- | -- | -- |
| SEP 28 |  | -- | 488 | -- | -- | 176 | 199 | 80 | 20.8 | 0.1 | 20.9 | 16.71 | --- | -- | 55 | 13.0 | 48 | 62 | 61 | 0.30 | -- | -- | -- | -- | -- |
| OCT 12 |  | 7.0 | 586 | 500 | 144 | 168 | 204 | 95 | 19.0 | 0.1 | 19.1 | 17.36 | 37 | 13 | 70 | 9.6 | 42 | 70 | 72 | -- | -- | -- | -- | -- | -- |
| NOV 16 |  | 7.6 | 487 | -- | 72 | 215 | 183 | 110 | 56.0 | 0.1 | 56.1 | 18.45 | 38 | 0 | 70 | 11.0 | 44 | 82 | 78 | -- | -- | -- | -- | -- | -- |
| DEC 21 |  | 7.4 | 318 | 520 | 55 | 240 | 226 | 72 | 47.5 | 0.1 | 47.6 | 11.90 | 10 | 7 | 47 | 12.5 | 44 | 33 | 70 | -- | -- | -- | -- | -- | -- |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 11 |  | 7.8 | 530 | 670 | 58 | 252 | 209 | 72 | 43.5 | 0.1 | 43.6 | 15.06 | 9 | 9 | 54 | 11.8 | 44 | 46 | 62 | -- | -- | -- | -- | -- | -- |
| FEB 1 |  | 7.0 | 503 | 500 | 48 | 225 | 175 | 87 | 31.4 | 0.1 | 31.5 | 16.43 | 12 | 4 | 57 | 11.0 | 42 | 38 | 71 | -- | -- | -- | -- | -- | -- |
| MAR 7 |  | 7.2 | 506 | 580 | 56 | 160 | 202 | 90 | 38.6 | 0.1 | 38.7 | 16.56 | 11 | 7 | 52 | 12.0 | 36 | 40 | 70 | -- | -- | -- | -- | -- | -- |
| APR 5 |  | 7.2 | 550 | 600 | 58 | 192 | 232 | 100 | 36.1 | 0.1 | 36.2 | 21.27 | 14 | 6 | 72 | 10.6 | 43 | 78 | 89 | -- | -- | -- | -- | -- | -- |
| MAY 30 |  | 7.1 | 590 | 520 | 62 | 136 | 170 | -- | 41.0 | 0.0 | 41.0 | 39.81 | 18 | 4 | -- | -- | 42 | -- | -- | -- | -- | -- | -- | -- | -- |
| JUN 12 |  | 7.1 | -- | 540 | 62 | -- | -- | 85 | 38.8 | 0.0 | 38.8 | 20.38 | 19 | 4 | 54 | 11.0 | 38 | -- | 65 | -- | -- | -- | -- | -- | -- |
| JUL 3 |  | 7.1 | 393 | 468 | 106 | -- | -- | 105 | 32.8 | 0.1 | 32.9 | 6.68 | 18 | 15 | 50 | 9.2 | 49 | 42 | 68 | -- | -- | -- | -- | -- | -- |
| AUG 8 |  | 6.9 | -- | -- | 40 | -- | -- | -- | 36.4 | 0.1 | 36.5 | 12.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |  |  |
| SEP 5 |  | 7.0 | -- | -- | 63 | -- | -- | -- | -- | 0.1 | -- | 26.11 | -- | -- | -- | -- | 78 | -- | -- | -- | -- | -- | -- |  |  |
| OCT 2 |  | -- | -- | -- | 75 | -- | -- | -- | -- | 1.55 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |  |  |
| DEC 11 |  | -- | -- | -- | 64 | -- | -- | -- | 17.9 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |  |  |

TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS | COND. @ 25°C | TOTAL HARDNESS | SS | $BOD_5$ | TOC | NITROGEN as N |  |  | $PO_4$-P | Ca | Mg⁑ | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | COLIFORMS |  | $Cl_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  | KJELDAHL | $NO_2$+ $NO_3$ | TOTAL |  |  |  |  |  |  |  |  |  |  | FECAL | TOTAL |  |
|  |  |  | mg/ℓ | µmhos/cm | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | no./100mℓ |  | mg/ℓ |
| (1974) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 9 | RAW SEWAGE | 6.9 | -- | 520 | 32 | -- | -- | -- | 25.2 | -- | -- | 16.87 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| AUG 21 |  | -- | -- | 620 | 60 | -- | -- | -- | -- | -- | -- | 13.56 | 13 | 7 | 57 | 9.8 | 42 | -- | 84 | -- | -- | -- | -- | -- |
| SEP 11 |  | -- | 576 | 580 | 72 | 72 | 182 | -- | 31.1 | -- | -- | 19.21 | 18 | 7 | 63 | 9.8 | 46 | -- | 74 | -- | -- | -- | -- | -- |
| OCT 9 |  | -- | 482 | 550 | 48 | 144 | 185 | -- | 28.3 | -- | -- | 17.90 | 11 | 5 | 60 | 9.1 | 41 | -- | 85 | -- | -- | -- | -- | -- |
| NOV 6 |  | -- | 556 | 570 | 58 | 200 | 342 | -- | 34.2 | -- | -- | 10.96 | 12 | 7 | 59 | 12.3 | 53 | -- | 87 | -- | -- | -- | -- | -- |
| NOV 20 |  | -- | 496 | 530 | 54 | 128 | 182 | -- | 25.5 | 0.02 | 25.5 | 11.36 | 12 | 6 | 61 | 9.2 | 41 | -- | 81 | -- | -- | -- | -- | -- |
| DEC 4 |  | -- | 492 | 490 | 54 | 136 | 188 | -- | 31.4 | 0.13 | 31.5 | 12.45 | 11 | 6 | 70 | 6.6 | 41 | -- | 91 | -- | -- | -- | -- | -- |
| DEC 18 |  | -- | 406 | 400 | 56 | 240 | 268 | -- | 29.7 | -- | -- | 16.33 | 12 | 6 | 56 | 8.8 | 43 | -- | 91 | -- | -- | -- | -- | -- |
| (1975) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 8 |  | -- | 456 | -- | 60 | 224 | 223 | -- | 32.5 | -- | -- | 9.64 | -- | 9 | 63 | 9.6 | -- | -- | 92 | -- | -- | -- | -- | -- |
| FEB 5 |  | -- | 580 | 560 | 60 | 184 | 196 | -- | 29.1 | 0.05 | 29.2 | 19.40 | -- | 9 | 72 | 10.8 | -- | -- | 73 | -- | -- | -- | -- | -- |
| (1972) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 25 | CHLORINATED SECONDARY EFFLUENT | -- | 328 | -- | -- | 88 | 49 | 25 | -- | 1.4 | -- | -- | -- | -- | 38 | 5.8 | 53 | 53 | 60 | 0.70 | -- | -- | -- | -- |
| FEB 1 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 9 | 70 | -- |
| FEB 10 |  | -- | 415 | -- | -- | 13 | 18 | 20 | 7.1 | 1.1 | 8.2 | -- | -- | -- | 41 | 8.5 | 50 | 57 | 53 | 0.80 | 5.1 | -- | -- | -- |
| FEB 28 |  | -- | 372 | -- | -- | 28 | 14 | 62 | 7.4 | 1.2 | 8.6 | -- | -- | -- | 45 | 10.0 | 53 | 58 | 62 | 0.31 | 11.1 | -- | -- | -- |
| FEB 29 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 | -- |
| MAR 9 |  | -- | 358 | -- | -- | 16 | 6 | 26 | 10.1 | 1.4 | 11.5 | 6.68 | -- | -- | 41 | 8.5 | 51 | 41 | 61 | 0.21 | 16.8 | -- | -- | -- |
| MAR 14 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 | -- |
| MAR 23 |  | -- | 330 | -- | -- | 12 | 23 | 16 | 13.8 | 4.3 | 18.1 | 10.73 | -- | -- | 39 | 9.0 | 42 | 42 | 58 | 0.28 | 8.7 | -- | -- | -- |
| MAR 29 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 2 | -- |
| APR 6 |  | -- | 344 | -- | -- | 4 | 17 | 28 | 3.2 | 2.5 | 5.7 | 9.88 | -- | -- | 45 | 9.2 | 50 | 40 | 58 | 0.50 | 19.1 | -- | -- | -- |
| APR 18 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 2 | -- |
| APR 20 |  | -- | 335 | -- | -- | 7 | 13 | 22 | 4.4 | 2.8 | 7.2 | 9.59 | -- | -- | 49 | 9.1 | 50 | 40 | 61 | 0.26 | 12.8 | -- | -- | -- |
| MAY 2 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 | -- |
| MAY 4 |  | -- | 325 | -- | -- | 5 | 11 | 14 | 3.6 | 5.4 | 9.0 | 10.34 | -- | -- | 46 | 10.1 | 48 | 39 | 57 | 0.43 | 30.4 | -- | -- | -- |
| MAY 16 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 3 | 4 | -- |
| MAY 18 |  | -- | 353 | -- | -- | 11 | 9 | 17 | 20.8 | 1.1 | 21.9 | 10.75 | -- | -- | 46 | 11.4 | 56 | 42 | 60 | 0.23 | 5.6 | -- | -- | -- |
| MAY 30 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 2 | -- |
| JUN 1 |  | 7.1 | 346 | 450 | -- | 12 | 7 | 18 | 11.5 | 1.0 | 12.5 | 10.85 | -- | -- | 54 | 9.9 | 48 | 60 | 55 | 0.70 | 4.8 | -- | -- | -- |

## TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N KJELDAHL | NITROGEN as N NO$_2$+NO$_3$ | NITROGEN as N TOTAL | PO$_4$-P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS FECAL | COLIFORMS TOTAL | Cl$_2$ | ALK. as CaCO$_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | no./100mℓ |  | mg/ℓ |  |
| (1972) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JUN 15 | CHLORINATED SECONDARY EFFLUENT | 6.9 | 374 | 400 | -- | 10 | 17 | 5 | 10.0 | 0.8 | 10.8 | 11.25 | -- | -- | 50 | 9.7 | 50 | 57 | 57 | 0.35 | -- | -- | -- | -- | -- |
| JUN 16 |  | -- | -- | 350 | -- | -- | -- | 17 | -- | 0.8 | -- | -- | -- | -- | 51 | 9.8 | 42 | 61 | 56 | 0.70 | 6.1 | -- | -- | -- | -- |
| JUN 22 |  | -- | -- | 370 | -- | -- | -- | 19 | 18.3 | 2.4 | 20.7 | — | -- | -- | 48 | 11.0 | 48 | 56 | 56 | 0.72 | 6.8 | -- | -- | -- | -- |
| JUN 27 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 10 | 30 | -- | -- |
| JUN 29 |  | 6.8 | 350 | 390 | -- | 4 | 21 | 19 | 9.5 | 0.1 | 9.6 | 9.58 | -- | -- | 43 | 9.6 | 46 | 53 | 56 | 0.75 | 3.6 | -- | -- | -- | -- |
| JUN 29 |  | 6.6 | -- | 355 | -- | -- | -- | 47 | 11.6 | 1.5 | 13.1 | -- | -- | -- | 50 | 9.5 | 46 | 72 | 57 | 0.26 | 54.4 | -- | -- | -- | -- |
| JUL 6 |  | 7.0 | — | 315 | 52 | -- | -- | 16 | 4.8 | 2.8 | 7.6 | — | 5 | 9 | 54 | 8.8 | 50 | 50 | 57 | 0.35 | -- | -- | -- | -- | -- |
| JUL 13 |  | 7.0 | 366 | 395 | 24 | 24 | 10 | 18 | 12.3 | 2.3 | 14.6 | 8.21 | 8 | 1 | 48 | 7.7 | 52 | 52 | 60 | -- | -- | -- | -- | -- | -- |
| JUL 20 |  | 7.1 | -- | 385 | 62 | -- | -- | 24 | 14.0 | 0.5 | 14.5 | — | 18 | 4 | 55 | 10.0 | 50 | 50 | 60 | -- | -- | -- | -- | -- | -- |
| JUL 27 |  | 7.0 | 413 | 540 | 55 | 134 | 148 | 32 | 20.4 | 0.1 | 20.5 | 11.75 | 8 | 9 | 49 | 11.2 | 49 | 53 | 73 | -- | -- | -- | -- | -- | -- |
| AUG 3 |  | 7.2 | -- | 400 | 54 | -- | -- | 17 | 12.3 | 0.6 | 12.9 | -- | 8 | 8 | 47 | 9.8 | 49 | 48 | 59 | -- | -- | -- | -- | -- | -- |
| AUG 8 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 37 | 160 | 0.8 | -- |
| AUG 10 |  | 7.1 | 361 | 410 | 55 | 11 | 12 | 21 | 4.5 | 2.5 | 7.0 | 10.50 | 7 | 9 | 56 | 10.0 | 50 | 50 | 55 | -- | -- | -- | -- | -- | -- |
| AUG 16 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | — | -- | -- | -- | -- | -- | 4 | 20 | 1.0 | -- |
| AUG 17 |  | 7.2 | -- | 350 | 54 | -- | -- | 17 | 3.6 | 1.4 | 5.0 | 7.10 | 9 | 8 | 53 | 9.0 | 52 | 54 | 61 | -- | -- | -- | -- | -- | -- |
| AUG 24 |  | 7.1 | -- | 425 | 57 | -- | -- | 20 | 12.1 | 3.5 | 15.6 | — | 8 | 9 | 51 | 9.5 | 51 | 51 | 57 | -- | -- | -- | -- | -- | -- |
| AUG 31 |  | 7.4 | 348 | 380 | 48 | 18 | 17 | 8 | 7.5 | 0.4 | 7.9 | 6.26 | 8 | 7 | 48 | 8.5 | 47 | 52 | 55 | -- | -- | -- | -- | -- | 97 |
| SEP 8 |  | 7.0 | -- | 450 | 59 | -- | -- | 24 | 7.7 | 0.7 | 8.4 | -- | 10 | 8 | 54 | 8.0 | 50 | 60 | 57 | -- | -- | -- | -- | -- | -- |
| SEP 9 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 13 | 0.7 | -- |
| SEP 14 |  | 7.1 | 336 | 350 | 59 | 53 | 31 | 32 | 7.0 | 0.3 | 7.3 | 5.20 | 8 | 9 | 51 | 7.8 | 46 | 53 | 53 | -- | -- | -- | -- | -- | 100 |
| SEP 21 |  | 7.0 | -- | 395 | 50 | -- | — | 26 | 10.0 | 0.4 | 10.4 | — | 6 | 9 | 54 | 7.5 | 49 | 55 | 59 | -- | -- | -- | -- | -- | -- |
| SEP 28 |  | 7.0 | 302 | 350 | 52 | 32 | 29 | 24 | 9.4 | 0.3 | 9.7 | 3.43 | 13 | 5 | 52 | 8.1 | 48 | 61 | 55 | -- | -- | -- | -- | -- | -- |
| SEP 28 |  | 7.1 | 262 | 400 | 55 | 8 | 11 | 9 | 11.1 | 0.3 | 11.4 | 3.00 | 9 | 8 | 50 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 100 |
| OCT 4 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 4 | 1.8 | -- |
| OCT 5 |  | -- | -- | 390 | 59 | -- | -- | 19 | 9.1 | 0.4 | 9.5 | -- | 12 | 7 | 53 | 7.9 | 50 | 60 | 61 | -- | -- | -- | -- | -- | -- |
| OCT 12 |  | -- | 342 | 395 | 49 | 27 | 18 | 17 | 9.4 | 0.4 | 9.8 | 3.26 | 13 | 4 | 53 | 8.9 | 49 | 40 | 64 | — | -- | -- | -- | -- | -- |
| OCT 12 |  | — | 328 | 380 | 59 | 8 | 10 | 23 | 8.1 | 0.4 | 8.5 | 3.36 | 11 | 8 | 52 | 7.8 | 48 | 94 | 64 | — | -- | -- | -- | -- | -- |
| OCT 18 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 4 | 1.8 | -- |
| OCT 19 |  | 7.0 | -- | 365 | 55 | -- | -- | 29 | 8.3 | 0.5 | 8.8 | -- | 11 | 7 | 53 | 9.3 | 48 | 48 | 59 | -- | -- | -- | -- | -- | -- |

TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS | COND.@ 25°C µmhos/ cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N KJELDAHL | NITROGEN as N NO$_2$+ NO$_3$ | NITROGEN as N TOTAL | PO$_4$-P | Ca | Mg$^{*}$ | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS FECAL | COLIFORMS TOTAL | Cl$_2$ | ALK. as CaCO$_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | mg/ℓ | cm | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | no./100mℓ |  | mg/ℓ |  |
| (1972) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| OCT 26 | CHLORINATED SECONDARY EFFLUENT | 7.3 | -- | 400 | 58 | -- | -- | 24 | 20.2 | 0.5 | 20.7 | -- | 13 | 6 | 55 | 9.4 | 48 | 47 | 58 | -- | -- | -- | -- | -- | -- |
| NOV 2 |  | 7.0 | -- | 370 | 54 | -- | -- | 19 | 7.4 | 0.8 | 8.2 | -- | 10 | 7 | 48 | 10.0 | 45 | 51 | 72 | -- | -- | -- | -- | -- | -- |
| NOV 14 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 4 | 1.5 | -- |
| NOV 16 |  | 7.1 | 308 | 405 | 51 | 22 | 19 | 27 | 16.6 | 0.6 | 17.2 | 3.71 | 11 | 6 | 50 | 9.4 | 47 | 45 | 61 | -- | -- | -- | -- | -- | -- |
| NOV 16 |  | 7.6 | 312 | 380 | 61 | 20 | 25 | 30 | 12.6 | 0.5 | 13.1 | 3.60 | 13 | 7 | 51 | 8.3 | 46 | 42 | 68 | -- | -- | -- | -- | -- | -- |
| NOV 18 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 4 | 6 | 1.1 | -- |
| NOV 30 |  | 7.4 | -- | 400 | 58 | -- | -- | 27 | 14.0 | 0.6 | 14.6 | -- | 13 | 6 | 54 | 8.4 | 49 | 39 | 59 | -- | -- | -- | -- | -- | -- |
| DEC 8 |  | 7.2 | -- | 445 | 50 | -- | -- | 25 | 10.3 | 0.6 | 10.9 | -- | 10 | 6 | 56 | 7.6 | 49 | 32 | 55 | -- | -- | -- | -- | -- | -- |
| DEC 12 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 26 | 0.8 | -- |
| DEC 21 |  | 7.4 | 283 | 400 | 62 | 28 | 20 | 20 | 11.3 | 0.5 | 11.8 | 5.10 | 8 | 10 | 55 | 8.3 | 47 | 28 | 68 | -- | -- | -- | -- | -- | -- |
| DEC 27 |  | 7.7 | -- | 450 | 58 | -- | -- | 27 | 11.3 | 0.7 | 12.0 | -- | 11 | 7 | 58 | 9.5 | 60 | 28 | 60 | -- | -- | -- | -- | -- | -- |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 11 |  | 7.1 | 386 | 490 | 58 | 22 | 22 | 22 | 15.6 | 0.7 | 16.3 | 9.39 | 24 | 0 | 51 | 10.2 | 47 | 40 | 67 | -- | -- | -- | -- | -- | -- |
| JAN 11 |  | 7.2 | -- | 500 | 55 | -- | -- | 34 | 15.9 | 0.8 | 16.7 | -- | 8 | 8 | 51 | 10.0 | -- | 39 | 63 | -- | -- | -- | -- | -- | -- |
| JAN 16 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 490 | 1.0 | -- |
| JAN 26 |  | 7.0 | -- | 400 | 45 | -- | -- | 23 | 10.3 | 2.3 | 12.6 | -- | 8 | 6 | 52 | 11.2 | 50 | 34 | 45 | -- | -- | -- | -- | -- | -- |
| JAN 30 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | >33,000 | 0.7 | -- |
| FEB 1 |  | 7.1 | 327 | 360 | 43 | 25 | 13 | 25 | 12.3 | 1.4 | 13.7 | 8.36 | 7 | 6 | 49 | 10.0 | 47 | 33 | 70 | -- | -- | -- | -- | -- | -- |
| FEB 13 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 330 | 1.4 | -- |
| FEB 15 |  | 7.2 | -- | 400 | 48 | -- | -- | 25 | 14.3 | 0.3 | 14.6 | -- | 10 | 6 | 45 | 10.0 | 48 | 47 | 72 | -- | -- | -- | -- | -- | -- |
| FEB 27 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 5 | 278 | 1.0 | -- |
| MAR 1 |  | 7.1 | -- | 400 | 48 | -- | -- | 28 | 11.2 | 0.6 | 11.8 | -- | 8 | 6 | 60 | 10.0 | 51 | 40 | 65 | -- | -- | -- | -- | -- | -- |
| MAR 7 |  | 7.1 | 342 | 420 | 60 | 12 | 22 | 28 | 22.2 | 0.9 | 23.1 | 7.86 | 15 | 5 | 49 | 9.5 | 44 | 42 | 68 | -- | -- | -- | -- | -- | -- |
| MAR 27 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 49 | 0.8 | -- |
| APR 5 |  | 7.1 | -- | 400 | 77 | -- | -- | 30 | 16.7 | 2.1 | 18.8 | -- | 14 | 10 | 60 | 9.8 | -- | 63 | 68 | -- | -- | -- | -- | -- | -- |
| APR 5 |  | 7.1 | -- | 420 | 63 | -- | -- | 25 | 14.9 | 1.9 | 16.8 | -- | 14 | 7 | 54 | 8.8 | 50 | 45 | 68 | -- | -- | -- | -- | -- | -- |
| APR 10 |  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 5 | 110 | 0.9 | -- |
| APR 16 |  | 7.2 | -- | 400 | 63 | -- | -- | -- | 15.8 | 0.1 | 15.9 | -- | 14 | 7 | 56 | 11.0 | 48 | 45 | 60 | -- | -- | -- | -- | 0.4 | -- |
| APR 18 |  | 6.8 | -- | 430 | 115 | -- | -- | -- | 16.0 | 0.3 | 16.3 | -- | 30 | 10 | 56 | 11.5 | 49 | 40 | 62 | -- | -- | -- | -- | -- | -- |
| APR 21 |  | 6.9 | -- | 450 | 55 | -- | -- | 28 | 17.7 | 0.2 | 17.9 | -- | 8 | 6 | 54 | 10.5 | 50 | 40 | 58 | -- | -- | -- | -- | -- | -- |

TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | $BOD_5$ | TOC | NITROGEN as N | | | $PO_4$-P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | COLIFORM | | $Cl_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | KJEL-DAHL | $NO_2$+$NO_3$ | TOTAL | | | | | | | | | | | FECAL | TOTAL | |
| | | | mg/ℓ | | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | no./100 ℓ | no./100 ℓ | mg/ℓ |
| (1973) | | | | | | | | | | | | | | | | | | | | | | | | |
| APR 24 | CHLORINATED SECONDARY EFFLUENT | 6.9 | -- | 400 | 50 | -- | -- | -- | 21.1 | 0.3 | 21.4 | -- | 10 | 6 | 56 | 11.0 | 50 | 38 | 61 | -- | -- | 0 | 4 | 0.4 |
| APR 25 | | 7.0 | -- | 380 | 60 | -- | -- | -- | 24.3 | 0.4 | 24.7 | -- | 13 | 7 | 55 | 11.5 | 47 | 50 | 66 | -- | -- | -- | -- | -- |
| APR 26 | | 7.2 | -- | 400 | 60 | -- | -- | -- | 18.0 | 0.1 | 18.1 | -- | 13 | 7 | 54 | 10.6 | -- | 41 | 64 | -- | -- | -- | -- | -- |
| MAY 1 | | 6.9 | -- | 400 | 48 | -- | -- | -- | 25.3 | 0.1 | 25.4 | -- | 14 | 3 | 54 | 10.1 | 53 | 41 | 64 | -- | -- | -- | -- | -- |
| MAY 3 | | 6.9 | -- | 450 | 48 | -- | -- | -- | 21.3 | 0.5 | 21.8 | -- | 8 | 2 | 58 | 9.2 | 54 | 56 | 64 | -- | -- | -- | -- | -- |
| MAY 5 | | 7.0 | -- | 400 | 62 | -- | -- | -- | 18.8 | 0.1 | 18.9 | -- | 8 | 10 | 53 | 10.0 | 60 | 52 | 62 | -- | -- | -- | -- | -- |
| MAY 8 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 110 | 490 | 0.8 |
| MAY 14 | | 7.0 | -- | 430 | 62 | -- | -- | -- | 24.4 | 0.2 | 24.6 | -- | 9 | 10 | 57 | 11.7 | 53 | 45 | 62 | -- | -- | -- | -- | -- |
| MAY 15 | | 7.0 | -- | 410 | 53 | -- | -- | -- | 23.8 | 0.1 | 23.9 | -- | 7 | 9 | 60 | 10.7 | 58 | 42 | 65 | -- | -- | -- | -- | -- |
| MAY 16 | | 6.9 | -- | 410 | 63 | -- | -- | -- | 25.7 | 0.1 | 25.8 | 12.55 | 7 | 11 | 55 | 10.0 | 48 | 41 | 68 | -- | -- | -- | -- | -- |
| MAY 17 | | 7.1 | -- | 400 | 62 | -- | -- | -- | 26.0 | 0.1 | 26.1 | -- | 7 | 11 | 55 | 10.6 | -- | 41 | 68 | -- | -- | -- | -- | -- |
| MAY 22 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 4900 | >22000 | 0 |
| MAY 29 | | 7.2 | -- | 480 | 62 | -- | -- | -- | 19.5 | 0.3 | 19.8 | -- | 16 | 5 | 50 | 10.8 | 53 | -- | -- | -- | -- | -- | -- | -- |
| MAY 30 | | 7.2 | -- | 480 | 58 | -- | -- | -- | 22.1 | 0.4 | 22.5 | -- | 14 | 6 | 56 | 10.8 | 50 | -- | -- | -- | -- | -- | -- | -- |
| JUN 1 | | -- | -- | 400 | 62 | -- | -- | -- | -- | 0.2 | -- | 13.20 | 20 | 3 | 49 | 9.5 | -- | -- | -- | -- | -- | -- | -- | -- |
| JUN 5 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1110 | 3300 | 0.9 |
| JUN 7 | | 6.9 | -- | 480 | 62 | -- | -- | -- | 17.0 | -- | -- | 13.04 | 16 | 5 | 58 | 10.2 | -- | -- | -- | -- | -- | -- | -- | -- |
| JUN 8 | | 7.0 | -- | 420 | 62 | -- | -- | -- | 17.5 | 0.8 | 18.3 | -- | 15 | 4 | 49 | 9.5 | 46 | -- | -- | -- | -- | -- | -- | -- |
| JUN 12 | | 7.1 | -- | 400 | 53 | -- | -- | -- | 21.2 | -- | -- | 8.64 | -- | -- | -- | -- | 86 | -- | -- | -- | -- | -- | -- | -- |
| JUN 12 | | 7.0 | -- | 415 | 58 | -- | -- | -- | 19.5 | 0.1 | 19.6 | 11.41 | -- | -- | -- | -- | 50 | -- | 68 | -- | -- | -- | -- | -- |
| JUN 13 | | 7.1 | -- | 420 | 58 | -- | -- | 29 | 17.5 | 0.1 | 17.6 | 9.29 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| JUN 14 | | 7.0 | -- | 450 | 62 | -- | -- | 30 | 16.2 | 0.2 | 16.4 | -- | -- | -- | 59 | 9.8 | 46 | -- | -- | -- | -- | -- | -- | -- |
| JUN 15 | | 6.9 | -- | 380 | 67 | -- | -- | 30 | 21.0 | 0.2 | 21.2 | -- | -- | -- | 58 | 10.0 | 48 | -- | -- | -- | -- | -- | -- | -- |
| JUN 20 | | 7.0 | -- | 400 | -- | -- | -- | -- | -- | -- | -- | 13.86 | -- | -- | -- | -- | 48 | -- | -- | -- | -- | -- | -- | -- |
| JUN 25 | | 7.2 | 388 | 500 | 67 | -- | -- | -- | 21.0 | 0.1 | 21.1 | -- | 14 | -- | 60 | 11.2 | -- | 53 | 62 | -- | -- | -- | -- | -- |
| JUN 26 | | 7.1 | 376 | 500 | 62 | -- | -- | -- | 24.3 | 0.2 | 24.5 | -- | 14 | -- | 60 | 10.2 | -- | 59 | 67 | -- | -- | -- | -- | -- |
| JUN 27 | | 6.9 | 332 | 480 | 58 | -- | -- | -- | 20.3 | 0.4 | 20.7 | 10.92 | 16 | -- | 46 | 9.7 | -- | 48 | 65 | -- | -- | -- | -- | -- |
| JUN 28 | | 7.0 | 328 | 410 | 62 | -- | -- | -- | 23.3 | 0.5 | 23.8 | 10.75 | 16 | -- | 48 | 9.7 | -- | 51 | 67 | -- | -- | -- | -- | -- |
| JUL 2 | | 7.0 | 322 | 420 | 62 | -- | -- | -- | 9.4 | 5.7 | 15.1 | 10.43 | 16 | 5 | 45 | 10.3 | 61 | 38 | 64 | -- | -- | -- | -- | -- |
| JUL 3 | | 7.0 | 342 | 370 | 62 | -- | -- | -- | 10.5 | 5.6 | 16.1 | 10.59 | 14 | 7 | 44 | 9.7 | 59 | 51 | 66 | -- | -- | -- | -- | -- |

## TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N | | | PO$_4$-P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS | | Cl$_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | KJELDAHL | NO$_2$+NO$_3$ | TOTAL | | | | | | | | | | | FECAL | TOTAL | |
| | | | | | mg/ℓ | | | | | | | | | | | | | | | | | no./100mℓ | | mg/ℓ |
| (1973) | | | | | | | | | | | | | | | | | | | | | | | | |
| JUL 6 | CHLORINATED SECONDARY EFFLUENT | 6.7 | 339 | 360 | 62 | -- | -- | -- | 9.5 | 6.8 | 16.3 | 7.66 | 14 | 7 | 45 | 9.7 | 59 | 44 | 67 | -- | -- | -- | -- | -- |
| JUL 9 | | 7.0 | 376 | 400 | 58 | -- | -- | -- | 18.1 | 0.3 | 18.4 | 17.12 | 12 | 7 | 58 | 10.0 | 71 | 53 | 64 | -- | -- | -- | -- | -- |
| JUL 10 | | 7.1 | 324 | 350 | 58 | -- | -- | -- | 26.8 | 0.9 | 27.7 | 11.74 | 16 | 4 | 48 | 9.7 | 49 | 46 | 64 | -- | -- | -- | -- | -- |
| JUL 11 | | 7.4 | 324 | 370 | 62 | -- | -- | -- | 18.0 | 1.5 | 19.5 | 10.60 | 20 | 3 | 44 | 9.7 | 56 | 42 | 59 | -- | -- | -- | -- | -- |
| JUL 12 | | 7.4 | 354 | 370 | 62 | -- | -- | -- | 18.7 | 0.4 | 19.1 | 12.06 | 18 | 4 | 48 | 10.0 | 54 | 50 | 64 | -- | -- | -- | -- | -- |
| JUL 16 | | 6.9 | 330 | 400 | 38 | -- | -- | -- | 16.8 | 0.6 | 17.4 | 11.90 | 12 | 2 | 54 | 9.5 | 56 | 49 | 64 | -- | -- | -- | -- | -- |
| JUL 23 | | 7.1 | 328 | 500 | 48 | -- | -- | -- | 19.6 | 0.4 | 20.0 | 11.88 | 12 | 4 | 50 | 9.8 | 51 | 29 | 71 | -- | -- | -- | -- | -- |
| JUL 24 | | 7.0 | 278 | 370 | 43 | -- | -- | -- | 17.5 | 0.2 | 17.7 | 10.74 | 12 | 3 | 45 | 8.2 | 47 | 35 | 61 | -- | -- | -- | -- | -- |
| JUL 25 | | 7.0 | 306 | 400 | 34 | -- | -- | -- | 16.5 | 2.3 | 18.8 | -- | 12 | 1 | 50 | 9.1 | 49 | 31 | 63 | -- | -- | -- | -- | -- |
| JUL 26 | | 7.4 | -- | 340 | 43 | -- | -- | -- | 11.8 | 1.1 | 12.9 | 10.30 | 14 | 2 | 56 | 8.7 | 47 | 31 | 44 | -- | -- | -- | -- | -- |
| JUL 30 | | 6.6 | 544 | 410 | 75 | -- | -- | -- | -- | 0.7 | -- | -- | 22 | 5 | 53 | 12.0 | 54 | -- | 78 | -- | -- | -- | -- | -- |
| AUG 1 | | 6.7 | 354 | 380 | 45 | -- | -- | -- | 24.4 | 0.5 | 24.9 | 12.40 | 14 | 2 | 48 | 9.5 | 49 | 42 | 74 | -- | -- | -- | -- | -- |
| AUG 6 | | 7.0 | -- | 400 | 40 | -- | -- | -- | 22.4 | 0.2 | 22.6 | 13.20 | 14 | 1 | 48 | 10.0 | 70 | 31 | 70 | -- | -- | -- | -- | -- |
| AUG 7 | | 6.7 | 336 | 300 | 30 | -- | -- | -- | 17.6 | 0.9 | 18.5 | 7.10 | 12 | 0 | 46 | -- | 48 | -- | 72 | -- | -- | -- | -- | -- |
| AUG 7 | | 7.0 | 196 | 360 | 50 | -- | -- | -- | 14.8 | 0.5 | 15.3 | 6.60 | 22 | 0 | 45 | 9.6 | -- | -- | 73 | -- | -- | -- | -- | -- |
| AUG 8 | | 6.8 | -- | 320 | 40 | -- | -- | -- | 16.8 | 0.3 | 17.1 | 5.20 | 16 | 0 | 49 | 8.0 | 45 | 29 | 70 | -- | -- | -- | -- | -- |
| AUG 8 | | 6.8 | 144 | 330 | 50 | -- | -- | -- | 21.8 | 0.3 | 22.1 | 8.50 | 18 | 1 | 60 | 10.0 | 65 | -- | 69 | -- | -- | -- | -- | -- |
| AUG 9 | | 6.7 | 290 | 330 | 45 | -- | -- | -- | 20.7 | 0.2 | 20.9 | 11.40 | 24 | 0 | 48 | 10.0 | 73 | 30 | 70 | -- | -- | -- | -- | -- |
| AUG 20 | | 6.6 | -- | 410 | 50 | -- | -- | -- | 20.2 | 0.1 | 20.3 | 12.80 | 5 | 9 | 53 | 11.0 | 70 | 45 | -- | -- | -- | -- | -- | -- |
| AUG 22 | | 6.9 | -- | 340 | 40 | -- | -- | -- | 10.6 | 1.0 | 11.7 | -- | 6 | 6 | 51 | 10.0 | 63 | 40 | -- | -- | -- | -- | -- | -- |
| AUG 23 | | -- | -- | 370 | 45 | -- | -- | -- | 11.5 | -- | -- | -- | 4 | 9 | 49 | 10.0 | 68 | 46 | -- | -- | -- | -- | -- | -- |
| AUG 24 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6 | -- | 48 | 10.0 | 68 | 36 | -- | -- | -- | -- | -- | -- |
| SEP 4 | | 6.9 | 338 | 380 | 65 | -- | -- | -- | 19.5 | 0.1 | 19.6 | 10.55 | 15 | 7 | 51 | 11.0 | 53 | 38 | 76 | -- | -- | -- | -- | -- |
| SEP 5 | | 6.8 | 254 | 410 | 60 | -- | -- | -- | 19.0 | 0.3 | 19.3 | 10.54 | 14 | 6 | 61 | 11.0 | 48 | 39 | 76 | -- | -- | -- | -- | -- |
| SEP 5 | | 6.9 | 314 | 450 | 58 | -- | -- | -- | 15.3 | 0.1 | 15.4 | 10.57 | 13 | 6 | 51 | 11.0 | 43 | 37 | 76 | -- | -- | 0 | 0 | -- |
| SEP 8 | | 6.8 | 332 | 450 | 60 | -- | -- | -- | 20.9 | 0.1 | 21.0 | 11.85 | 17 | 4 | 50 | 9.0 | 45 | 23 | 66 | -- | -- | -- | -- | -- |
| SEP 18 | | 7.0 | 174 | 440 | 55 | -- | -- | -- | 22.3 | 0.1 | 22.4 | 10.82 | 17 | 3 | 49 | 8.8 | 45 | 32 | 66 | -- | -- | -- | -- | -- |
| SEP 18 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 79 | 490 | 0.8 |
| SEP 19 | | 7.0 | 170 | 400 | 60 | -- | -- | -- | 19.6 | 0.1 | 19.7 | 10.62 | 17 | 4 | 50 | 8.5 | 45 | 30 | 66 | -- | -- | -- | -- | -- |
| SEP 20 | | 7.0 | 166 | 370 | 60 | -- | -- | -- | 17.2 | 0.3 | 17.5 | 8.83 | 17 | 4 | 49 | 6.5 | 43 | 36 | 66 | -- | -- | -- | -- | -- |

TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARD-NESS | SS | BOD$_5$ | TOC | NITROGEN as N KJEL-DAHL | NITROGEN as N NO$_2$+NO$_3$ | NITROGEN as N TOTAL | PO$_4$-P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS FECAL | COLIFORMS TOTAL | Cl$_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/ℓ | | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | mg/ℓ | no./100mℓ | no./100mℓ | mg/ℓ |
| (1973) | | | | | | | | | | | | | | | | | | | | | | | | |
| SEP 21 | CHLORINATED SECONDARY EFFLUENT | 6.8 | 198 | 410 | 65 | -- | -- | -- | 18.1 | 0.2 | 18.3 | 9.04 | 18 | 5 | 48 | 8.0 | 48 | 38 | 66 | -- | -- | -- | -- | -- |
| SEP 22 | | 7.1 | 198 | 410 | 64 | -- | -- | -- | 24.0 | 0.1 | 24.1 | 11.98 | 17 | 6 | 30 | 9.4 | -- | 41 | 67 | -- | -- | -- | -- | -- |
| OCT 1 | | 6.9 | 170 | 420 | 70 | -- | -- | -- | 21.6 | 0.2 | 21.8 | 12.28 | 19 | 6 | 36 | 8.2 | 48 | 43 | 67 | -- | -- | -- | -- | -- |
| OCT 2 | | -- | -- | -- | 73 | -- | -- | -- | -- | -- | -- | -- | 17 | -- | 54 | 10.3 | -- | -- | -- | -- | -- | -- | -- | -- |
| OCT 2 | | 6.9 | 220 | 380 | 60 | -- | -- | -- | 11.9 | 0.3 | 12.2 | 10.83 | 18 | 4 | 50 | 7.9 | 48 | 35 | 66 | -- | -- | -- | -- | -- |
| OCT 3 | | 6.8 | 340 | 410 | 70 | -- | -- | -- | 21.6 | 0.3 | 21.9 | 11.14 | 19 | 6 | 48 | 8.4 | 48 | 32 | 67 | -- | -- | -- | -- | -- |
| OCT 4 | | 6.8 | 350 | 410 | 75 | -- | -- | -- | 23.1 | 0.1 | 23.2 | 11.77 | 19 | 7 | 51 | 9.2 | 48 | 43 | 69 | -- | -- | -- | -- | -- |
| OCT 5 | | 6.5 | 340 | 390 | 75 | -- | -- | -- | 27.2 | 0.1 | 28.3 | 11.14 | 18 | 7 | 49 | 8.2 | 45 | 34 | 67 | -- | -- | -- | -- | -- |
| OCT 15 | | 6.9 | 322 | 400 | 70 | -- | -- | -- | 25.4 | 0.1 | 25.5 | 9.22 | 12 | 10 | 54 | 10.3 | 48 | 43 | 67 | -- | -- | -- | -- | -- |
| OCT 16 | | 6.8 | 200 | 420 | 63 | -- | -- | -- | 26.2 | 0.3 | 26.5 | 10.26 | 12 | 8 | 54 | 10.6 | 48 | 41 | 68 | -- | -- | 2 | 2 | 1.0 |
| OCT 17 | | 6.9 | 300 | 400 | 65 | -- | -- | -- | 23.1 | 1.0 | 24.1 | 8.62 | 12 | 9 | 54 | 10.4 | 48 | 34 | 68 | -- | -- | -- | -- | -- |
| OCT 18 | | 6.9 | 308 | 370 | 63 | -- | -- | -- | 20.2 | 0.6 | 20.8 | 8.74 | 12 | 8 | 50 | 10.9 | 43 | 41 | 68 | -- | -- | -- | -- | -- |
| NOV 1 | | 6.8 | 384 | 390 | 68 | -- | -- | -- | 16.2 | 2.0 | 18.2 | 10.62 | -- | -- | 48 | 11.1 | 48 | 44 | 70 | -- | -- | -- | -- | -- |
| NOV 5 | | 6.7 | -- | 370 | 60 | -- | -- | -- | 15.8 | 0.1 | 15.9 | 9.63 | 10 | 9 | 54 | 7.5 | 50 | 28 | 71 | -- | -- | -- | -- | -- |
| NOV 5 | | 6.9 | 336 | 420 | 73 | -- | -- | -- | 23.5 | 0.7 | 24.2 | 10.88 | 7 | 14 | 48 | 11.1 | 50 | 54 | 71 | -- | -- | -- | -- | -- |
| NOV 6 | | 6.8 | -- | 590 | 60 | -- | -- | -- | 17.9 | 0.3 | 18.2 | 11.31 | 5 | 12 | 48 | 11.4 | 45 | 35 | 71 | -- | -- | 5 | 23 | 0.7 |
| NOV 6 | | 6.6 | 420 | 400 | 60 | -- | -- | -- | 24.6 | 0.1 | 24.7 | 14.46 | -- | -- | 63 | 10.8 | 50 | 45 | 70 | -- | -- | -- | -- | -- |
| NOV 7 | | 6.7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 12.67 | -- | -- | -- | -- | 48 | 47 | 71 | -- | -- | -- | -- | -- |
| NOV 8 | | 6.7 | 300 | 480 | 72 | -- | -- | -- | 34.2 | -- | -- | 15.36 | 5 | 15 | 50 | 12.0 | 45 | 55 | 69 | -- | -- | -- | -- | -- |
| NOV 9 | | 6.7 | 290 | 380 | 64 | -- | -- | -- | 23.1 | -- | -- | 12.67 | 11 | 9 | 48 | 10.8 | 48 | 39 | 72 | -- | -- | -- | -- | -- |
| NOV 19 | | 7.2 | 434 | 575 | 60 | -- | -- | -- | 24.9 | 0.1 | 25.0 | -- | -- | -- | 64 | 11.7 | 40 | 60 | 74 | -- | -- | -- | -- | -- |
| NOV 21 | | 7.0 | -- | 440 | 64 | -- | -- | -- | 21.8 | 0.1 | 21.9 | 15.09 | -- | -- | -- | -- | 70 | 57 | 72 | -- | -- | -- | -- | -- |
| NOV 23 | | 6.7 | 370 | 400 | 60 | -- | -- | -- | 22.1 | 0.1 | 22.2 | -- | -- | -- | 50 | 12.3 | 70 | 68 | 73 | -- | -- | -- | -- | -- |
| NOV 26 | | 6.8 | 328 | 400 | 60 | -- | -- | -- | 14.4 | 0.7 | 15.1 | -- | -- | -- | 54 | 11.1 | 60 | 54 | 63 | -- | -- | -- | -- | -- |
| NOV 27 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 33 | 0.5 |
| NOV 28 | | 7.1 | -- | 555 | 60 | -- | -- | -- | 33.7 | 0.1 | 33.8 | -- | -- | -- | 50 | 5.7 | 38 | 41 | 63 | -- | -- | -- | -- | -- |
| NOV 28 | | 7.1 | -- | 440 | 60 | -- | -- | -- | 25.5 | 0.1 | 25.6 | 12.75 | -- | -- | 48 | 11.3 | 38 | 34 | 94 | -- | -- | -- | -- | -- |
| DEC 3 | | 6.8 | 452 | 700 | 67 | -- | -- | -- | 28.6 | 0.1 | 28.7 | -- | 12 | 9 | 65 | 10.8 | 50 | 50 | 74 | -- | -- | -- | -- | -- |
| DEC 5 | | 7.1 | 410 | 500 | 60 | -- | -- | -- | 14.0 | 0.8 | 14.8 | 13.28 | 11 | 8 | 70 | 10.0 | 58 | 47 | 72 | -- | -- | -- | -- | -- |
| DEC 7 | | 7.0 | 384 | 540 | 67 | -- | -- | -- | 16.0 | 0.1 | 16.1 | 14.28 | 10 | 10 | 67 | 10.0 | 55 | 38 | 72 | -- | -- | -- | -- | -- |

## TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS | COND. @ 25°C | TOTAL HARDNESS | SS | $BOD_5$ | TOC | NITROGEN as N | | | $PO_4$-P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | COLIFORMS | | $Cl_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | KJELDAHL | $NO_2$+$NO_3$ | TOTAL | | | | | | | | | | | FECAL | TOTAL | |
| | | | mg/ℓ | µmhos/cm | mg/ℓ | | | | | | | | | | | | | | | | | no./100mℓ | | mg/ℓ |
| (1973) | | | | | | | | | | | | | | | | | | | | | | | | |
| DEC 11 | CHLORINATED SECONDARY EFFLUENT | -- | -- | -- | 64 | -- | -- | -- | 16.8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 130 | 330 | 0.5 |
| DEC 12 | | 7.0 | 324 | 500 | 67 | -- | -- | -- | 24.9 | 1.4 | 26.3 | -- | 12 | 9 | 61 | 10.5 | 53 | 39 | 75 | -- | -- | -- | -- | -- |
| DEC 14 | | 7.1 | 110 | -- | 53 | -- | -- | -- | -- | 0.1 | -- | 12.24 | 10 | 7 | -- | -- | 48 | -- | 73 | -- | -- | -- | -- | -- |
| DEC 17 | | 6.9 | 336 | 450 | 60 | -- | -- | -- | 19.3 | 0.7 | 20.0 | 13.46 | 20 | 9 | 63 | 9.4 | 48 | 47 | 73 | -- | -- | -- | -- | -- |
| DEC 17 | | 6.7 | 380 | 480 | 73 | -- | -- | -- | 22.1 | 0.9 | 23.0 | 11.34 | 10 | 12 | 63 | 9.0 | 48 | 40 | 73 | -- | -- | -- | -- | -- |
| DEC 18 | | 6.7 | 304 | 490 | 67 | -- | -- | -- | 21.6 | 1.0 | 22.6 | 13.17 | 7 | 12 | 45 | 7.8 | 50 | 38 | 73 | -- | -- | -- | -- | -- |
| DEC 18 | | 6.8 | 316 | 420 | 60 | -- | -- | -- | 16.2 | 0.8 | 17.0 | 13.80 | 10 | 9 | 65 | 9.2 | 50 | 42 | 73 | -- | -- | -- | -- | -- |
| DEC 19 | | 6.6 | 270 | 380 | 53 | -- | -- | -- | 11.2 | 0.9 | 12.1 | 10.98 | 10 | 7 | 58 | 9.0 | 50 | 40 | 73 | -- | -- | -- | -- | -- |
| DEC 19 | | 7.0 | 306 | 440 | 60 | -- | -- | -- | 20.2 | 1.1 | 21.3 | 10.44 | 5 | 12 | -- | 2.5 | 46 | 51 | 62 | -- | -- | -- | -- | -- |
| DEC 20 | | 7.5 | 286 | 470 | 53 | -- | -- | -- | 10.6 | 2.1 | 12.7 | 11.18 | 9 | 7 | -- | 5.8 | 50 | 39 | 61 | -- | -- | -- | -- | -- |
| DEC 21 | | 6.6 | 290 | 420 | 67 | -- | -- | -- | 20.2 | 0.7 | 20.9 | 11.71 | 10 | 10 | 60 | 9.2 | 46 | 52 | 73 | -- | -- | -- | -- | -- |
| DEC 22 | | 6.8 | 336 | 490 | 67 | -- | -- | -- | 27.2 | 0.2 | 27.4 | 13.49 | 10 | 10 | 59 | 10.8 | -- | 40 | 75 | -- | -- | -- | -- | -- |
| DEC 24 | | 6.8 | 280 | 480 | 60 | -- | -- | -- | 22.9 | 0.5 | 23.4 | 15.50 | 10 | 9 | 63 | 10.0 | 48 | 40 | 73 | -- | -- | -- | --- | -- |
| (1974) | | | | | | | | | | | | | | | | | | | | | | | | |
| JAN 7 | | 7.4 | 244 | 430 | 60 | -- | -- | -- | 23.0 | 0.5 | 23.5 | 11.09 | 10 | 9 | 61 | 9.4 | 50 | 46 | 61 | -- | -- | -- | -- | -- |
| JAN 8 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 5 | 23 | -- |
| JAN 9 | | 7.2 | -- | 500 | 36 | -- | -- | -- | 23.0 | -- | -- | 13.53 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| JAN 11 | | 6.6 | -- | 560 | 80 | -- | -- | -- | 34.4 | 0.1 | 34.5 | 15.83 | 13 | 12 | 59 | 10.4 | 48 | 45 | 75 | -- | -- | -- | -- | -- |
| JAN 18 | | 6.7 | -- | 500 | 73 | -- | -- | -- | 25.7 | 0.1 | 25.8 | 15.00 | 11 | 11 | 61 | 10.2 | 46 | 37 | 73 | -- | -- | -- | -- | -- |
| JAN 21 | | 6.9 | -- | -- | -- | -- | -- | -- | 15.2 | 3.0 | 18.2 | -- | 12 | -- | 61 | 10.0 | -- | 39 | 70 | -- | -- | -- | -- | -- |
| JAN 21 | | 6.9 | -- | -- | -- | -- | -- | -- | -- | 3.0 | -- | -- | -- | -- | -- | -- | 48 | -- | 70 | -- | -- | -- | -- | -- |
| JAN 23 | | -- | 220 | 450 | 60 | -- | -- | -- | 14.0 | 2.6 | 16.6 | -- | 10 | 9 | 63 | 10.0 | -- | -- | -- | -- | -- | 23 | 46 | 0.7 |
| FEB 12 | | 6.7 | 234 | 400 | 60 | -- | -- | -- | 14.0 | 2.6 | 16.6 | 13.61 | 10 | 9 | 63 | 10.4 | 46 | 33 | -- | -- | -- | -- | -- | -- |
| FEB 13 | | -- | 324 | 420 | 60 | -- | -- | -- | 9.3 | -- | -- | 11.83 | 12 | 7 | 63 | 10.4 | 48 | 33 | 74 | -- | -- | -- | -- | -- |
| FEB 14 | | -- | 338 | 420 | 60 | -- | -- | -- | 14.0 | -- | -- | 12.60 | 12 | 7 | 63 | 10.5 | -- | 34 | 74 | -- | -- | -- | -- | -- |
| FEB 15 | | 7.1 | 320 | 430 | 60 | -- | -- | -- | 14.0 | 3.8 | 17.8 | 14.62 | 12 | 7 | 59 | 11.0 | 44 | 38 | 75 | -- | -- | -- | -- | -- |
| FEB 19 | | -- | 350 | 430 | 64 | -- | -- | -- | 8.7 | -- | -- | 14.77 | 11 | 9 | 57 | 9.6 | 48 | 29 | 76 | -- | -- | -- | -- | -- |
| FEB 20 | | 6.7 | 346 | 440 | 64 | -- | -- | -- | 9.3 | 4.9 | 14.2 | 13.05 | 13 | 7 | 61 | 10.8 | 48 | 33 | 73 | -- | -- | 8 | 33 | 1.2 |
| FEB 20 | | 7.0 | 200 | 520 | 64 | -- | -- | -- | 26.8 | 1.6 | 18.4 | 13.54 | 10 | 10 | 59 | 10.4 | 46 | 43 | 74 | -- | -- | -- | -- | -- |
| FEB 21 | | -- | 332 | 450 | 60 | -- | -- | -- | 17.4 | -- | -- | 13.46 | 10 | 8 | 57 | 10.0 | 50 | 34 | 74 | -- | -- | -- | -- | -- |

TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | $BOD_5$ | TOC | NITROGEN as N | | | $PO_4$-P | Ca | Mg$^{**}$ | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | COLIFORMS | | $Cl_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | KJEL-DAHL | $NO_2$+ $NO_3$ | TOTAL | | | | | | | | | | | FECAL | TOTAL | |
| | | | mg/ℓ | cm | mg/ℓ | | | | | | | | | | | | | | | | | no./100mℓ | | mg/ℓ |
| (1974) | CHLORINATED SECONDARY EFFLUENT | | | | | | | | | | | | | | | | | | | | | | | |
| FEB 25 | | 7.0 | 274 | 440 | 64 | -- | -- | -- | 15.2 | 0.5 | 15.7 | 12.81 | 8 | 10 | 61 | 10.0 | 54 | 38 | 74 | -- | -- | -- | -- | -- |
| FEB 25 | | 7.1 | 350 | 460 | 64 | -- | -- | -- | 16.3 | 1.3 | 17.6 | 10.44 | 8 | 11 | 57 | 10.0 | 48 | 41 | 75 | -- | -- | -- | -- | -- |
| FEB 26 | | 7.1 | 260 | 570 | 68 | -- | -- | -- | 28.3 | 0.3 | 28.6 | 15.99 | 9 | 11 | 54 | 11.4 | 46 | 57 | 75 | -- | -- | -- | -- | -- |
| FEB 27 | | 7.1 | 310 | 540 | 68 | -- | -- | -- | 28.0 | 1.4 | 29.4 | 14.19 | 10 | 11 | 52 | 10.7 | 48 | 43 | 75 | -- | -- | -- | -- | -- |
| FEB 27 | | 6.7 | 356 | 445 | 68 | -- | -- | -- | 16.2 | 0.8 | 17.0 | 14.36 | 10 | 9 | 60 | 10.5 | 50 | 35 | 75 | -- | -- | -- | -- | -- |
| MAR 8 | | 6.8 | 320 | 450 | 68 | -- | -- | -- | 12.9 | 4.2 | 17.1 | 12.81 | 12 | 9 | 62 | 9.8 | 48 | 33 | 74 | -- | -- | -- | -- | -- |
| MAR 11 | | 7.0 | 362 | 460 | 68 | -- | -- | -- | 19.6 | 0.1 | 19.7 | 16.32 | 10 | 10 | 66 | 9.8 | 50 | 39 | 74 | -- | -- | -- | -- | -- |
| MAR 20 | | 6.8 | 364 | 440 | 68 | -- | -- | -- | 17.1 | 3.3 | 20.4 | 13.54 | 12 | 9 | 57 | 9.3 | 50 | 39 | 74 | -- | -- | -- | -- | -- |
| MAR 21 | | 6.9 | 276 | 455 | 68 | -- | -- | -- | 20.7 | 1.1 | 21.8 | 12.64 | 9 | 8 | 57 | 9.0 | -- | 3 | 74 | -- | -- | -- | -- | -- |
| MAR 25 | | 6.9 | 330 | 430 | 68 | -- | -- | -- | 17.1 | 1.3 | 18.4 | 11.75 | 10 | 8 | 67 | 10.7 | 48 | 38 | 74 | -- | -- | -- | -- | -- |
| MAR 29 | | 7.4 | 310 | 520 | 56 | -- | -- | -- | 19.3 | 2.1 | 21.4 | 12.83 | 9 | 8 | -- | -- | 52 | 36 | 84 | -- | -- | -- | -- | -- |
| APR 1 | | 7.0 | 320 | 510 | 64 | -- | -- | -- | 21.6 | 0.9 | 22.5 | 10.44 | 10 | 7 | 55 | 10.3 | -- | 33 | 75 | -- | -- | -- | -- | -- |
| APR 2 | | 7.0 | 220 | 540 | 60 | -- | -- | -- | 22.4 | 0.4 | 22.3 | 10.60 | 7 | 10 | 60 | 9.6 | 46 | 43 | 74 | -- | -- | -- | -- | -- |
| APR 4 | | 6.8 | 314 | 490 | 56 | -- | -- | -- | 21.8 | 1.7 | 23.5 | 12.54 | 11 | 7 | 60 | 9.8 | -- | 45 | -- | -- | -- | 4 | 130 | 1.8 |
| APR 4 | | 7.0 | 270 | 540 | 60 | -- | -- | -- | 23.5 | 0.3 | 23.8 | 11.01 | 7 | 10 | 59 | 9.4 | 48 | 45 | 74 | -- | -- | -- | -- | -- |
| APR 5 | | 7.0 | 240 | 520 | 68 | -- | -- | -- | 26.0 | 0.4 | 26.4 | 10.12 | 5 | 14 | 66 | 9.0 | 48 | 40 | 74 | -- | -- | -- | -- | -- |
| APR 11 | | 7.1 | 354 | 520 | 60 | -- | -- | -- | 25.8 | 1.7 | 27.5 | 12.24 | 7 | 13 | 70 | 9.0 | 48 | 55 | 84 | -- | -- | -- | -- | -- |
| APR 12 | | 7.2 | 354 | 510 | 60 | -- | -- | -- | 26.9 | 0.8 | 27.7 | 12.00 | 9 | 10 | 64 | 10.0 | 48 | 49 | 84 | -- | -- | -- | -- | -- |
| APR 15 | | 7.2 | 360 | 520 | 60 | -- | -- | -- | 25.2 | 0.1 | 25.3 | 8.65 | 10 | 7 | 65 | 9.5 | 48 | 33 | 84 | -- | -- | -- | -- | -- |
| APR 17 | | 7.6 | 390 | 480 | 56 | -- | -- | -- | 26.3 | 0.2 | 26.5 | 11.94 | 11 | 7 | 69 | 9.8 | 46 | 25 | 74 | -- | -- | 79 | 130 | 1.5 |
| APR 30 | | 7.3 | 354 | 585 | 56 | -- | -- | -- | 18.8 | 0.2 | 19.0 | 10.54 | 9 | 8 | 60 | 9.6 | -- | 31 | -- | -- | -- | -- | -- | -- |
| MAY 1 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 30 | 460 | 1.2 |
| MAY 6 | | -- | 588 | 480 | 56 | -- | -- | -- | 26.3 | 0.2 | 26.5 | 10.31 | 11 | 7 | 60 | 9.3 | -- | 31 | -- | -- | -- | -- | -- | -- |
| MAY 7 | | 7.2 | -- | 590 | 60 | -- | -- | -- | 26.3 | 0.7 | 27.0 | 10.90 | 10 | 9 | 55 | 9.6 | -- | 40 | -- | -- | -- | -- | -- | -- |
| MAY 8 | | 7.1 | -- | 600 | 60 | -- | -- | -- | 36.4 | 0.9 | 37.3 | 10.81 | 9 | 9 | 53 | 10.2 | -- | 33 | -- | -- | -- | -- | -- | -- |
| MAY 8 | | 7.1 | -- | 700 | 72 | -- | -- | -- | 37.8 | 0.4 | 38.2 | 16.16 | 12 | 10 | 55 | 11.2 | -- | 76 | -- | -- | -- | -- | -- | -- |
| MAY 9 | | 7.2 | 386 | 630 | 68 | -- | -- | -- | 32.2 | 0.2 | 32.4 | 11.70 | 12 | 9 | 51 | 10 5 | -- | 43 | -- | -- | -- | -- | -- | -- |
| MAY 10 | | 7.3 | 380 | 600 | 60 | -- | -- | -- | 27.2 | 0.4 | 27.6 | 2.71 | 10 | 9 | 53 | 10.5 | -- | 43 | -- | -- | -- | -- | -- | -- |
| MAY 10 | | 7.3 | -- | 565 | 56 | -- | -- | -- | 24.9 | 0.5 | 25.4 | 11.41 | 9 | 8 | 53 | 10.2 | -- | 39 | -- | -- | -- | -- | -- | -- |

## TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS | COND. @ 25°C | TOTAL | | | | NITROGEN as N | | | | | | | | | | | | | COLIFORMS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/ℓ | µmhos/cm | HARDNESS | SS | $BOD_5$ | TOC | KJELDAHL | $NO_2+NO_3$ | TOTAL | $PO_4$-P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | FECAL | TOTAL | $Cl_2$ |
| | | | | | mg/ℓ | | | | | | | | | | | | | | | | | no./100mℓ | | mg/ℓ |
| (1974) | | | | | | | | | | | | | | | | | | | | | | | | |
| MAY 20 | CHLORINATED SECONDARY EFFLUENT | 7.0 | -- | 620 | 54 | -- | -- | -- | 30.0 | 0.1 | 30.1 | 11.96 | 8 | 8 | 53 | 10.4 | 44 | 45 | 74 | -- | -- | -- | -- | -- |
| MAY 22 | | 7.0 | 340 | 485 | 60 | -- | -- | -- | 11.8 | 0.3 | 12.1 | 10.85 | 9 | 9 | 55 | 10.0 | 46 | 35 | 75 | -- | -- | -- | -- | -- |
| MAY 23 | | 7.0 | 336 | 520 | 56 | -- | -- | -- | 16.5 | 0.4 | 16.9 | 10.62 | 10 | 8 | 53 | 10.2 | 48 | 46 | 74 | -- | -- | -- | -- | -- |
| MAY 23 | | 7.2 | 358 | 500 | 56 | -- | -- | -- | 15.7 | 1.2 | 16.9 | 10.70 | 10 | 8 | 53 | 10.0 | 46 | 34 | 74 | -- | -- | -- | -- | -- |
| MAY 24 | | 7.1 | 350 | 495 | 52 | -- | -- | -- | 14.0 | 1.3 | 15.3 | 11.79 | 9 | 7 | 53 | 9.8 | 46 | 37 | 74 | -- | -- | -- | -- | -- |
| JUN 3 | | 7.0 | 360 | 575 | 54 | -- | -- | -- | 24.6 | 0.8 | 25.4 | 10.31 | 9 | 8 | 55 | 9.8 | 52 | 35 | 64 | -- | -- | -- | -- | -- |
| JUN 10 | | 7.4 | 370 | 540 | 56 | -- | -- | -- | 20.2 | 0.1 | 20.3 | 12. 2 | 8 | 9 | 52 | 10.0 | -- | 48 | 75 | -- | -- | -- | -- | -- |
| JUN 12 | | 7.3 | 588 | 480 | 52 | -- | -- | -- | 9.5 | -- | -- | 10.31 | 9 | 7 | 55 | 9.8 | -- | 37 | -- | -- | -- | -- | -- | -- |
| JUN 13 | | 7.0 | -- | 510 | 56 | -- | -- | -- | 16.5 | 2.0 | 18.5 | 10.93 | 7 | 9 | 54 | 10.0 | -- | -- | 73 | -- | -- | -- | -- | -- |
| JUN 14 | | 7.3 | 352 | 490 | 52 | -- | -- | -- | 13.2 | -- | -- | 9.44 | 8 | 8 | 53 | 10.4 | -- | 38 | -- | -- | -- | -- | -- | -- |
| JUN 14 | | 7.1 | 370 | 475 | 52 | -- | -- | -- | 11.8 | -- | -- | 10.85 | 9 | 7 | 60 | 10.2 | -- | -- | -- | -- | -- | -- | -- | -- |
| JUN 20 | | 7.4 | 332 | 480 | 56 | -- | -- | -- | 17.4 | 1.4 | 18.8 | 11.16 | 8 | 9 | 54 | 10.7 | -- | 46 | -- | -- | -- | -- | -- | -- |
| JUN 24 | | 7.3 | 330 | 485 | 56 | -- | -- | -- | 16.8 | 1.5 | 18.3 | 8.37 | 8 | 9 | 55 | 10.2 | -- | 49 | -- | -- | -- | -- | -- | -- |
| JUN 26 | | 6.6 | 384 | 470 | 56 | -- | -- | -- | 15.1 | -- | -- | 10.31 | 9 | 8 | 54 | 10.0 | -- | 55 | -- | -- | -- | -- | -- | -- |
| JUN 27 | | 7.0 | -- | -- | 56 | -- | -- | -- | 12.0 | 3.1 | 15.1 | 10.56 | 8 | 9 | 54 | 10.2 | -- | -- | -- | -- | -- | -- | -- | -- |
| JUN 28 | | 7.7 | 308 | 485 | 60 | -- | -- | -- | 17.6 | 2.2 | 19.8 | 10.23 | 9 | 9 | 55 | 10.7 | -- | 43 | -- | -- | -- | -- | -- | -- |
| JUN 28 | | 7.0 | -- | -- | 56 | -- | -- | -- | 18.5 | 2.3 | 20.8 | 11.24 | 9 | -- | 54 | 10.7 | -- | -- | -- | -- | -- | -- | -- | -- |
| JUL 2 | | 6.6 | 322 | 500 | 64 | -- | -- | -- | 14.0 | 3.2 | 14.2 | 10.96 | 8 | 11 | 55 | 10.2 | -- | 49 | 73 | -- | -- | -- | -- | -- |
| JUL 5 | | 6.5 | 346 | 490 | 60 | -- | -- | -- | 12.6 | 2.8 | 15.4 | 10.20 | 8 | 10 | 60 | 10.2 | -- | 43 | 73 | -- | -- | -- | -- | -- |
| JUL 8 | | 6.5 | 350 | -- | 56 | -- | -- | -- | 11.2 | 4.9 | 16.1 | 10.92 | 8 | 9 | 61 | 10.0 | -- | 43 | 73 | -- | -- | -- | -- | -- |
| JUL 10 | | 6.5 | 340 | 485 | 60 | -- | -- | -- | 13.7 | 0.9 | 14.6 | 12.61 | 7 | 10 | 60 | 10.5 | -- | -- | -- | -- | -- | -- | -- | -- |
| JUL 10 | | 6.7 | 402 | 580 | 64 | -- | -- | -- | 26.6 | 1.6 | 28.2 | 10.98 | 9 | 10 | 55 | 10.7 | -- | 60 | -- | -- | -- | -- | -- | -- |
| JUL 11 | | 6.6 | 356 | 520 | 60 | -- | -- | -- | 19.0 | 3.0 | 22.0 | 11.52 | 8 | 10 | 55 | 10.7 | -- | 54 | -- | -- | -- | -- | -- | -- |
| JUL 12 | | 6.6 | 390 | 485 | 60 | -- | -- | -- | 14.0 | 3.5 | 17.5 | 10.72 | 8 | 10 | 54 | 10.7 | -- | 46 | -- | -- | -- | -- | -- | -- |
| JUL 15 | | 6.5 | 370 | -- | 60 | -- | -- | -- | 19.0 | 0.8 | 19.8 | 11.74 | 7 | 10 | 65 | 11.0 | -- | 50 | -- | -- | -- | -- | -- | -- |
| JUL 23 | | -- | -- | -- | -- | -- | -- | -- | -- | 1.4 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| JUL 24 | | -- | -- | -- | -- | -- | -- | -- | -- | 1.9 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| JUL 25 | | -- | -- | -- | -- | -- | -- | -- | -- | 2.0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| JUL 31 | | 7.0 | -- | 410 | 60 | -- | -- | -- | 15.3 | 1.3 | 16.6 | 8.33 | -- | -- | 67 | 9.5 | 52 | -- | 74 | -- | -- | -- | -- | -- |
| AUG 1 | | 7.0 | -- | 390 | 60 | -- | -- | -- | 11.3 | 1.8 | 13.1 | 7.68 | -- | -- | 60 | 9.0 | 51 | -- | 72 | -- | -- | -- | -- | -- |

TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS mg/ℓ | COND. @ 25 C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N KJELDAHL | NITROGEN as N NO$_2$+NO$_3$ | NITROGEN as N TOTAL | PO$_4$-P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS FECAL no./100mℓ | COLIFORMS TOTAL no./100mℓ | Cl$_2$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1974) | | | | | | | | | | | | | | | | | | | | | | | | |
| AUG 2 | CHLORINATED SECONDARY EFFLUENT | 7.0 | -- | 410 | 60 | -- | -- | -- | 10.1 | 1.3 | 11,4 | 8.34 | -- | -- | 60 | 9.0 | 51 | -- | 72 | -- | -- | -- | -- | -- |
| AUG 5 | | 6.7 | -- | 420 | 60 | -- | -- | -- | 11.9 | 2.3 | 14.2 | 8.01 | -- | -- | 67 | 10.0 | 56 | -- | 72 | -- | -- | -- | -- | -- |
| AUG 14 | | -- | -- | 420 | 60 | -- | -- | -- | 14.7 | 1.5 | 16.2 | 8.07 | -- | -- | 58 | 9.0 | 52 | -- | 72 | -- | -- | -- | -- | -- |
| AUG 15 | | -- | -- | 400 | 60 | -- | -- | -- | 9.9 | 2.6 | 13.5 | 7.84 | -- | 58 | 58 | 9.0 | 50 | -- | 72 | -- | -- | -- | -- | -- |
| AUG 16 | | -- | -- | 430 | 60 | -- | -- | -- | 16.8 | 1.6 | 18.4 | 10.62 | -- | -- | 60 | 10.5 | 50 | -- | 73 | -- | -- | -- | -- | -- |
| AUG 19 | | -- | -- | 400 | 60 | -- | -- | -- | 12.6 | 0.7 | 13.3 | 9.80 | -- | -- | 63 | 10.5 | 56 | -- | 72 | -- | -- | -- | -- | -- |
| AUG 21 | | -- | -- | 440 | 60 | -- | -- | -- | 7.6 | -- | -- | 7.27 | 8 | 10 | 52 | 4.8 | 164 | -- | 75 | -- | -- | 490 | 1400 | -- |
| AUG 22 | | -- | -- | 370 | 60 | -- | -- | -- | 9.8 | 2.5 | 12.3 | 8.58 | -- | -- | 60 | 10.0 | 55 | -- | 73 | -- | -- | -- | -- | -- |
| AUG 26 | | -- | -- | 410 | 68 | -- | -- | -- | 9.0 | 2.6 | 11.6 | 8.66 | -- | -- | 56 | 8.5 | 53 | -- | 74 | -- | -- | -- | -- | -- |
| AUG 28 | | -- | -- | 430 | 64 | -- | -- | -- | 11.5 | 1.4 | 12.9 | 9.31 | -- | -- | 53 | 9.4 | 53 | -- | 73 | -- | -- | -- | -- | -- |
| AUG 29 | | -- | -- | 440 | 64 | -- | -- | -- | 12.6 | 3.6 | 16.2 | 9.80 | -- | -- | 57 | 9.9 | 53 | -- | 74 | -- | -- | -- | -- | -- |
| AUG 29 | | -- | -- | 430 | 64 | -- | -- | -- | 11.2 | 4.0 | 15.2 | 9.48 | -- | -- | 52 | 9.4 | 52 | -- | 72 | -- | -- | -- | -- | -- |
| AUG 30 | | -- | -- | 400 | 64 | -- | -- | -- | 7.0 | 4.8 | 11.8 | 9.80 | -- | -- | 52 | 7.9 | 50 | -- | 72 | -- | -- | -- | -- | -- |
| SEP 11 | | -- | 326 | 400 | 55 | 8 | 6 | -- | 7.8 | — | -- | 9.40 | 8 | 9 | 50 | 5.3 | 49 | -- | 76 | -- | -- | 130 | 460 | 0.8 |
| SEP 12 | | -- | -- | 420 | 60 | -- | -- | -- | 8.0 | 4.8 | 12.8 | 9.72 | -- | -- | 47 | 9.7 | 49 | -- | 72 | -- | -- | -- | -- | -- |
| SEP 17 | | -- | -- | 470 | 56 | -- | -- | -- | 13.3 | 3.4 | 16.7 | 9.97 | -- | -- | 49 | 10.0 | 53 | -- | 71 | -- | -- | -- | -- | -- |
| SEP 18 | | -- | -- | 450 | 58 | -- | -- | -- | 11.2 | 3.5 | 14.7 | 9.40 | -- | -- | 47 | 9.7 | 50 | -- | 70 | -- | -- | -- | -- | -- |
| SEP 19 | | -- | -- | 440 | 58 | -- | -- | -- | 6.3 | 3.6 | 9. | 9.72 | -- | -- | 50 | 9.7 | 51 | -- | 72 | -- | -- | -- | -- | -- |
| OCT 2 | | -- | -- | 490 | 66 | -- | -- | -- | 14.3 | 1.9 | 16.2 | 6.86 | -- | -- | 63 | 8.6 | 51 | -- | 70 | -- | -- | -- | -- | -- |
| OCT 9 | | -- | -- | 460 | 66 | -- | -- | -- | 13.0 | 3.5 | 16.5 | 9.23 | -- | -- | 58 | 8.6 | 52 | -- | 45 | -- | -- | -- | -- | -- |
| OCT 9 | | -- | 354 | 470 | 56 | 10 | 7 | -- | 16.0 | -- | -- | 8.74 | 8 | 9 | 45 | 9.1 | 50 | -- | 78 | -- | -- | 130 | 350 | 0.6 |
| OCT 10 | | -- | -- | 470 | 64 | -- | -- | -- | 16.9 | 4.5 | 21.4 | 8.99 | -- | -- | 58 | 8.6 | 49 | -- | 71 | -- | -- | -- | -- | -- |
| OCT 14 | | -- | -- | 430 | 66 | -- | -- | -- | 9.5 | 4.9 | 14.4 | 6.45 | -- | -- | 50 | 9.1 | 49 | -- | 72 | -- | -- | -- | -- | -- |
| OCT 16 | | -- | -- | 430 | 60 | -- | -- | -- | 11.2 | 4.9 | 16.1 | 8.25 | -- | -- | 49 | 9.5 | 51 | -- | 72 | -- | -- | -- | -- | -- |
| OCT 4 | | -- | -- | 460 | 60 | -- | -- | -- | 6.2 | 3.6 | 9.8 | 10.00 | -- | -- | 41 | 10.0 | 57 | -- | 73 | -- | -- | -- | -- | -- |
| OCT 25 | | -- | -- | 410 | 58 | -- | -- | -- | 8.4 | 6.0 | 14.4 | 9.04 | -- | -- | 41 | 10.2 | 52 | -- | 71 | -- | -- | -- | -- | -- |
| NOV 2 | | -- | -- | 390 | 64 | -- | -- | -- | 11.8 | 7.2 | 19.0 | 9.70 | 8 | 11 | 54 | 10.3 | 52 | -- | 71 | -- | -- | -- | -- | -- |
| NOV 4 | | -- | -- | 420 | 58 | -- | -- | -- | 13.4 | 6.7 | 20.1 | 8.43 | 7 | 10 | 50 | 10.7 | 54 | -- | 69 | -- | -- | -- | -- | -- |
| NOV 5 | | -- | -- | 390 | 58 | -- | -- | -- | 8.7 | 8.6 | 17.3 | 8.84 | 7 | 10 | 50 | 10.7 | 52 | -- | 70 | -- | -- | -- | -- | -- |
| NOV 6 | | -- | 330 | 470 | 60 | 10 | 8 | -- | 17.4 | -- | -- | 9.70 | 9 | 9 | 50 | 10.3 | 55 | -- | 74 | -- | -- | 70 | 140 | 1.1 |

## TABLE A-1--CONTINUED

| DATE | WASTE WATER TYPE | pH | TDS | COND. @ 25°C μmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N | | | PO$_4$-P | Ca | Mg[⁑] | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS | | Cl$_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | KJELDAHL | NO$_2$+ NO$_3$ | TOTAL | | | | | | | | | | | FECAL | TOTAL | |
| | | | mg/ℓ | | mg/ℓ | | | | | | | | | | | | | | | | | no./100mℓ | | mg/ℓ |
| (1974)<br>NOV 20 | CHLORINATED SECONDARY EFFLUENT | -- | 321 | 460 | 56 | 5 | 9 | -- | 11.5 | 2.7 | 14.2 | 7.92 | 10 | 8 | 47 | 8.8 | 50 | -- | 76 | -- | -- | 23 | 23 | 1.5 |
| NOV 27 | | -- | -- | 420 | 60 | -- | -- | -- | 11.8 | 4.1 | 15.9 | 10.80 | 7 | 10 | 51 | 7.5 | 52 | -- | 71 | -- | -- | -- | -- | -- |
| NOV 29 | | -- | -- | 420 | 64 | -- | -- | -- | 14.0 | 4.2 | 18.2 | 10.62 | 8 | 11 | 51 | 8.3 | 55 | -- | 70 | -- | -- | -- | -- | -- |
| DEC 2 | | -- | -- | 540 | 72 | -- | -- | — | 18.8 | 2.7 | 21.5 | 10.95 | 11 | 11 | 53 | 8.7 | 59 | -- | 73 | -- | -- | -- | -- | -- |
| DEC 3 | | -- | -- | 540 | 68 | -- | -- | — | 18.2 | 2.6 | 20.8 | 10.43 | 12 | 9 | 51 | 8.3 | 54 | -- | 71 | -- | -- | -- | -- | -- |
| DEC 4 | | -- | 344 | 440 | 62 | 8 | 6 | -- | 14.8 | 4.8 | 19.6 | 9.68 | 12 | 8 | 49 | 7.9 | 50 | -- | 90 | -- | -- | 17 | 49 | -- |
| DEC 18 | | -- | 326 | 390 | 58 | 8 | 8 | -- | 7.6 | -- | -- | 9.53 | 9 | 9 | 40 | 8.6 | 55 | -- | 86 | -- | -- | 110 | 170 | -- |
| DEC 19 | | -- | -- | -- | 62 | -- | -- | -- | 8.1 | -- | -- | 10.74 | 7 | 10 | -- | -- | 99 | -- | -- | -- | -- | -- | -- | -- |
| DEC 20 | | -- | -- | -- | 62 | -- | -- | -- | 15.4 | -- | -- | 10.20 | 8 | 10 | -- | -- | 47 | -- | -- | -- | -- | -- | -- | -- |
| DEC 21 | | -- | -- | -- | 62 | -- | -- | -- | 11.8 | -- | -- | 10.32 | 9 | 10 | -- | -- | 46 | -- | -- | -- | -- | -- | -- | -- |
| (1975)<br>JAN 8 | | -- | 356 | -- | 60 | 12 | 4 | -- | 13.4 | -- | -- | 7.85 | 9 | 9 | 55 | 9.6 | -- | -- | -- | -- | -- | -- | -- | -- |
| FEB 5 | | -- | 398 | 530 | 58 | 16 | 7 | -- | 13.2 | 3.1 | 16.3 | 10.40 | 10 | 8 | 55 | 10.9 | -- | -- | 79 | -- | -- | -- | -- | -- |

[⁑] CALCULATED BY THE EQUIVALENT WEIGHT DIFFERENCE BETWEEN TOTAL HARDNESS AND CALCIUM.

TABLE B-1. WEIGHTED COMPOSITE MILILANI STP ANALYSES

| CONSTITUENT* | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
|---|---|---|---|
| 22-23 OCTOBER 1971† | | | |
| pH RANGE | 6.3-7.0 | 5.8-6.2 | -- |
| CONDUCTIVITY RANGE (µmhos/cm) | -- | -- | -- |
| DISSOLVED OXYGEN RANGE | 1.0-2.0 | 1.6-2.9 | -- |
| SUSPENDED SOLIDS | 178 | -- | -- |
| TOTAL DISSOLVED SOLIDS | 307 | -- | -- |
| TOTAL VOLATILE SOLIDS | 188 | -- | -- |
| GREASE | 64.4 | 18.0 | 72 |
| BOD | 204 | 16 | 92 |
| COD | 470 | 28 | 94 |
| CHLORIDE | 75 | 60 | 20 |
| SULFATE | 64 | 85 | -33 |
| BORON | 0.46 | 0.10 | 78 |
| AMMONIA NITROGEN<br>ORGANIC NITROGEN | 27.7 | 9.5 | 66 |
| NITRITE NITROGEN | -- | -- | -- |
| NITRATE NITROGEN | 0.3 | 4.5 | -1400 |
| TOTAL NITROGEN | -- | -- | -- |
| ORTHOPHOSPHATE PHOSPHORUS | 13.4 | 17.9 | -34 |
| SODIUM | 64 | 64 | 0 |
| POTASSIUM | 8.2 | 5.8 | 29 |
| CALCIUM | 12 | 9 | 25 |
| MAGNESIUM | 17 | 22 | -23 |
| ALKALINITY ($CaCO_3$) | 186 | 73 | 61 |
| SILICA ($SiO_2$) | 30 | 44 | -47 |
| RESIDUAL CHLORINE RANGE | -- | -- | -- |
| TOTAL COLIFORM RANGE (/100 mℓ) | -- | -- | -- |
| FECAL COLIFORM RANGE (/100 mℓ) | -- | -- | -- |
| FECAL STREPTOCOCCUS RANGE (/100 mℓ) | -- | -- | -- |
| 9 AUGUST 1972‡ | | | |
| pH RANGE | 6.9-7.7 | 6.7-7.0 | -- |
| CONDUCTIVITY RANGE (µmhos/cm) | 390-560 | 280-480 | -- |
| DISSOLVED OXYGEN RANGE | 0.5-1.0 | 2.0-3.3 | -- |
| SUSPENDED SOLIDS | 200 | 11 | 94 |
| TOTAL DISSOLVED SOLIDS | 436 | 361 | 17 |
| TOTAL VOLATILE SOLIDS | 340 | 114 | 66 |
| GREASE | 72 | 60 | 16 |
| BOD | 204 | 12 | 94 |
| COD | 288 | 97 | 66 |
| CHLORIDE | 42.5 | 49.0 | 0 |
| SULFATE | 69 | 48 | 30 |
| BORON | 0.47 | 0.28 | 40 |
| AMMONIA NITROGEN | 25.60 | 10.25 | 59 |
| ORGANIC NITROGEN | 2.80 | 1.20 | 59 |
| NITRITE NITROGEN | 0.48 | 0.73 | 0 |
| NITRATE NITROGEN | 0.22 | 0.20 | 9 |
| TOTAL NITROGEN | 29.10 | 12.38 | 57 |
| ORTHOPHOSPHATE PHOSPHORUS | 14.15 | 10.50 | 25 |

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*All units in mg/ℓ unless noted otherwise.

†24-hr composite samples.

‡16-hr composite samples.

TABLE B-1. CONTINUED

9 AUGUST 1972†

| CONSTITUENT* | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
|---|---|---|---|
| SODIUM | 54 | 50 | 7 |
| POTASSIUM | 10.8 | 9.8 | 9 |
| CALCIUM | 20 | 18 | 10 |
| MAGNESIUM | 4.4 | 4.2 | 4 |
| ALKALINITY ($CaCO_3$) | 182 | 100 | 45 |
| SILICA ($SiO_2$) | 61 | 54 | 11 |
| RESIDUAL CHLORINE RANGE | -- | 0.4-1.9 | -- |
| OXYGEN-REDUCTION POTENTIAL RANGE (mv) | -10-140 | 170-360 | -- |
| **13 FEBRUARY 1973†** | | | |
| pH RANGE | 6.9-8.2 | 6.8-7.2 | -- |
| CONDUCTIVITY RANGE (μmhos/cm) | 420-600 | 380-480 | -- |
| DISSOLVED OXYGEN RANGE | 2.0-4.0 | 3.9-5.7 | -- |
| TURBIDITY (FTU) | 380 | 20 | 94 |
| TOTAL DISSOLVED SOLIDS | 498 | 374 | 24 |
| SUSPENDED SOLIDS | 124 | 14 | 88 |
| TOTAL VOLATILE SOLIDS | 330 | 136 | 58 |
| SETTLEABLE SOLIDS | 4.0 | 0.6 | 85 |
| GREASE | 54.5 | 11.8 | 78 |
| BOD | 200 | 15 | 93 |
| COD | 498 | 148 | 70 |
| CHLORIDE | 51.5 | 49.5 | 3 |
| SULPHATE | 52 | 48 | 7 |
| BORON | 1.05 | 0.70 | 33 |
| AMMONIA NITROGEN | 24.5 | 15.7 | 35 |
| ORGANIC NITROGEN | 3.5 | 1.6 | 54 |
| NITRITE NITROGEN | 0.09 | 0.06 | 33 |
| NITRATE NITROGEN | 0.05 | 0.38 | 0 |
| TOTAL NITROGEN | 28.14 | 17.74 | 37 |
| ORTHOPHOSPHATE PHOSPHORUS | 11.91 | 8.94 | 24 |
| SODIUM | 60 | 60 | 0 |
| POTASSIUM | 11.5 | 10.5 | 8 |
| CALCIUM | 10 | 8 | 20 |
| MAGNESIUM | 8.5 | 6.9 | 18 |
| ALKALINITY ($CaCO_3$) | 149 | 115 | 22 |
| SILICA ($SiO_2$) | 73 | 70 | 4 |
| RESIDUAL CHLORINE RANGE | -- | 1.2-3.0 | -- |
| TOTAL COLIFORM RANGE (/100 mℓ) | $5.6 \times 10^7$-<br>$24.2 \times 10^7$ | 12-432 | -- |
| FECAL COLIFORM RANGE (/100 mℓ) | $1.24 \times 10^7$-<br>$8.3 \times 10^7$ | 6-200 | -- |
| FECAL STREPTOCOCCUS RANGE (/100 mℓ) | $2.2 \times 10^5$-<br>$11.0 \times 10^5$ | 2-168 | -- |
| **5 JUNE 1973†** | | | |
| pH RANGE | 6.9-7.8 | 6.8-7.2 | -- |
| CONDUCTIVITY RANGE (μmhos/cm) | 400-600 | 450-600 | -- |

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*All units in mg/ℓ unless noted otherwise.

†16-hr composite samples.

TABLE B-1. CONTINUED

| CONSTITUENT* | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
|---|---|---|---|
| 5 JUNE 1973† | | | |
| DISSOLVED OXYGEN RANGE | 1.0-3.2 | 1.1-3.7 | -- |
| TURBIDITY (FTU) | 450 | 21 | 95 |
| TOTAL DISSOLVED SOLIDS | 377 | 351 | 6 |
| SUSPENDED SOLIDS | 280 | 7 | 97 |
| TOTAL VOLATILE SOLIDS | 201 | 118 | 41 |
| SETTLEABLE SOLIDS | 10 | 0.6 | 94 |
| GREASE | 112 | 21.6 | 80 |
| BOD | 225 | 8 | 96 |
| COD | 607 | 113 | 81 |
| CHLORIDE | 48 | 50 | 0 |
| SULFATE | 66 | 52 | 21 |
| BORON | 0.85 | 0.50 | 41 |
| AMMONIA NITROGEN | 27.72 | 16.1 | 41 |
| ORGANIC NITROGEN | 6.78 | 1.26 | 81 |
| NITRITE NITROGEN | 0.00 | 0.29 | 0 |
| NITRATE NITROGEN | 0.00 | 0.21 | 0 |
| TOTAL NITROGEN | 34.50 | 17.86 | 48 |
| ORTHOPHOSPHATE PHOSPHORUS | 22.5 | 15.4 | 31 |
| SODIUM | 56 | 53 | 5 |
| POTASSIUM | 11.1 | 10.5 | 5 |
| CALCIUM | 18 | 14.5 | 26 |
| MAGNESIUM | 7.5 | 6.5 | 18 |
| ALKALINITY ($CaCO_3$) | 185.2 | 139.4 | 24 |
| SILICA ($SiO_2$) | 65.4 | 60 | 8 |
| RESIDUAL CHLORINE RANGE | -- | 1.0-3.0 | -- |
| TOTAL COLIFORM RANGE (/100 mℓ) | $5.6 \times 10^5$-<br>$19.9 \times 10^5$ | 2-1600 | -- |
| FECAL COLIFORM RANGE (/100 mℓ) | $0.5 \times 10^7$-<br>$12.2 \times 10^7$ | 1-1505 | -- |
| FECAL STREPTOCOCCUS RANGE (/100 mℓ) | $5.9 \times 10^5$-<br>$15.5 \times 10^5$ | 1-1350 | -- |
| 2 OCTOBER 1973† | | | |
| pH RANGE | 7.1-7.7 | 6.5-7.8 | -- |
| CONDUCTIVITY RANGE (μmhos/cm) | 320-560 | 300-540 | -- |
| DISSOLVED OXYGEN RANGE | 0.6-2.5 | 0.6-3.7 | -- |
| OXYGEN-REDUCTION POTENTIAL RANGE (mv) | 10-190 | 125-395 | -- |
| CHLORINE RESIDUAL RANGE | -- | 0-2.0 | -- |
| TOTAL COLIFORM RANGE (/100 mℓ) | $3.8 \times 10^7$-<br>$1.1 \times 10^{10}$ | $2.8 \times 10^2$-<br>$1.4 \times 10^5$ | -- |
| FECAL COLIFORM RANGE (/100 mℓ) | $3.2 \times 10^7$-<br>$1.2 \times 10^8$ | $8.0 \times 10^2$-<br>$8.0 \times 10^5$ | -- |
| FECAL STREPTOCOCCUS RANGE (/100 mℓ) | $2.0 \times 10^5$-<br>$1.8 \times 10^7$ | 8.0-<br>$7.3 \times 10^3$ | -- |

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*All units in mg/ℓ unless noted otherwise.

†16-hr composite samples.

TABLE B-1. CONTINUED

| CONSTITUENT[*] | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
|---|---|---|---|
| 9 JANUARY 1974[†] | | | |
| pH RANGE | 7.0-8.0 | 6.8-7.1 | -- |
| CONDUCTIVITY RANGE (µmhos/cm) | 248-800 | 390-600 | -- |
| DISSOLVED OXYGEN RANGE | 1.3-2.0 | 1.1-2.8 | -- |
| OXYGEN-REDUCTION POTENTIAL RANGE (mv) | (-70)-(-5) | (-15)-0 | -- |
| RESIDUAL CHLORINE RANGE | -- | 0.3-2.0 | -- |
| TOTAL DISSOLVED SOLIDS | 345 | 367 | - 6.4 |
| CHLORIDE | 42 | 45 | - 7.1 |
| SULFATE | 40 | 32 | 20 |
| TOTAL KJELDAHL NITROGEN | 31.9 | 16.9 | 47 |
| $NO_2$ + $NO_3$ NITROGEN | 0.04 | 3.20 | -7900 |
| TOTAL NITROGEN | 31.94 | 20.10 | 37 |
| ORTHOPHOSPHATE PHOSPHORUS | 16.62 | 15.20 | 8.5 |
| SODIUM | 70 | 63 | 10 |
| POTASSIUM | 10.6 | 10.2 | 3.8 |
| CALCIUM | 10 | 8 | 20 |
| MAGNESIUM | 8 | 10 | -25 |
| ALKALINITY ($CaCO_3$) | 58 | 60 | - 3.4 |
| SILICA ($SiO_2$) | 62 | 75 | -21 |
| 26 AUGUST 1974[†] | | | |
| pH RANGE | 6.4-7.8 | 6.7-6.9 | -- |
| CONDUCTIVITY RANGE (µmhos/cm) | 550-780 | 520-600 | -- |
| DISSOLVED OXYGEN RANGE | 0-0.9 | 1.8-6.1 | -- |
| OXYGEN-REDUCTION POTENTIAL RANGE (mv) | (-75)-(-10) | 15-150 | -- |
| TOTAL DISSOLVED SOLIDS | 401 | 343 | 14 |
| GREASE | 50 | 10 | 80 |
| CHLORIDE | 45 | 53 | -18 |
| SULFATE | 54 | 37 | 31 |
| TOTAL KJELDAHL NITROGEN | 31.8 | 13.4 | -- |
| $NO_2$ + $NO_3$ NITROGEN | 0.01 | 1.40 | -13900 |
| TOTAL NITROGEN | 31.81 | 14.80 | -- |
| ORTHOPHOSPHATE PHOSPHORUS | 15.36 | 11.27 | 27 |
| SODIUM | 69 | 66 | 4.3 |
| POTASSIUM | 12.0 | 10.5 | 13 |
| CALCIUM | 8 | 7 | 13 |
| MAGNESIUM | 9 | 10 | -11 |
| ALKALINITY ($CaCO_3$) | 56 | 56 | 0 |
| SILICA ($SiO_2$) | 63 | 61 | 3.2 |
| RESIDUAL CHLORINE RANGE | -- | 0.6-2.5 | -- |
| TOTAL COLIFORM RANGE (/100 mℓ) | 8.0 x $10^6$-<br>2.1 x $10^9$ | 48-800 | -- |
| FECAL COLIFORM RANGE (/100 mℓ) | 1.0 x $10^6$-<br>2.3 x $10^9$ | 36-600 | -- |

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[*] All units in mg/ℓ unless noted otherwise.

[†] 16-hr composite samples.

TABLE B-1. CONTINUED

| CONSTITUENT* | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
|---|---|---|---|
| 26 AUGUST 1974† | | | |
| FECAL STREPTOCOCCUS RANGE (/100 mℓ) | $1.0 \times 10^6$-<br>$1.0 \times 10^8$ | 2-58 | -- |
| 13 JANUARY 1975† | | | |
| pH RANGE | 6.7-8.1 | 6.4-7.0 | -- |
| CONDUCTIVITY RANGE (μmhos/cm) | 460-700 | 440-540 | -- |
| DISSOLVED OXYGEN RANGE | 0 | 2.7-3.4 | -- |
| OXYGEN-REDUCTION POTENTIAL RANGE (mv) | (-230)-(+75) | 150-285 | -- |
| SUSPENDED SOLIDS | 159 | 6 | 96 |
| TOTAL DISSOLVED SOLIDS | 411 | 333 | 19 |
| TOTAL VOLATILE SOLIDS | 252 | 65 | 74 |
| VOLATILE SUSPENDED SOLIDS | 135 | 3 | 98 |
| $BOD_5$ | 241 | 12 | 95 |
| CHLORIDE | 48 | 55 | -15 |
| SULFATE | 76 | 33 | 57 |
| MBAS RANGE | 1.5-19.0 | 0.3-0.9 | -- |
| TOTAL KJELDAHL NITROGEN | 36.4 | 13.9 | 62 |
| $NO_2 + NO_3$ NITROGEN | 0.02 | 3.62 | 18000 |
| TOTAL NITROGEN | 36.42 | 17.52 | 52 |
| ORTHOPHOSPHATE PHOSPHORUS | 15.9 | 13.5 | 15 |
| SODIUM | 50 | 55 | -10 |
| POTASSIUM | 10.0 | 9.2 | 8 |
| CALCIUM | 10 | 11 | -10 |
| MAGNESIUM | 6.6 | 7.9 | -20 |
| ALKALINITY ($CaCO_3$) | 52 | 60 | -15 |
| SILICA ($SiO_2$) | 84 | 81 | 3.6 |
| RESIDUAL CHLORINE RANGE | -- | 0.7-3.0 | -- |
| TOTAL COLIFORM RANGE (/100 mℓ) | $1.3 \times 10^7$-<br>$1.3 \times 10^9$ | 52-650 | -- |
| FECAL COLIFORM RANGE (/100 mℓ) | $2.4 \times 10^6$-<br>$1.0 \times 10^8$ | 0-260 | -- |
| FECAL STREPTOCOCCUS RANGE (/100 mℓ) | $3.0 \times 10^5$-<br>$4.0 \times 10^8$ | 0-62 | -- |

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*All units in mg/ℓ unless noted otherwise.

†16-hr composite samples.

## TABLE B-2. PESTICIDE ANALYSES OF RAW SEWAGE AND UNCHLORINATED SECONDARY EFFLUENT, MILILANI STP

| PESTICIDE | SAMPLING DATE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 22-23 OCT 1971[1] | | 9 AUG 1972[2] | | 2 OCT 1973[2] | | 26 AUG 1974[2] | | 13 JAN 1975[2] | |
| | raw | effl. | raw | effl. | raw | effl. | raw | effl. | raw | effl. |
| | mg/ℓ | | | | | | | | | |
| LINDANE | 0.000295 | 0.000032 | 0.000180 | 0.000146 | 0.000176 | 0.000024 | 0.000131 | 0.000075 | 0.000160 | 0.000120 |
| HEPTACHLOR | -- | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| HEPTACHLOR EPOXIDE | -- | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| ALDRIN | -- | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| DIELDRIN | 0.000051 | 0.000017 | 0.000054 | 0.000020 | 0.000019 | 0.000013 | 0.000032 | 0.000022 | 0.000015 | 0.000010 |
| DDE | -- | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| DDD | 0.000042 | 0.000008 | ND | ND | ND | ND | ND | ND | 0.000011 | ND |
| DDT | 0.000003 | 0.000002 | 0.000010 | 0.000010 | 0.000014 | 0.000008 | 0.000025 | 0.000006 | 0.000018 | 0.000010 |
| α CHLORDANE | 0.000013 | 0.000006 | ND | ND | ND[3] | 0.000018 | 0.000081 | 0.000014 | 0.000038 | 0.000100 |
| γ CHLORDANE | 0.000025 | 0.000004 | ND | ND | ND[3] | 0.000010 | 0.000035 | 0.000006 | 0.000021 | 0.000050 |
| PCP | 0.003245 | 0.000730 | 0.002360 | 0.000910 | 0.000592 | 0.000672 | 0.001060 | 0.001590 | 0.000600 | 0.000300 |
| PCB | -- | -- | -- | -- | 0.000220[4] | 0.000040[4] | ND | ND | -- | -- |
| MIREX | -- | -- | -- | -- | ND | ND | -- | -- | -- | -- |

NOTE: ND = nondetectable.

[1] 24-hr composite sample.

[2] 16-hr composite sample

[3] May have been present but undetected due to interfering peaks.

[4] Arochlor (Mansato compound polychlorinated biphenol) 1254 detected.

TABLE B-3. HEAVY METAL ANALYSES OF RAW SEWAGE AND UNCHLORINATED SECONDARY EFFLUENT, MILILANI STP

| HEAVY METAL | SAMPLING DATE | | | | | |
|---|---|---|---|---|---|---|
| | 22-23 OCT 1971[1] | | 2 OCT 1973[2] | | 13 JAN 1975[2] | |
| | raw | effl. | raw | effl. | raw | effl. |
| | mg/ℓ | | | | | |
| CADMIUM | 0.004 | 0.005 | ND | ND | ND | ND |
| LEAD | 0.028 | 0.047 | 0.003 | ND | -- | -- |
| MERCURY | ND[3] | ND[3] | ND[3] | ND[3] | ND | ND |
| COPPER | -- | -- | 0.021 | 0.010 | ND | 0.00024 |
| ZINC | -- | -- | 0.025 | 0.027 | ND | 0.0037 |
| NICKEL | -- | -- | 0.015 | 0.015 | ND | 0.0065 |
| IRON | -- | -- | 0.432 | 0.164 | -- | -- |
| ALUMINUM | -- | -- | 0.592 | 0.532 | -- | -- |
| CHROMIUM | -- | -- | -- | -- | ND | ND |

NOTE: ND = nondetectable.

[1] 24-hr composite sample.

[2] 16-hr composite sample.

[3] Nondetectable below 0.003 mg/ℓ.

# TABLE B-4. PERCOLATE ANALYSES FROM GRASS-SOD LYSIMETER WITH REPLACED SOIL, MILILANI STP

| DATE | TDS | COND. @ 25 C | TOTAL HARD-NESS | SS | $BOD_5$ | TOC | NITROGEN as N |  |  | $PO_4$-P | Ca | $Mg^{++}$ | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | COLIFORM |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  | KJEL-DAHL | $NO_2$+ $NO_3$ | TOTAL |  |  |  |  |  |  |  |  |  |  | FECAL | TOTAL |
|  | mg/ℓ | µmhos/cm | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | no./100mℓ |  |
| (1972) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 7 | -- | -- | -- | -- | -- | 6.2 | 0 | 10.8 | 10.8 | -- | -- | -- | 55 | 2.5 | 110 | 50 | 44 | 0.09 | -- | -- | -- |
| JAN 10 | -- | -- | -- | -- | -- | 4.2 | 0 | 10.5 | 10.5 | -- | -- | -- | 55 | 2.5 | 84 | 50 | 44 | 0.01 | -- | -- | -- |
| JAN 13 | -- | -- | -- | -- | -- | 3.4 | 0 | 9.8 | 9.8 | -- | -- | -- | 85 | 2.3 | 88 | 43 | 38 | 0.01 | -- | -- | -- |
| JAN 18 | -- | -- | -- | -- | -- | 3.3 | 0 | 5.9 | 5.9 | -- | -- | -- | 61 | 2.3 | -- | 38 | 30 | 0.04 | -- | -- | -- |
| JAN 20 | -- | -- | -- | -- | -- | 3.3 | 0 | 6.1 | 6.1 | -- | -- | -- | 61 | 2.1 | -- | 34 | 25 | 0.07 | 10.1 | -- | -- |
| JAN 24 | -- | -- | -- | -- | -- | 3.3 | 0 | 10.2 | 10.2 | -- | -- | -- | 56 | 2.0 | -- | 30 | 32 | 0.12 | -- | -- | -- |
| JAN 25 | 512 | -- | -- | 9 | 1.8 | 2.9 | 0 | 11.1 | 11.1 | -- | -- | -- | 53 | 2.7 | 141 | 31 | 30 | 0.08 | 1.7 | -- | -- |
| JAN 26 | -- | -- | -- | -- | -- | 3.4 | 0 | 11.7 | 11.7 | -- | -- | -- | 65 | 2.6 | -- | 31 | 14 | 0.04 | -- | -- | -- |
| JAN 27 | -- | -- | -- | -- | -- | 6.0 | 0 | 12.2 | 12.2 | -- | -- | -- | 60 | 2.8 | -- | 32 | 32 | 0.07 | 11.3 | -- | -- |
| JAN 28 | -- | -- | -- | -- | -- | 7.0 | 0 | 12.0 | 12.0 | -- | -- | -- | 59 | 2.8 | -- | 31 | 18 | 0.12 | 7.5 | -- | -- |
| FEB 1 | -- | -- | -- | -- | -- | 11.0 | 0 | 11.3 | 11.3 | -- | -- | -- | 60 | 2.8 | -- | 31 | 20 | 0.02 | 11.2 | 0 | 0 |
| FEB 3 | -- | -- | -- | -- | -- | 11.0 | 0 | 11.3 | 11.3 | -- | -- | -- | 61 | 3.0 | -- | 34 | 22 | 0.07 | -- | -- | -- |
| FEB 4 | -- | -- | -- | -- | -- | 12.5 | 0 | 11.5 | 11.5 | -- | -- | -- | 65 | 3.4 | -- | 33 | 18 | 0.12 | 15.2 | -- | -- |
| FEB 7 | -- | -- | -- | -- | -- | 8.0 | 0 | 11.7 | 11.7 | -- | -- | -- | 60 | 2.9 | -- | 30 | 19 | 0.07 | -- | -- | -- |
| FEB 10 | 475 | -- | -- | 6 | 1.7 | 10.0 | 0 | 11.3 | 11.3 | -- | -- | -- | 61 | 3.0 | 175 | 30 | 18 | 0.05 | 5.1 | -- | -- |
| FEB 23 | -- | -- | -- | -- | -- | 9.0 | 0 | 11.7 | 11.7 | -- | -- | -- | 56 | 2.9 | -- | 28 | 19 | 0.04 | 2.0 | -- | -- |
| FEB 24 | -- | -- | -- | -- | -- | 6.5 | 0 | 11.1 | 11.1 | -- | -- | -- | 58 | 2.6 | -- | 36 | 18 | 0.07 | 2.0 | -- | -- |
| FEB 25 | -- | -- | -- | -- | -- | 5.5 | 0 | 11.3 | 11.3 | -- | -- | -- | 58 | 2.6 | -- | 36 | 21 | 0.07 | 2.0 | -- | -- |
| FEB 28 | 690 | -- | -- | 14 | 1.0 | 6.5 | 0 | 11.3 | 11.3 | -- | -- | -- | 53 | 3.0 | 185 | 30 | 18 | 0.06 | 0.8 | -- | -- |
| FEB 29 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 |
| MAR 3 | -- | -- | -- | -- | -- | 4.5 | 0 | 11.7 | 11.7 | -- | -- | -- | 53 | 2.9 | -- | 30 | 21 | 0.07 | 3.2 | -- | -- |
| MAR 7 | -- | -- | -- | -- | -- | 3.0 | 0 | 11.7 | 11.7 | -- | -- | -- | 56 | 2.0 | -- | 32 | 20 | 0.05 | 3.8 | -- | -- |
| MAR 9 | 648 | -- | -- | 2 | 0.1 | 5.5 | 0.2 | 11.5 | 11.7 | 0.04 | -- | -- | 56 | 2.9 | 180 | 30 | 19 | 0.03 | 6.6 | -- | -- |
| MAR 14 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 |
| MAR 16 | -- | -- | -- | -- | -- | 12.5 | 0 | 13.1 | 13.1 | -- | -- | -- | 56 | 2.3 | -- | 40 | 16 | 0.02 | -- | -- | -- |
| MAR 23 | 720 | -- | -- | 2 | 0.2 | 7.5 | 0 | 10.5 | 10.5 | 0.03 | -- | -- | 25 | 3.0 | 175 | 42 | 23 | 0.12 | 0.5 | -- | -- |

## TABLE B-4--CONTINUED

| | | | | | | | NITROGEN as N | | | | | | | | | | | | | COLIFORM | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | KJELDAHL | NO$_2$+NO$_3$ | TOTAL | PO$_4$-P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | FECAL | TOTAL |
| | mg/ℓ | | mg/ℓ | | | | | | | | | | | | | | | | | no./100mℓ | |
| MAR 29 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 |
| APR 3 | -- | -- | -- | -- | -- | 7.5 | 0 | 8.1 | 8.1 | -- | -- | -- | 51 | 2.9 | -- | 38 | 34 | 0.07 | 0 | -- | -- |
| APR 6 | 620 | -- | -- | 6 | 0.9 | 6.4 | 0 | 6.6 | 6.6 | 0.04 | -- | -- | 58 | 3.1 | 170 | 46 | 25 | 0.04 | 2.2 | -- | -- |
| APR 13 | -- | -- | -- | -- | -- | 9.0 | 0 | 6.6 | 6.6 | -- | -- | -- | 33 | 2.5 | -- | 42 | 26 | 0.01 | 0 | -- | -- |
| APR 14 | -- | -- | -- | -- | -- | 4.2 | 0 | 6.7 | 6.7 | -- | -- | -- | 53 | 2.1 | -- | 42 | 20 | 0.04 | 0 | -- | -- |
| APR 15 | -- | -- | -- | -- | -- | 5.6 | 0 | 6.6 | 6.6 | -- | -- | -- | 49 | 1.6 | -- | 42 | 12 | 0.09 | 0 | -- | -- |
| APR 17 | 390 | -- | -- | 2 | 0.4 | 2.9 | 0 | 3.2 | 3.2 | 0.02 | -- | -- | 54 | 2.2 | 113 | 57 | 19 | 0.05 | 4.9 | -- | -- |
| APR 18 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 |
| APR 20 | 620 | -- | -- | 6 | 0.9 | 6.0 | 0.2 | 2.3 | 2.5 | 0.04 | -- | -- | 47 | 2.2 | 170 | 65 | 12 | 0.05 | 7.3 | -- | -- |
| APR 25 | -- | -- | -- | -- | -- | 2.5 | 0 | 1.4 | 1.4 | -- | -- | -- | 55 | 2.5 | -- | 63 | 25 | 0.12 | 5.7 | -- | -- |
| APR 27 | -- | -- | -- | -- | -- | 9.4 | 0.1 | 1.4 | 1.5 | -- | -- | -- | 43 | 2.1 | -- | 63 | 24 | 0.06 | 0.7 | -- | -- |
| APR 28 | -- | -- | -- | -- | -- | 7.5 | 0 | 1.4 | 1.4 | -- | -- | -- | 45 | 1.6 | -- | 65 | 17 | 0.09 | 0.7 | -- | -- |
| MAY 2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 |
| MAY 4 | 390 | -- | -- | 4 | 0.2 | 4.0 | 0.1 | 1.2 | 1.3 | 0.02 | -- | -- | 44 | 2.8 | 82 | 63 | 32 | 0.09 | 9.6 | -- | -- |
| MAY 5 | -- | -- | -- | -- | -- | 7.5 | 0 | 0.9 | 0.9 | -- | -- | -- | 41 | 1.8 | -- | 64 | 16 | 0.09 | 3.2 | -- | -- |
| MAY 11 | -- | -- | -- | -- | -- | 10.0 | 0 | 1.0 | 1.0 | -- | -- | -- | 45 | 2.4 | -- | 62 | 19 | 0.09 | 1.7 | -- | -- |
| JUN 7 | -- | 380 | 198 | -- | -- | 5.0 | 0.1 | 0.2 | 0.3 | -- | 40 | 24 | 51 | 2.1 | 56 | 72 | 16 | 0.05 | 5.8 | -- | -- |
| JUN 9 | -- | 320 | 137 | -- | -- | 9.0 | 0 | 0.2 | 0.2 | -- | 30 | 15 | 46 | 2.0 | 56 | 58 | 19 | 0.05 | 7.5 | -- | -- |
| JUN 13 | -- | 340 | 142 | -- | -- | 7.5 | 0.1 | 0.1 | 0.2 | -- | 32 | 15 | 45 | 1.8 | 50 | 68 | 19 | 0.05 | 5.8 | -- | -- |
| JUN 15 | -- | 345 | 167 | -- | -- | 5.5 | 0.1 | 0.1 | 0.2 | -- | 31 | 22 | 46 | 2.0 | 50 | 80 | 21 | 0.02 | 3.3 | -- | -- |
| JUN 16 | 226 | 350 | 140 | 8 | 1.0 | 14.0 | 0.2 | 0.4 | 0.6 | 0.01 | 32 | 15 | 44 | 1.6 | 50 | 64 | 16 | 0.09 | 1.0 | -- | -- |
| JUN 22 | -- | 330 | 138 | -- | -- | 2.5 | 0 | 1.0 | 1.0 | -- | 30 | 16 | 45 | 2.0 | 42 | 78 | 20 | 0.05 | 0.6 | -- | -- |
| JUN 27 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 0 |
| JUN 30 | -- | 450 | 148 | -- | -- | 2.0 | 0 | 0.2 | 0.2 | -- | 32 | 17 | 46 | 1.2 | 40 | 75 | 20 | 0.10 | 0.2 | -- | -- |
| JUL 3 | -- | 450 | 190 | -- | -- | 3.5 | 0.9 | 0.2 | 1.1 | -- | 35 | 26 | 45 | 2.0 | 46 | 78 | 23 | -- | -- | -- | -- |
| JUL 13 | 431 | 390 | 190 | 13 | 1.7 | 3.5 | 0.1 | 0.1 | 0.2 | 0.02 | 40 | 32 | 52 | 1.8 | 41 | 66 | 14 | -- | -- | -- | -- |
| JUL 17 | -- | 420 | 132 | -- | -- | 2.5 | 0.1 | 0.1 | 0.2 | -- | 31 | 13 | 52 | 2.0 | 43 | 72 | 25 | -- | -- | -- | -- |

NOTE: LEACHATE COLLECTED BY PUMPING FROM THE BOTTOM OF THE LYSIMETER.

* CALCULATED BY THE EQUIVALENT WEIGHT DIFFERENCE BETWEEN TOTAL HARDNESS AND CALCIUM.

TABLE B-4--CONTINUED

| | | | | | | | | NITROGEN as N | | | | | | | | | | | | | | COLIFORM | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | KJELDAHL | NO$_2$+ NO$_3$ | TOTAL | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL C | FECAL | TOTAL |
| | | mg/ℓ | | mg/ℓ | | | | | | | | | | | | | | | | | | no./100mℓ | |
| (1972) | | | | | | | | | | | | | | | | | | | | | | | |
| JUL 21 | 6.8 | -- | 380 | 160 | -- | -- | 2.5 | 0.05 | 0.01 | 0.06 | -- | 34 | 18 | 53 | 2.2 | 42 | 62 | 24 | -- | -- | -- | -- | -- |
| JUL 24 | 7.0 | -- | 400 | 156 | -- | -- | 1.5 | 0.08 | 0.02 | 0.10 | -- | 33 | 18 | 52 | 2.1 | 42 | 64 | 22 | -- | -- | -- | -- | -- |
| JUL 27 | 7.3 | 359 | 420 | 138 | 19 | -- | 2.0 | 0.10 | 0.01 | 0.11 | 0.02 | 30 | 15 | 52 | 2.0 | 42 | 63 | 23 | -- | -- | -- | $^{0}$(7/26) | $^{0}$ |
| JUL 31 | 6.6 | -- | 430 | 164 | -- | >1 | 2.0 | -- | 0.01 | -- | -- | 35 | 19 | 53 | 2.3 | 44 | 62 | 27 | -- | -- | -- | -- | -- |
| AUG 2 | 6.6 | -- | 480 | 154 | -- | -- | -- | 0.05 | 0.01 | 0.06 | -- | 32 | 18 | 44 | 2.0 | 43 | 76 | 25 | -- | -- | -- | -- | -- |
| AUG 15 | 7.1 | -- | 400 | 192 | -- | -- | -- | 0.04 | 0.01 | 0.05 | -- | 44 | 20 | 50 | 2.2 | -- | 77 | 24 | -- | -- | -- | -- | -- |
| AUG 16 | 7.1 | -- | 390 | 178 | -- | -- | 1.5 | 0.02 | 0.01 | 0.03 | -- | 36 | 21 | -- | -- | 40 | 80 | -- | -- | -- | -- | 0 | 0 |
| AUG 17 | 7.1 | -- | 400 | 184 | -- | -- | 1.5 | 0.01 | 0.01 | 0.02 | -- | 37 | 22 | -- | -- | 41 | 80 | -- | -- | -- | -- | -- | -- |
| AUG 22 | 7.0 | -- | 400 | 180 | -- | -- | -- | 0.01 | <0.01 | 0.02 | -- | 38 | 21 | 55 | 2.0 | 42 | 84 | 28 | -- | -- | 21 | -- | -- |
| SEP 8 | 7.0 | -- | 400 | 176 | -- | -- | 2.0 | 0.01 | <0.01 | 0.02 | -- | 35 | 22 | 53 | 2.0 | 43 | 84 | 29 | -- | -- | 20 | -- | -- |
| SEP 11 | 6.9 | -- | 400 | 178 | -- | -- | 2.0 | 0.01 | <0.01 | 0.02 | -- | 35 | 22 | 53 | 2.3 | 41 | 84 | 30 | -- | -- | -- | -- | -- |
| SEP 18 | 7.0 | -- | 480 | 145 | -- | -- | 2.0 | 0.01 | <0.01 | 0.02 | -- | 31 | 19 | 52 | 2.0 | 42 | 84 | 29 | -- | -- | -- | -- | -- |
| SEP 19 | 7.0 | -- | 400 | 160 | -- | -- | -- | 0.01 | <0.01 | 0.02 | -- | 30 | 21 | 52 | 2.2 | 42 | 85 | 28 | -- | -- | -- | -- | -- |
| SEP 20 | 7.0 | -- | 420 | 170 | -- | -- | -- | 0.01 | <0.01 | 0.02 | -- | 31 | 22 | 53 | 2.0 | 42 | 80 | 27 | -- | -- | -- | -- | -- |
| SEP 21 | 7.2 | -- | 400 | 175 | -- | -- | 3.0 | 0.01 | <0.01 | 0.02 | -- | 32 | 23 | 52 | 2.0 | 40 | 87 | 26 | -- | -- | -- | -- | -- |
| SEP 22 | 7.1 | -- | 380 | 175 | -- | -- | -- | 0.01 | <0.01 | 0.02 | -- | 32 | 23 | 52 | 1.9 | 41 | 83 | 26 | -- | -- | -- | -- | -- |
| SEP 25 | 7.1 | -- | 480 | 180 | -- | -- | -- | 0.01 | <0.01 | 0.02 | -- | 35 | 22 | 51 | 1.8 | 41 | 83 | 23 | -- | -- | -- | -- | -- |
| SEP 28 | 7.1 | 330 | 390 | 178 | 3 | >1 | -- | 0.01 | <0.01 | 0.02 | 0.04 | 33 | 23 | 52 | 1.7 | 41 | 85 | 22 | -- | -- | 18 | -- | -- |
| OCT 4 | 7.1 | -- | 410 | 175 | -- | -- | -- | 0.01 | 0.01 | 0.02 | -- | 31 | 24 | 53 | 1.6 | 44 | 84 | 21 | -- | -- | -- | 0 | 0 |
| OCT 5 | 7.0 | -- | 450 | 151 | -- | -- | -- | 0.01 | 0.01 | 0.02 | -- | 27 | 20 | 53 | 1.6 | 47 | 75 | 17 | -- | -- | -- | -- | -- |
| OCT 6 | 7.0 | -- | 400 | 121 | -- | -- | -- | 0.01 | 0.01 | 0.02 | -- | 26 | 14 | 52 | 1.1 | 52 | 82 | 17 | -- | -- | -- | -- | -- |
| OCT 12 | 6.9 | 349 | 480 | 84 | 1 | >1 | -- | 0.01 | 0.04 | 0.05 | 0.02 | 26 | 5 | 56 | 1.4 | 68 | 75 | 15 | -- | -- | 21 | -- | -- |
| OCT 16 | 6.9 | -- | 380 | 113 | -- | -- | -- | 0.01 | 0.03 | 0.04 | -- | 29 | 10 | -- | -- | 70 | 78 | 18 | -- | -- | -- | -- | -- |
| OCT 18 | 6.9 | -- | 350 | -- | -- | -- | -- | 0.01 | 0.05 | 0.06 | -- | 31 | -- | 56 | 1.5 | -- | 80 | 20 | -- | -- | -- | -- | -- |
| OCT 24 | 7.0 | -- | 450 | 108 | -- | -- | -- | -- | 0.12 | -- | -- | 31 | 7 | 56 | 1.5 | 76 | 68 | 20 | -- | -- | -- | -- | -- |
| OCT 26 | 6.9 | -- | 420 | 106 | -- | -- | 3.0 | 0.05 | 0.14 | 0.19 | -- | 28 | 9 | 56 | 1.4 | 83 | 75 | 16 | -- | -- | 15 | -- | -- |
| OCT 29 | 7.0 | -- | 450 | 106 | -- | -- | -- | 0.05 | 0.02 | 0.07 | -- | 28 | 9 | 57 | 1.4 | 83 | 72 | 18 | -- | -- | -- | -- | -- |
| OCT 30 | 7.0 | -- | 500 | 103 | -- | -- | -- | 0.07 | -- | -- | -- | 28 | 8 | 60 | 1.3 | 87 | 68 | 15 | -- | -- | -- | -- | -- |
| NOV 2 | 7.2 | -- | 500 | 103 | -- | -- | -- | 0.07 | 0.02 | 0.09 | -- | 27 | 9 | 70 | 1.4 | 85 | 75 | 15 | -- | -- | -- | -- | -- |
| NOV 6 | 7.4 | -- | 520 | 106 | -- | -- | -- | 0.07 | 0.00 | 0.07 | -- | 28 | 9 | 78 | 1.4 | 89 | 75 | 18 | -- | -- | -- | -- | -- |

TABLE B-4--CONTINUED

| DATE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N |  |  | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL C | COLIFORM |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  | KJELDAHL | NO$_2$+ NO$_3$ | TOTAL |  |  |  |  |  |  |  |  |  |  |  | FECAL | TOTAL |
|  |  | mg/ℓ |  |  |  |  |  |  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  | no./100mℓ |  |
| NOV 8 | 7.7 | -- | 540 | 108 | -- | -- | 1.0 | -- | 0.00 | -- | -- | 28 | 9 | 77 | 1.5 | 86 | 75 | 15 | -- | -- | 20 | -- | -- |
| NOV 9 | 7.5 | -- | 540 | 110 | -- | -- | 4.0 | 0.07 | 0.00 | 0.07 | -- | 28 | 10 | 78 | 1.5 | 86 | 75 | 15 | -- | -- | 14 | -- | -- |
| NOV 13 | 7.4 | -- | 520 | 108 | -- | -- | -- | 0.00 | 0.01 | 0.01 | -- | 27 | 10 | 80 | 1.7 | 85 | 72 | 18 | -- | -- | -- | -- | -- |
| NOV 16 | 7.8 | 346 | 470 | 132 | 2 | 1 | 1.5 | 0.00 | 0.04 | 0.04 | 0.01 | 27 | 16 | 78 | 1.7 | 86 | 71 | 16 | -- | -- | 10 | 0 (11/14) | 0 |
| NOV 20 | 7.4 | -- | 470 | 137 | -- | -- | -- | 0.00 | 0.01 | 0.01 | -- | 28 | 16 | 78 | 1.7 | 74 | 73 | 17 | -- | -- | -- | 0 (11/18) | 0 |
| NOV 22 | 6.8 | -- | 500 | 135 | -- | -- | -- | 0.00 | -- | -- | -- | 28 | 16 | 77 | 1.6 | 75 | 73 | 17 | -- | -- | -- | -- | -- |
| NOV 27 | 6.8 | -- | 520 | -- | -- | -- | -- | 0.00 | 0.01 | 0.01 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| NOV 29 | 7.5 | -- | 480 | 118 | -- | -- | -- | 0.00 | 0.00 | 0.00 | -- | 25 | 13 | 52 | 1.0 | 75 | 77 | 15 | -- | -- | -- | -- | -- |
| NOV 30 | 7.9 | -- | 420 | 120 | -- | -- | -- | 0.00 | 0.01 | 0.01 | -- | 25 | 14 | 51 | 1.0 | 72 | 77 | 15 | -- | -- | -- | -- | -- |
| DEC 1 | 6.8 | -- | 420 | -- | -- | -- | 1.0 | 0.00 | 0.01 | 0.01 | -- | -- | -- | 51 | 1.2 | 70 | -- | -- | -- | -- | 13 | -- | -- |
| DEC 4 | 7.2 | -- | 450 | 120 | -- | -- | -- | 0.00 | 0.00 | 0.00 | -- | 25 | 14 | 50 | 1.0 | 70 | 80 | 15 | -- | -- | -- | -- | -- |
| DEC 5 | 7.2 | -- | 400 | 118 | -- | -- | -- | 0.00 | 0.00 | 0.00 | -- | 24 | 14 | 51 | 1.0 | 69 | 80 | 15 | -- | -- | -- | -- | -- |
| DEC 13 | 7.4 | -- | 400 | 120 | -- | -- | -- | -- | 0.00 | -- | -- | 24 | 15 | 51 | 1.0 | 67 | 77 | 18 | -- | -- | -- | 0 (12/12) | 0 |
| DEC 18 | 7.1 | -- | 420 | 115 | -- | -- | -- | -- | 0.01 | -- | -- | 22 | 15 | 47 | 1.0 | 61 | 80 | 12 | -- | -- | -- | -- | -- |
| DEC 20 | -- | -- | 400 | 108 | -- | -- | -- | -- | 0.01 | -- | -- | 20 | 14 | 48 | 1.2 | 60 | 80 | 14 | -- | -- | -- | -- | -- |
| DEC 21 | -- | 329 | 400 | 108 | 1 | <1 | 1.0 | -- | 0.01 | -- | 0.04 | 20 | 14 | 46 | 1.2 | 57 | 77 | 13 | -- | -- | 18 | -- | -- |
| DEC 26 | 7.1 | -- | 420 | 110 | -- | -- | -- | 0.00 | 0.01 | 0.01 | -- | 21 | 14 | 47 | 1.0 | 57 | 75 | 13 | -- | -- | -- | -- | -- |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 8 | 7.0 | -- | 460 | 127 | -- | -- | -- | 0.00 | 0.00 | 0.00 | -- | 28 | 14 | 47 | 1.0 | 54 | 77 | 18 | -- | -- | -- | -- | -- |
| JAN 11 | 7.0 | 311 | 470 | 113 | 3 | <1 | 3.0 | 0.00 | 0.00 | 0.00 | 0.01 | 21 | 15 | 51 | 1.0 | 53 | 75 | 20 | -- | -- | 20 | -- | -- |
| JAN 15 | 6.8 | -- | 500 | 106 | -- | -- | 2.0 | 0.01 | >0.01 | >0.02 | -- | 23 | 12 | 52 | 1.2 | 48 | 70 | 18 | -- | -- | 20 | -- (1/16) | 79 |
| JAN 24 | 7.2 | -- | 320 | 86 | -- | -- | 1.0 | 0.06 | 0.01 | 0.07 | -- | 19 | 9 | 48 | 1.2 | 44 | 75 | 13 | -- | -- | 18 | -- (1/30) | 14 |
| FEB 1 | 7.2 | 262 | 380 | 89 | 2 | 1.3 | 2.0 | 0.06 | 0.01 | 0.07 | 0.02 | 20 | 9 | 42 | 1.2 | 46 | 60 | 23 | -- | -- | 18 | -- | -- |
| FEB 8 | 7.0 | -- | 380 | 93 | -- | -- | -- | >0.01 | 0.03 | >0.04 | -- | 22 | 9 | 43 | 1.0 | 49 | 48 | 20 | -- | -- | -- | -- | -- |
| FEB 13 | 7.1 | -- | 360 | 95 | -- | -- | -- | >0.01 | 0.01 | >0.02 | -- | 22 | 10 | 45 | 1.0 | 51 | 48 | 22 | -- | -- | -- | 0 (2/13) | 23 |
| FEB 21 | 7.1 | -- | 380 | 98 | -- | -- | 2.0 | 0.01 | 0.01 | 0.02 | -- | 21 | 11 | 42 | 0.8 | 43 | 53 | 20 | -- | -- | 20 | -- (2/27) | 0 |
| MAR 1 | 7.0 | -- | 400 | 79 | -- | -- | -- | 0.01 | 0.01 | 0.02 | -- | 20 | 7 | 48 | 1.0 | 45 | 68 | 24 | -- | -- | -- | -- | -- |
| MAR 7 | 6.8 | 268 | 400 | 87 | <1 | 0.6 | <1.0 | 0.01 | <0.01 | <0.02 | 0.0 | 20 | 9 | 47 | 1.0 | 47 | 65 | 31 | -- | -- | 20 | -- | -- |
| MAR 13 | 6.8 | -- | 420 | 75 | -- | -- | -- | 0.01 | 0.01 | 0.02 | -- | 20 | 6 | 47 | 1.0 | 46 | 70 | 33 | -- | -- | -- | -- | -- |
| MAR 22 | 7.0 | -- | 400 | 75 | -- | -- | <1.0 | <0.01 | <0.01 | <0.02 | -- | 21 | 6 | 42 | 0.6 | -- | 75 | 15 | -- | -- | 19 | -- (3/27) | 0 |
| MAR 29 | 6.9 | -- | 380 | 67 | -- | -- | -- | <0.01 | <0.01 | <0.02 | -- | 22 | 3 | 43 | 0.6 | -- | 72 | 10 | -- | -- | -- | -- | -- |

## TABLE B-4--CONTINUED

| DATE | pH | TDS | COND. @ 25°C µmhos/ cm | TOTAL HARD-NESS | SS | BOD$_5$ | TOC | NITROGEN as N |  |  | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL C | COLIFORM |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  | KJEL-DAHL | NO$_2$+ NO$_3$ | TOTAL |  |  |  |  |  |  |  |  |  |  |  | FECAL | TOTAL |
|  |  | mg/ℓ |  | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | mg/ℓ | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | no./100mℓ |  |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| APR 5 | 6.9 | -- | 380 | 67 | -- | -- | <1.0 | <0.01 | <0.01 | <0.02 | -- | 22 | 3 | 42 | 0.8 | -- | 70 | 12 | -- | -- | 20 | $^{0}_{(4/10)}$ | $^{23}$ |
| APR 12 | 6.9 | -- | 360 | 82 | -- | -- | <1.0 | <0.01 | 0.01 | <0.02 | -- | 24 | 2 | 45 | 1.2 | -- | 72 | 13 | -- | -- | 18 | -- | -- |
| APR 17 | 6.9 | -- | 380 | 96 | -- | -- | -- | -- | 1.63 | -- | -- | 34 | 3 | 45 | 1.3 | -- | 58 | 14 | -- | -- | -- | -- | -- |
| APR 24 | 6.9 | -- | 360 | 75 | -- | -- | -- | -- | 0.01 | -- | -- | 20 | 6 | 46 | 1.0 | -- | 65 | 14 | -- | -- | -- | -- | -- |
| APR 26 | 7.0 | -- | 370 | 80 | -- | -- | -- | <0.01 | <0.01 | <0.02 | -- | 23 | 5 | 45 | 1.0 | -- | 65 | 14 | -- | -- | -- | -- | -- |
| MAY 3 | 6.9 | -- | 360 | 67 | -- | -- | -- | -- | <0.01 | -- | -- | 24 | 2 | 45 | 0.7 | 65 | 71 | 11 | -- | -- | -- | -- | -- |
| MAY 8 | 7.0 | -- | 360 | 106 | -- | -- | -- | <0.01 | <0.01 | <0.02 | -- | 24 | 11 | 45 | 0.8 | 63 | 72 | 12 | -- | -- | -- | -- | -- |
| MAY 16 | 6.9 | -- | 320 | 116 | -- | -- | -- | <0.01 | 0.02 | <0.01 | -- | 24 | 14 | 41 | 0.8 | -- | 70 | 13 | -- | -- | -- | -- | -- |
| MAY 23 | 7.0 | -- | 350 | 106 | -- | -- | 1.0 | 0.00 | 0.01 | 0.02 | -- | 24 | 11 | 45 | 0.8 | 60 | 68 | 10 | -- | -- | 21 | -- | -- |
| MAY 30 | 7.0 | -- | 400 | 106 | -- | -- | -- | 0.00 | 0.05 | 0.05 | -- | 24 | 11 | 45 | 0.6 | 60 | -- | 11 | -- | -- | -- | -- | -- |
| JUN 6 | 6.9 | -- | 400 | 106 | -- | -- | -- | -- | 0.01 | -- | 0.15 | 19 | 14 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| JUN 12 | 6.9 | -- | 400 | 130 | -- | -- | -- | -- | 0.01 | -- | -- | 21 | 19 | 45 | 0.5 | -- | -- | -- | -- | -- | -- | -- | -- |
| JUL 8 | 7.0 | 210 | -- | 76 | -- | -- | -- | ND | 0.01 | 0.01 | 0.274 | 14 | 10 | 58 | 0.7 | -- | 79 | 15 | -- | -- | -- | -- | -- |
| JUL 15 | 7.1 | 274 | -- | 32 | -- | -- | -- | 0.01 | 0.03 | 0.04 | 0.075 | 14 | 0 | 54 | 0.7 | -- | 80 | -- | -- | -- | -- | -- | -- |
| JUL 18 | -- | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- | -- | -- | -- | -- | -- | -- | -- | 14 | -- | -- | -- | -- | -- |
| JUL 22 | -- | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| AUG 4 | 7.2 | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| AUG 6 | 7.1 | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| AUG 7 | 6.5 | 540 | -- | -- | -- | -- | -- | 0.50 | 0.02 | 0.52 | 0.04 | 14 | -- | 46 | 8.7 | 81 | 49 | 20 | -- | -- | -- | -- | -- |
| AUG 13 | 6.4 | 502 | -- | -- | -- | -- | -- | 1.08 | 0.02 | 1.10 | 0.04 | 8 | -- | 41 | 5.0 | 56 | 58 | 20 | -- | -- | -- | -- | -- |
| AUG 21 | 6.5 | 238 | 400 | 120 | -- | -- | -- | 0.09 | 0.87 | 0.96 | -- | 31 | 10 | 48 | 1.0 | 83 | 75 | -- | -- | -- | -- | -- | -- |
| AUG 22* | -- | -- | -- | -- | -- | -- | -- | -- | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| AUG 23* | -- | -- | -- | -- | -- | -- | -- | -- | ND | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| AUG 24 | -- | -- | -- | -- | -- | -- | -- | -- | ND | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| AUG 27 | 7.7 | -- | -- | 115 | -- | -- | -- | -- | 0.03 | 0.03 | 0.04 | 30 | 10 | -- | -- | -- | 1 | 15 | -- | -- | -- | -- | -- |
| SEP 6 | 6.9 | -- | -- | 130 | -- | -- | -- | -- | 0.03 | 0.03 | 0.04 | 29 | 14 | 49 | 1.0 | -- | 79 | 20 | -- | -- | -- | $^{0}_{(9/5)}$ | 7 |
| SEP 22 | 6.6 | -- | -- | 135 | -- | -- | -- | -- | ND | ND | 0.05 | 28 | 15 | 50 | 0.5 | -- | 78 | 20 | -- | -- | -- | -- | -- |
| SEP 26 | 6.5 | -- | -- | 125 | -- | -- | -- | -- | ND | ND | 0.04 | 27 | 14 | 50 | 0.6 | -- | 53 | 17 | -- | -- | -- | -- | -- |
| OCT 1 | 6.5 | 264 | -- | 130 | -- | -- | -- | -- | ND | ND | 0.03 | 28 | 15 | 49 | 0.4 | 70 | 79 | 18 | -- | -- | -- | -- | -- |
| OCT 2 | 6.4 | 256 | -- | 125 | -- | -- | -- | -- | ND | ND | 0.04 | 27 | 14 | 49 | 0.3 | 73 | 75 | 16 | -- | -- | -- | -- | -- |

TABLE B-4--CONTINUED

| DATE | pH | TDS | COND. @ 25°C µmhos/ | TOTAL HARD-NESS | SS | BOD$_5$ | TOC | NITROGEN as N |  |  | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL C | COLIFORM |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  | KJEL-DAHL | NO$_2$+ NO$_3$ | TOTAL |  |  |  |  |  |  |  |  |  |  |  | FECAL | TOTAL |
|  |  | mg/ℓ | cm | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | no./100mℓ |  |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| OCT 4 | 6.6 | 216 | 370 | 125 | -- | -- | -- | -- | ND | ND | 0.03 | 26 | 15 | 50 | 0.4 | 73 | 58 | 17 | -- | -- | -- | -- | -- |
| OCT 9 | 6.7 | 264 | 400 | 135 | -- | -- | -- | 0.14 | 0.01 | 0.15 | 0.01 | 19 | 21 | 54 | 0.4 | 73 | 79 | 20 | -- | -- | -- | -- | -- |
| OCT 10* | 7.0 | 260 | 360 | 125 | -- | -- | -- | 0.21 | 0.01 | 0.22 | 0.04 | 19 | 19 | 51 | ND | 73 | 80 | 17 | -- | -- | -- | -- | -- |
| OCT 10 | 6.2 | 284 | 360 | 128 | -- | -- | -- | 0.26 | 0.01 | 0.27 | -- | 19 | 20 | 54 | ND | 73 | 59 | 18 | -- | -- | -- | -- | -- |
| OCT 11 | 6.2 | 250 | 360 | 125 | -- | -- | -- | 0.15 | 0.01 | 0.16 | 0.01 | 19 | 19 | 54 | ND | 73 | 74 | 15 | -- | -- | -- | -- | -- |
| OCT 12 | 6.6 | 254 | 330 | 130 | -- | -- | -- | 0.17 | 0.01 | 0.18 | 0.03 | 19 | 20 | 52 | ND | 75 | 74 | 14 | -- | -- | -- | -- | -- |
| OCT 12 | 6.3 | 268 | 375 | 125 | -- | -- | -- | 0.21 | 0.01 | 0.22 | ND | 19 | 19 | 54 | 0.4 | 73 | 77 | 15 | -- | -- | -- | -- | -- |
| OCT 15 | 6.8 | 252 | 350 | 128 | -- | -- | -- | 0.10 | ND | 0.10 | 0.02 | 19 | 20 | 52 | 0.4 | 75 | 71 | 17 | -- | -- | -- | -- | -- |
| OCT 16 | 6.8 | 258 | -- | 130 | -- | -- | -- | 0.09 | ND | 0.09 | 0.01 | 19 | 20 | 52 | 0.7 | 75 | 78 | 15 | -- | -- | -- | -- | -- |
| OCT 18 | 6.7 | 270 | 335 | 136 | -- | -- | -- | 0.49 | 0.01 | 0.50 | 0.01 | -- | -- | -- | -- | 75 | 67 | 17 | -- | -- | -- | -- | -- |
| OCT 19 | 6.7 | 814 | -- | 128 | -- | -- | -- | 0.22 | 0.01 | 0.23 | 0.01 | 19 | 20 | 51 | 0.7 | 75 | 68 | 15 | -- | -- | -- | -- | -- |
| OCT 25 | 6.7 | 226 | 360 | 128 | -- | -- | -- | 0.19 | 0.03 | 0.22 | 0.03 | 19 | 20 | 52 | 0.7 | 75 | 66 | 18 | -- | -- | -- | -- | -- |
| NOV 2 | 6.6 | 240 | 385 | 124 | -- | -- | -- | 0.45 | ND | 0.45 | 0.03 | 13 | 22 | 48 | 0.6 | 75 | 71 | 18 | -- | -- | -- | -- | -- |
| NOV 5 | 6.6 | 239 | 390 | 132 | -- | -- | -- | 0.46 | ND | 0.46 | 0.02 | 13 | 24 | 52 | 0.8 | 78 | 72 | 19 | -- | -- | -- | -- | -- |
| NOV 6 | 6.7 | 224 | 370 | 120 | -- | -- | -- | 0.47 | ND | 0.47 | 0.02 | 12 | 22 | 48 | 0.8 | 78 | 68 | 17 | -- | -- | -- | -- | 0 |
| NOV 7 | 7.0 | 450 | 380 | 124 | -- | -- | -- | 0.37 | ND | 0.37 | 0.02 | 16 | 21 | 51 | 1.1 | 75 | 72 | 15 | -- | -- | -- | -- | -- |
| NOV 9 | 6.9 | 400 | 355 | 132 | -- | -- | -- | ND | 0.01 | 0.01 | 0.02 | 15 | 23 | 48 | 0.8 | 75 | 66 | 16 | -- | -- | -- | -- | -- |
| NOV 12 | 6.9 | 390 | 370 | 116 | -- | -- | -- | ND | 0.01 | 0.01 | 0.02 | 12 | 21 | 52 | 0.8 | 75 | 69 | 14 | -- | -- | -- | -- | -- |
| NOV 14 | 7.0 | 260 | 420 | 116 | -- | -- | -- | ND | 0.01 | 0.01 | 1.00 | 16 | 19 | 47 | 0.6 | -- | 69 | 15 | -- | -- | -- | -- | -- |
| NOV 16 | 7.1 | 280 | 400 | 127 | -- | -- | -- | ND | ND | ND | 0.02 | 15 | 22 | 48 | 0.8 | 53 | 66 | 17 | -- | -- | -- | -- | -- |
| NOV 20 | 6.8 | 290 | 400 | 128 | -- | -- | -- | ND | ND | ND | 0.16 | 12 | 24 | 48 | 0.5 | 55 | 54 | 14 | -- | -- | -- | -- | -- |
| NOV 21 | 7.1 | 280 | 335 | 100 | -- | -- | -- | ND | ND | ND | 0.13 | 12 | 17 | 48 | 0.9 | 73 | 72 | 12 | -- | -- | -- | -- | -- |
| NOV 23 | 6.8 | -- | 360 | 128 | -- | -- | -- | ND | 0.01 | 0.01 | 0.23 | 16 | 22 | 48 | 0.6 | 75 | 70 | 15 | -- | -- | -- | -- | -- |
| NOV 26 | 6.9 | 360 | 395 | 112 | -- | -- | -- | ND | ND | ND | 0.05 | 12 | 20 | 48 | 0.5 | 70 | 73 | -- | -- | -- | -- | -- | -- |
| NOV 28 | 7.1 | 316 | 400 | 112 | -- | -- | -- | ND | 0.01 | 0.01 | 0.04 | 13 | 19 | 47 | 0.5 | 48 | 62 | -- | -- | -- | -- | -- | -- |
| NOV 29 | 6.8 | 320 | 400 | 102 | -- | -- | -- | ND | ND | ND | ND | 17 | 15 | 46 | 0.6 | 45 | 72 | -- | -- | -- | -- | -- | -- |
| DEC 3 | 6.9 | 294 | 370 | 87 | -- | -- | -- | ND | ND | ND | ND | 16 | 11 | 31 | 0.4 | 53 | 68 | 14 | -- | -- | -- | -- | -- |
| DEC 5 | 6.6 | 280 | 360 | 82 | -- | -- | -- | ND | ND | ND | ND | 9 | 15 | 22 | 0.2 | 50 | 70 | 13 | -- | -- | -- | -- | -- |
| DEC 6 | 7.2 | 300 | 340 | 87 | -- | -- | -- | ND | ND | ND | 0.03 | 10 | 15 | 30 | 0.4 | 50 | 69 | 11 | -- | -- | -- | -- | -- |
| DEC 7 | 7.0 | 274 | 315 | 82 | -- | -- | -- | ND | ND | ND | ND | 9 | 15 | 17 | 0.2 | 45 | 67 | 11 | -- | -- | -- | -- | -- |

## TABLE B-4--CONTINUED

| DATE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARD-NESS | SS | BOD$_5$ | TOC | NITROGEN as N KJEL-DAHL | NO$_2$+ NO$_3$ | TOTAL | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL C | COLIFORM FECAL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | mg/ℓ | cm | mg/ℓ | | | | | | | | | | | | | | | | | | no./100mℓ | |
| DEC 10 | 7.4 | 280 | 360 | 87 | -- | -- | -- | ND | ND | ND | ND | 10 | 15 | 17 | 0.2 | 45 | 73 | 12 | -- | -- | -- | -- | -- |
| DEC 11 | 6.9 | 250 | 350 | 82 | -- | -- | -- | ND | ND | ND | ND | 11 | 13 | 19 | 0.2 | 48 | 68 | 13 | -- | -- | -- | -- | -- |
| DEC 12 | 6.8 | 260 | 240 | 87 | -- | -- | -- | ND | ND | ND | ND | 13 | 13 | 31 | 0.2 | 45 | 67 | 13 | -- | -- | -- | -- | -- |
| DEC 19 | 6.6 | 270 | 255 | 87 | -- | -- | -- | ND | 6.97 | 6.97 | ND | 11 | 15 | 49 | 0.4 | 44 | 73 | 12 | -- | -- | -- | -- | -- |
| DEC 20 | 6.9 | 228 | 375 | 82 | -- | -- | -- | ND | ND | ND | ND | 16 | 10 | 20 | 0.5 | 43 | 59 | 11 | -- | -- | -- | -- | -- |
| DEC 22 | 6.7 | 270 | 350 | 82 | -- | -- | -- | ND | 0.28 | 0.28 | 0.03 | 9 | 15 | 28 | 0.4 | 44 | 66 | 13 | -- | -- | -- | -- | -- |
| DEC 24 | 7.1 | 250 | 305 | 76 | -- | -- | -- | ND | 1.89 | 1.89 | 0.05 | 10 | 12 | 49 | 0.4 | 46 | 73 | 13 | -- | -- | -- | -- | -- |
| DEC 28 | 6.8 | 140 | 380 | 82 | -- | -- | -- | 0.15 | ND | 0.15 | 0.05 | 16 | 10 | 49 | 0.5 | 46 | 62 | 14 | -- | -- | -- | -- | -- |
| DEC 31 | 6.8 | 190 | 370 | 76 | -- | -- | -- | 0.08 | ND | 0.08 | 0.08 | 14 | 10 | 49 | 0.7 | 44 | 72 | 14 | -- | -- | -- | -- | -- |
| (1974) | | | | | | | | | | | | | | | | | | | | | | | |
| JAN 2 | 6.8 | 150 | 385 | 82 | -- | -- | -- | ND | ND | ND | 0.06 | 16 | 10 | 24 | 0.5 | 46 | 80 | 12 | -- | -- | -- | -- | -- |
| JAN 3 | 6.5 | 274 | 300 | 87 | -- | -- | -- | ND | 0.21 | 0.21 | 0.05 | -- | -- | -- | -- | 45 | 80 | 10 | -- | -- | -- | -- | -- |
| JAN 4 | 7.2 | 262 | 280 | 82 | -- | -- | -- | ND | 0.01 | 0.01 | 0.05 | 11 | 13 | 24 | 0.5 | 48 | 75 | 9 | -- | -- | -- | -- | -- |
| JAN 7 | 7.4 | 262 | 210 | 87 | -- | -- | -- | ND | 0.04 | 0.04 | 0.15 | 9 | 16 | 48 | 0.4 | 48 | 75 | 11 | -- | -- | -- | -- | -- |
| JAN 14 | 7.2 | 234 | 385 | 76 | -- | -- | -- | ND | ND | ND | ND | 14 | 10 | 52 | 0.5 | 48 | 64 | 12 | -- | -- | -- | -- | -- |
| JAN 16 | 7.1 | 160 | 380 | 71 | -- | -- | -- | 0.04 | ND | 0.04 | ND | 14 | 9 | 50 | 0.4 | 52 | 65 | 13 | -- | -- | -- | -- | -- |
| JAN 18 | 6.6 | 244 | 390 | 66 | -- | -- | -- | 0.12 | ND | 0.12 | ND | 15 | 7 | 49 | 0.5 | 50 | 66 | 12 | -- | -- | -- | -- | -- |
| JAN 21 | 6.9 | 256 | 390 | 76 | -- | -- | -- | ND | ND | ND | ND | 11 | 12 | 59 | 0.5 | 50 | 69 | 12 | -- | -- | -- | -- | -- |
| JAN 22 | 6.9 | 220 | 370 | 76 | -- | -- | -- | ND | ND | ND | ND | 14 | 10 | 49 | 0.4 | 50 | 60 | 11 | -- | -- | -- | -- | -- |
| JAN 23 | 6.9 | 202 | 375 | 61 | -- | -- | -- | ND | ND | ND | ND | 14 | 6 | 49 | 0.7 | 52 | 63 | 11 | -- | -- | -- | -- | -- |
| JAN 24 | 6.9 | 266 | 395 | 66 | -- | -- | -- | ND | ND | ND | ND | 15 | 7 | 50 | 0.5 | 50 | 59 | 12 | -- | -- | -- | -- | -- |
| JAN 28 | 6.8 | 250 | 400 | 66 | -- | -- | -- | ND | ND | ND | ND | 12 | 9 | 52 | 0.5 | 50 | 64 | 12 | -- | -- | -- | -- | -- |
| JAN 31 | 6.8 | 244 | 385 | 71 | -- | -- | -- | ND | ND | ND | ND | 12 | 10 | 49 | 0.5 | 48 | 62 | 13 | -- | -- | -- | -- | -- |
| FEB 1 | 6.8 | 250 | 375 | 71 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 13 | 9 | 48 | 0.5 | 48 | 63 | 10 | -- | -- | -- | -- | -- |
| FEB 4 | 6.7 | 248 | 365 | 71 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 9 | 12 | 50 | 0.7 | 46 | 61 | 11 | -- | -- | -- | -- | -- |
| FEB 5 | 7.0 | 240 | 370 | 66 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 13 | 8 | 48 | 0.4 | 42 | 62 | 10 | -- | -- | -- | -- | -- |
| FEB 11 | 6.7 | 88 | 365 | 76 | -- | -- | -- | 0.05 | 0.01 | 0.06 | ND | 15 | 9 | 49 | 0.7 | 42 | 60 | -- | -- | -- | -- | -- | -- |
| FEB 12 | 6.9 | 132 | 370 | 68 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 16 | 7 | 50 | 0.7 | -- | 60 | -- | -- | -- | -- | -- | -- |
| FEB 13 | 7.0 | 90 | 350 | 68 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 15 | 7 | 49 | 0.7 | -- | 59 | -- | -- | -- | -- | -- | -- |
| FEB 14 | 6.9 | 56 | 340 | 70 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 14 | 9 | 48 | 0.5 | -- | 65 | -- | -- | -- | -- | -- | -- |
| FEB 15 | 6.9 | 138 | 340 | 64 | -- | -- | -- | 0.42 | ND | 0.42 | ND | 14 | 7 | 48 | 0.5 | -- | 64 | -- | -- | -- | -- | -- | -- |

TABLE B-4--CONTINUED

| | | | | | | | | NITROGEN as N | | | | | | | | | | | | | | COLIFORM | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | pH | TDS | COND.@ 25°C µmhos/cm | TOTAL HARD-NESS | SS | BOD$_5$ | TOC | KJEL-DAHL | NO$_2$+NO$_3$ | TOTAL | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | S O | B | GREASE | TOTAL C | FECAL | TOTAL |
| | | mg/ℓ | | mg/ℓ | | | | | | | | | | | | | | | | | | no./100mℓ | |
| (1974) | | | | | | | | | | | | | | | | | | | | | | | |
| FEB 19 | 6.8 | 206 | 340 | 68 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 16 | 7 | 46 | 0.4 | 32 | 76 | 12 | -- | -- | -- | -- | -- |
| FEB 20 | 7.0 | -- | 315 | 61 | -- | -- | -- | ND | ND | ND | ND | 14 | 6 | 45 | 0.5 | 26 | 82 | 12 | -- | -- | -- | -- | -- |
| FEB 22 | 6.9 | -- | 335 | 66 | -- | -- | -- | ND | ND | ND | ND | 13 | 8 | 45 | 0.5 | 26 | 76 | 11 | -- | -- | -- | -- | -- |
| FEB 25 | 7.3 | -- | 320 | 76 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 12 | 11 | 43 | 0.5 | 22 | 80 | 12 | -- | -- | -- | -- | -- |
| FEB 27 | 6.7 | -- | 325 | 51 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 10 | 6 | 43 | 0.5 | 20 | 80 | 11 | -- | -- | -- | -- | -- |
| MAR 8 | 7.0 | 224 | 325 | 76 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 14 | 10 | 45 | 0.4 | 22 | 76 | 14 | -- | -- | -- | -- | -- |
| MAR 11 | 6.9 | -- | 325 | 76 | -- | -- | -- | ND | 0.01 | 0.01 | ND | 13 | 11 | 41 | 0.4 | 20 | 73 | 13 | -- | -- | -- | -- | -- |
| MAR 13 | 6.6 | — | 310 | 68 | -- | -- | -- | ND | ND | ND | ND | 13 | 9 | 41 | 0.4 | 22 | 74 | 12 | -- | -- | -- | -- | -- |
| MAR 14 | 7.2 | -- | 305 | 68 | -- | -- | -- | ND | ND | ND | ND | 13 | 9 | 41 | 0.4 | 20 | 88 | 11 | -- | -- | -- | -- | -- |
| MAR 19 | 7.5 | 200 | 325 | 72 | -- | -- | -- | 0.06 | ND | 0.06 | ND | 13 | 10 | 43 | 0.4 | -- | 75 | -- | -- | -- | -- | -- | -- |
| MAR 20 | 7.3 | 204 | 315 | 68 | -- | -- | -- | 1.11 | ND | 1.11 | 0.03 | 13 | 9 | 43 | 0.4 | -- | 78 | -- | -- | -- | -- | -- | -- |
| MAR 21 | 7.2 | 206 | 300 | 68 | -- | -- | -- | 0.49 | 0.01 | 0.50 | 0.02 | 13 | 9 | 43 | 0.4 | -- | 78 | -- | -- | -- | -- | -- | -- |
| MAR 22 | — | 200 | 315 | 72 | -- | -- | -- | 0.58 | 0.03 | 0.61 | ND | 13 | 10 | 41 | 0.4 | -- | 66 | 10 | -- | -- | -- | -- | -- |
| MAR 25 | 7.2 | 200 | 320 | 72 | -- | -- | -- | 0.55 | ND | 0.55 | 0.01 | 14 | 9 | 43 | 0.5 | -- | 74 | 12 | -- | -- | -- | -- | -- |
| MAR 29 | 7.6 | 204 | 305 | 60 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 14 | 6 | 48 | 0.4 | 22 | -- | 13 | -- | -- | -- | -- | -- |
| APR 1 | 7.2 | 224 | 310 | 72 | -- | -- | -- | 0.42 | ND | 0.42 | 0.01 | 13 | 10 | 41 | 0.4 | -- | 82 | -- | -- | -- | -- | -- | -- |
| APR 2 | 7.0 | 184 | 315 | 72 | -- | -- | -- | ND | ND | ND | 0.01 | 13 | 10 | 45 | 0.5 | 24 | 80 | -- | -- | -- | -- | -- | -- |
| APR 5 | 7.0 | 214 | 320 | 72 | -- | -- | -- | ND | ND | ND | 0.01 | 13 | 10 | 45 | 0.5 | 20 | 85 | 13 | -- | -- | -- | -- | -- |
| APR 8 | 6.9 | 212 | 330 | 64 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 14 | 7 | 46 | 0.5 | 20 | 88 | 13 | -- | -- | -- | -- | -- |
| APR 11 | 7.1 | 194 | 330 | 60 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 14 | 6 | 46 | 0.5 | 22 | 75 | 13 | -- | -- | -- | -- | -- |
| APR 12 | 7.3 | 190 | 325 | 60 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 13 | 7 | 46 | 0.5 | 22 | 81 | 12 | -- | -- | -- | -- | -- |
| APR 15 | 6.9 | 202 | 340 | 64 | -- | -- | -- | 0.08 | ND | 0.08 | 0.01 | 14 | 7 | 46 | 0.5 | 36 | 86 | 14 | -- | -- | -- | -- | -- |
| APR 17 | 7.5 | 214 | 335 | 65 | -- | -- | -- | 0.03 | 0.20 | 0.23 | 0.01 | 13 | 7 | 48 | 0.5 | 24 | 80 | 13 | -- | -- | -- | -- | -- |
| APR 22 | -- | 220 | 335 | 66 | -- | -- | -- | ND | ND | ND | 0.01 | 14 | 7 | 48 | 0.4 | 24 | 75 | 14 | -- | -- | -- | -- | -- |
| APR 25 | -- | 200 | 345 | 68 | -- | -- | -- | 0.06 | 0.01 | 0.61 | 0.01 | 15 | 8 | 48 | 0.4 | 22 | 77 | -- | -- | -- | -- | -- | -- |
| APR 29 | -- | 200 | 355 | 64 | -- | -- | -- | 0.03 | 0.01 | 0.04 | 0.01 | 15 | 7 | 50 | 0.6 | 34 | 78 | -- | -- | -- | -- | -- | -- |
| MAY 1 | -- | 220 | 370 | 72 | -- | -- | -- | -- | -- | -- | 0.01 | 15 | 8 | 50 | 0.5 | -- | 86 | -- | -- | -- | -- | -- | -- |
| MAY 2 | 6.7 | 190 | 355 | 68 | -- | -- | -- | 0.07 | ND | 0.07 | 0.02 | 13 | 9 | 47 | 0.6 | 36 | 81 | 12 | -- | -- | -- | -- | -- |
| MAY 3 | -- | 200 | 355 | 68 | -- | -- | -- | 0.16 | ND | 0.16 | 0.02 | 15 | 9 | 48 | 0.9 | -- | 82 | -- | -- | -- | -- | -- | -- |
| MAY 6 | -- | 200 | 370 | 68 | -- | -- | -- | -- | ND | -- | 0.01 | 15 | 7 | 50 | 0.5 | -- | 86 | -- | -- | -- | -- | -- | -- |

## TABLE B-4--CONTINUED

| | | | | | | | | NITROGEN as N | | | | | | | | | | | | | | COLIFORM | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | $BOD_5$ | TOC | KJELDAHL | $NO_2$+ $NO_3$ | TOTAL | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | TOTAL C | FECAL | TOTAL |
| | | mg/ℓ | | mg/ℓ | | | | | | | | | | | | | | | | | | no./100mℓ | |
| MAY 8 | -- | 218 | 370 | 72 | -- | -- | -- | -- | 0.01 | -- | 0.01 | 15 | 8 | 51 | 0.5 | -- | 73 | -- | -- | -- | -- | -- | -- |
| MAY 13 | -- | 204 | 380 | 76 | -- | -- | -- | -- | 0.01 | -- | 0.01 | 16 | 9 | 53 | -- | -- | 83 | -- | -- | -- | -- | -- | -- |
| MAY 17 | 6.9 | 214 | 380 | 84 | -- | -- | -- | 0.04 | 0.01 | 0.05 | 0.01 | 14 | 12 | 54 | 0.6 | 40 | 79 | 15 | -- | -- | -- | -- | -- |
| MAY 29 | 6.9 | 248 | 380 | 84 | -- | -- | -- | 0.03 | 0.02 | 0.05 | 0.01 | 15 | 11 | 60 | 0.6 | 42 | 78 | 16 | -- | -- | -- | -- | -- |
| JUN 3 | 7.0 | 202 | 400 | 80 | -- | -- | -- | 0.04 | 0.00 | 0.04 | 0.01 | 14 | 11 | 52 | 0.6 | 42 | 88 | 16 | -- | -- | -- | -- | -- |
| JUN 7 | 6.8 | 256 | 395 | 80 | -- | -- | -- | 0.08 | 0.00 | 0.08 | 0.01 | 15 | 10 | 52 | 0.6 | -- | 75 | 15 | -- | -- | -- | -- | -- |
| JUN 12 | 6.8 | 236 | 400 | 84 | -- | -- | -- | 0.13 | 0.02 | 0.15 | 0.01 | 15 | 11 | 54 | 0.6 | -- | 65 | 15 | -- | -- | -- | -- | -- |
| JUN 13 | 6.9 | 214 | 380 | 76 | -- | -- | -- | 0.14 | 0.01 | 0.15 | 0.02 | 14 | 10 | 52 | 0.6 | -- | 66 | 14 | -- | -- | -- | -- | -- |
| JUN 14 | 6.8 | 216 | 388 | 80 | -- | -- | -- | 0.04 | 0.00 | 0.04 | 0.01 | 14 | 11 | 52 | 0.9 | -- | 71 | 14 | -- | -- | -- | -- | -- |
| JUN 15 | 6.7 | 204 | 380 | 80 | -- | -- | -- | 0.07 | 0.00 | 0.07 | 0.01 | 12 | 12 | 50 | 0.6 | -- | 78 | 13 | -- | -- | -- | -- | -- |
| JUN 20 | 6.8 | 224 | 400 | 84 | -- | -- | -- | 0.02 | 0.00 | 0.02 | 0.02 | 15 | 11 | 52 | 0.6 | -- | 71 | 16 | -- | -- | -- | -- | -- |
| JUN 24 | 6.4 | 230 | 370 | 76 | -- | -- | -- | 0.06 | 0.00 | 0.06 | 0.02 | 15 | 9 | 52 | 0.8 | -- | 42 | 17 | -- | -- | -- | -- | -- |
| JUN 26 | 6.6 | 234 | 350 | 76 | -- | -- | -- | ND | -- | -- | 0.02 | 14 | 10 | 50 | 0.6 | -- | 74 | -- | -- | -- | -- | -- | -- |
| JUN 28 | 6.4 | 220 | 360 | 72 | -- | -- | -- | 0.01 | 0.02 | 0.03 | 0.03 | 14 | 9 | 54 | 0.5 | -- | 76 | 15 | -- | -- | -- | -- | -- |
| JUL 1 | 6.3 | 210 | 370 | 76 | -- | -- | -- | 0.07 | 0.01 | 0.08 | 0.03 | 15 | 9 | 52 | 0.7 | -- | 83 | 16 | -- | -- | -- | -- | -- |
| JUL 2 | 6.5 | 210 | 360 | 72 | -- | -- | -- | 0.04 | 0.01 | 0.05 | 0.03 | 14 | 9 | 52 | 0.7 | -- | 77 | 16 | -- | -- | -- | -- | -- |
| JUN 5 | 6.6 | 200 | 360 | 72 | -- | -- | -- | 0.02 | 0.02 | 0.04 | 0.03 | 14 | 9 | 54 | 0.7 | -- | 79 | 15 | -- | -- | -- | -- | -- |
| JUN 10 | 6.6 | 310 | 365 | 72 | -- | -- | -- | 0.03 | 0.03 | 0.06 | 0.02 | 14 | 9 | 52 | 0.7 | -- | 74 | 14 | -- | -- | -- | -- | -- |
| JUN 11 | 6.7 | 196 | 360 | 72 | -- | -- | -- | 0.04 | 0.01 | 0.05 | 0.01 | 13 | 11 | 52 | 0.7 | -- | 69 | 13 | -- | -- | -- | -- | -- |
| AUG 7 | -- | -- | -- | 80 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 29 | 2 | 45 | 0.6 | 44 | -- | 16 | -- | -- | -- | -- | -- |
| AUG 14 | -- | -- | -- | 94 | -- | -- | -- | ND | ND | ND | 0.01 | 29 | 5 | 43 | 0.6 | 48 | -- | 18 | -- | -- | -- | -- | -- |
| AUG 15 | -- | -- | -- | 88 | -- | -- | -- | 0.32 | ND | 0.32 | 0.01 | 24 | 7 | 46 | 0.6 | 43 | -- | 15 | -- | -- | -- | -- | -- |
| AUG 16 | -- | -- | -- | 88 | -- | -- | -- | ND | ND | ND | 0.01 | 27 | 5 | 45 | 0.6 | 46 | -- | 15 | -- | -- | -- | -- | -- |
| AUG 18 | -- | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- | -- | -- | -- | -- | -- | -- | -- | 15 | -- | -- | -- | -- | -- |
| AUG 21 | -- | -- | -- | 90 | -- | -- | -- | 0.11 | ND | 0.11 | 0.01 | 28 | 5 | 57 | 1.0 | 48 | -- | 17 | -- | -- | -- | -- | -- |
| AUG 22 | -- | -- | -- | 86 | -- | -- | -- | ND | 0.01 | 0.01 | 0.02 | 28 | 4 | 43 | 0.6 | 45 | -- | 17 | -- | -- | -- | -- | -- |
| AUG 26 | -- | -- | -- | 90 | -- | -- | -- | 0.12 | 0.01 | 0.01 | 0.02 | 29 | 4 | 56 | 0.8 | 46 | -- | 18 | -- | -- | -- | -- | -- |
| AUG 29 | -- | -- | -- | 82 | -- | -- | -- | 0.04 | 0.01 | 0.05 | 0.01 | 26 | 4 | 57 | 1.0 | 47 | -- | 16 | -- | -- | -- | -- | -- |
| SEP 3 | -- | -- | -- | 80 | -- | -- | -- | 0.13 | 0.01 | 0.14 | 0.01 | 28 | 2 | 58 | 1.0 | 49 | -- | 17 | -- | -- | -- | -- | -- |
| SEP 9 | -- | -- | -- | 90 | -- | -- | -- | ND | 0.01 | 0.01 | 0.02 | 30 | 4 | 50 | 0.8 | 52 | -- | 17 | -- | -- | -- | -- | -- |
| SEP 10 | -- | -- | -- | 104 | -- | -- | -- | ND | 0.06 | 0.06 | 0.01 | 30 | 7 | 53 | 0.4 | 49 | -- | 14 | -- | -- | -- | -- | -- |

TABLE B-4--CONTINUED

| DATE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | $BOD_5$ | TOC | NITROGEN as N | | | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | TOTAL C | COLIFORM | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | KJELDAHL | $NO_2$+ $NO_3$ | TOTAL | | | | | | | | | | | | FECAL | TOTAL |
| | | mg/ℓ | | mg/ℓ | | | | | | | | | | | | | | | | | | no./100mℓ | |
| (1974) | | | | | | | | | | | | | | | | | | | | | | | |
| SEP 13 | -- | -- | -- | 78 | -- | -- | -- | ND | 0.01 | 0.01 | 0.04 | 26 | 3 | 48 | 0.8 | 53 | -- | 15 | -- | -- | -- | -- | -- |
| SEP 18 | -- | -- | -- | 84 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 31 | 2 | 54 | 0.6 | 54 | -- | 15 | -- | -- | -- | -- | -- |
| SEP 19 | -- | -- | -- | 76 | -- | -- | -- | ND | ND | ND | 0.01 | 29 | 1 | 52 | 0.7 | 53 | -- | 14 | -- | -- | -- | -- | -- |
| SEP 20 | -- | -- | -- | 92 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 26 | 7 | 48 | 0.7 | 54 | -- | 14 | -- | -- | -- | -- | -- |
| SEP 23 | -- | -- | -- | 82 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 34 | -- | 53 | 0.5 | 57 | -- | 14 | -- | -- | -- | -- | -- |
| OCT 5 | -- | -- | -- | 88 | -- | -- | -- | ND | ND | ND | 0.01 | 30 | 3 | 56 | 1.0 | 61 | -- | 17 | -- | -- | -- | -- | -- |
| OCT 16 | -- | -- | -- | 06 | -- | -- | -- | ND | 0.01 | 0.01 | 0.02 | 32 | 4 | 60 | 1.1 | 61 | -- | 18 | -- | -- | -- | -- | -- |
| OCT 17 | -- | -- | -- | 84 | -- | -- | -- | -- | 0.02 | -- | 0.01 | 30 | 2 | 60 | 1.1 | 63 | -- | 16 | -- | -- | -- | -- | -- |
| OCT 20 | -- | -- | -- | 86 | -- | -- | -- | -- | 0.05 | -- | 0.02 | 30 | 3 | 45 | 0.5 | 64 | -- | 16 | -- | -- | -- | -- | -- |
| OCT 28 | -- | -- | -- | 92 | -- | -- | -- | -- | 0.01 | -- | ND | 30 | 4 | 45 | 1.0 | 67 | -- | 17 | -- | -- | -- | -- | -- |
| NOV 7 | -- | -- | -- | 108 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 30 | 6 | 52 | 0.1 | 74 | -- | 19 | -- | -- | -- | -- | -- |
| NOV 18 | -- | -- | -- | 104 | -- | -- | -- | ND | 0.01 | 0.01 | 0.01 | 24 | 11 | 57 | 0.7 | 70 | -- | 19 | -- | -- | -- | -- | -- |
| NOV 22 | -- | -- | -- | 98 | -- | -- | -- | ND | 0.05 | 0.05 | -- | 24 | 9 | 61 | 0.7 | 67 | -- | 17 | -- | -- | -- | -- | -- |
| NOV 27 | -- | -- | -- | 98 | -- | -- | -- | ND | 0.02 | 0.02 | -- | 24 | 9 | 58 | 0.5 | 73 | -- | 37 | -- | -- | -- | -- | -- |
| DEC 6 | -- | -- | -- | 102 | -- | -- | -- | -- | 0.04 | -- | -- | 25 | 10 | 59 | 0.6 | 71 | -- | 18 | -- | -- | -- | -- | -- |
| (1975) | | | | | | | | | | | | | | | | | | | | | | | |
| JAN 13 | -- | -- | -- | 108 | -- | -- | -- | -- | -- | -- | -- | 30 | 8 | 58 | 0.9 | 64 | -- | -- | -- | -- | -- | -- | -- |
| JAN 14 | -- | -- | -- | 90 | -- | -- | -- | -- | -- | -- | -- | 27 | 6 | 60 | 1.0 | 63 | -- | -- | -- | -- | -- | -- | -- |
| JAN 15 | -- | -- | -- | 90 | -- | -- | -- | -- | -- | -- | -- | 24 | 7 | 52 | 0.5 | 61 | -- | -- | -- | -- | -- | -- | -- |
| JAN 16 | -- | -- | -- | 86 | -- | -- | -- | -- | -- | -- | -- | 26 | 5 | 52 | 0.6 | 60 | -- | -- | -- | -- | -- | -- | -- |
| JAN 20 | -- | -- | -- | 94 | -- | -- | -- | -- | ND | -- | -- | 24 | 8 | 60 | 0.6 | 61 | -- | -- | -- | -- | -- | -- | -- |
| FEB 5 | -- | -- | -- | 80 | -- | -- | -- | -- | 0.07 | -- | -- | 28 | 2 | 66 | 0.4 | 56 | -- | -- | -- | -- | -- | -- | -- |
| FEB 7 | -- | -- | -- | 78 | -- | -- | -- | -- | 0.01 | -- | -- | 24 | 4 | 54 | 0.5 | 51 | -- | -- | -- | -- | -- | -- | -- |

NOTE: LEACHATE COLLECTED BY PUMPING FROM THE BOTTOM OF THE LYSIMETER.

## TABLE B-5. GRASS-SOD LYSIMETER WATER BALANCE

| DATE | RAINFALL[1] in. | APPLIED IRRIG. WATER[2] in. | EVAPOTRANSPIRATION[3] in. | EVAPOTRANSPIRATION[3] in./day* | PERCOLATE[4] in. | TENSION centibar* | PAN EVAPORATION[5] in./day* |
|---|---|---|---|---|---|---|---|
| 1972 | | | | | | | |
| July | 0.92 | 7.50 | 6.85 | 0.221 | 3.89 | 16 | 0.257 |
| Aug. | 1.00 | 2.40 | 5.05 | 0.168 | 1.60 | 16 | 0.255 |
| Sept. | 3.03 | 6.48 | 4.74 | 0.158 | 4.73 | 11 | 0.222 |
| Oct. | 3.56 | 15.51 | 3.94 | 0.127 | 12.21 | 6 | 0.206 |
| Nov. | 2.42 | 9.47 | 3.59 | 0.120 | 2.65 | 8 | 0.141 |
| Dec. | 3.70 | 9.46 | 4.83 | 0.156 | 7.74 | 14 | 0.142 |
| 1973 | | | | | | | |
| Jan. | 1.01 | 15.82 | 6.51 | 0.210 | 4.55 | 5 | 0.185 |
| Feb. | 0.69 | 16.80 | 9.01 | 0.322 | 6.30 | 7 | 0.215 |
| Mar. | 1.84 | 19.12 | 8.22 | 0.265 | 10.15 | 11 | 0.238 |
| Apr. | 1.23 | 14.97 | 6.80 | 0.227 | 6.23 | 11 | 0.236 |
| May | 1.74 | 16.94 | 8.84 | 0.285 | 10.29 | 18 | 0.274 |
| June | 0.63 | 6.62 | 6.85 | 0.228 | 2.86 | 19 | 0.259 |
| July | 1.01 | 8.51 | 5.55 | 0.179 | 0.00 | 11 | 0.274 |
| Aug. | 0.97 | 17.45 | 5.78 | 0.186 | 10.57 | 10 | 0.264 |
| Sept. | 1.08 | 10.29 | 5.58 | 0.186 | 6.38 | 11 | 0.248 |
| Oct. | 2.74 | 7.65 | 5.23 | 0.169 | 7.29 | 9 | 0.234 |
| Nov. | 3.42 | 12.43 | 4.55 | 0.152 | 10.89 | 7 | 0.146 |
| Dec. | 6.52 | 8.88 | 4.45 | 0.144 | 12.25 | 17 | 0.166 |
| 1974 | | | | | | | |
| Jan. | 9.47 | 5.55 | 2.68 | 0.086 | 14.56 | 8 | 0.172 |
| Feb. | 4.73 | 11.10 | 4.91 | 0.175 | 11.55 | 11 | 0.183 |
| Mar. | 6.31 | 4.99 | 4.33 | 0.140 | 8.26 | 14 | -- |
| Apr. | 4.61 | 9.07 | 5.68 | 0.189 | 7.40 | 25 | -- |
| May | 3.10 | 5.99 | 4.92 | 0.159 | 4.18 | 17 | 0.206 |
| June | 1.06 | 9.99 | 6.43 | 0.214 | 4.55 | 30 | 0.247 |
| July | 2.69 | 6.12 | 5.96 | 0.192 | 6.33 | 21 | 0.228 |
| Aug. | 0.34 | 11.39 | 5.90 | 0.190 | 4.06 | 21 | 0.231 |
| Sept. | 9.57 | 4.16 | 4.57 | 0.152 | 8.61 | 15 | 0.230 |
| Oct. | 3.06 | 5.80 | 4.69 | 0.151 | 5.46 | 24 | 0.183 |
| Nov. | 4.70 | 0.00 | 1.95 | 0.065 | 3.94 | 11 | 0.138 |
| Dec. | 1.31 | 1.40 | 2.58 | 0.083 | 1.16 | 17 | 0.156 |
| 1975 | | | | | | | |
| Jan. | 8.36 | 0.00 | 2.60 | 0.084 | 4.83 | 15 | 0.130 |
| Feb. | 6.43 | 0.00 | 3.13 | 0.112 | 3.15 | 7 | 0.161 |

NOTE: in. x 2.54 = cm.

[1] Absolute rainfall values measured at Mililani STP = 1.09 x 8 in. (Std. 8-in. gage).

[2] Metered.

[3] Measured by a pressure gage attached to the lysimeter.

[4] Volume of water pumped from the bottom of the lysimeter.

[5] Standard U.S. Weather Bureau pan located in OSC Field No. 245.

*Average.

## TABLE B-6. COMPOSITE LEACHATE FROM CERAMIC POINT SAMPLERS IN OSC FIELD NO. 240 TEST PLOT IRRIGATION WITH SECONDARY SEWAGE EFFLUENT

| DATE | POINT SAMPLER | | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | TOC | NITROGEN as N | | | $PO_4$-P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | ALK. as $CaCO_3$ | TOTAL COLIFORM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEPTH in. | LOCATION | | mg/ℓ | | mg/ℓ | | KJELDAHL | $NO_2$+$NO_3$ | TOTAL | | | | | | | | | | | | no./100mℓ |
| (1972) | | | | | | | | | | | | | | | | | | | | | | |
| JUNE 29 | 9 | F† | 7.0 | -- | 380 | 225 | 4.5 | -- | 5.0 | -- | -- | 48 | 26 | 23 | 2.3 | 34 | 55 | 21 | 0.01 | -- | -- | -- |
| | 21 | F‡ | 7.0 | -- | 460 | 223 | 3.5 | -- | 4.0 | -- | -- | 47 | 26 | 22 | 3.5 | 32 | 31 | 23 | 0.01 | -- | -- | -- |
| | 21 | R† | 7.2 | -- | -- | -- | 4.0 | -- | 0.2 | -- | -- | -- | -- | 18 | 4.8 | 28 | 43 | 27 | 0.02 | -- | -- | -- |
| | 33 | R | 7.0 | -- | 440 | 264 | 3.5 | -- | 2.2 | -- | -- | -- | 35 | 18 | 3.0 | 33 | 21 | 18 | 0.01 | -- | -- | -- |
| JUNE 30 | 9 | F | 6.9 | -- | 320 | -- | 4.0 | -- | 2.3 | -- | -- | -- | -- | 18 | 4.0 | 28 | 38 | 30 | 0.02 | -- | -- | -- |
| | 21 | F | 6.9 | -- | 350 | -- | 3.5 | -- | 1.3 | -- | -- | 48 | -- | 22 | 2.0 | 26 | 17 | 23 | 0.01 | -- | -- | -- |
| | 21 | R | 7.0 | -- | 360 | -- | 4.5 | -- | 0.3 | -- | -- | -- | -- | 18 | 5.6 | 25 | 50 | 29 | 0.02 | -- | -- | -- |
| | 33 | R | 7.1 | -- | 400 | -- | 4.0 | -- | 0.4 | -- | -- | 48 | -- | 17 | 2.3 | 28 | 31 | 24 | 0.02 | | | |
| JULY 6 | 9 | F | 8.0 | -- | 260 | 160 | 4.0 | -- | 3.3 | -- | -- | 54 | 6 | 18 | 5.5 | 28 | 18 | 12 | 0.04 | -- | -- | -- |
| | 21 | F | 8.0 | -- | 190 | 165 | 3.0 | -- | 3.3 | -- | -- | 60 | 4 | 18 | 4.9 | 28 | 20 | 16 | 0.04 | -- | -- | -- |
| | 21 | R | 7.9 | -- | 370 | 294 | 3.5 | -- | 2.0 | -- | -- | 100 | 11 | 17 | 3.0 | 32 | 28 | 16 | 0.05 | -- | -- | -- |
| | 33 | R | 8.0 | -- | 320 | 274 | 3.5 | -- | 1.7 | -- | -- | 100 | 6 | 15 | 1.8 | 30 | 25 | 14 | 0.04 | -- | -- | -- |
| JULY 7 | 9 | F | 8.2 | -- | 260 | 180 | 4.0 | -- | 2.3 | -- | -- | 60 | 7 | 13 | 6.1 | 26 | 20 | 15 | 0.02 | -- | -- | -- |
| | 21 | F | 8.2 | -- | 260 | 186 | 4.0 | -- | 1.6 | -- | -- | 74 | 1 | 17 | 5.8 | 24 | 22 | 18 | 0.03 | -- | -- | -- |
| | 9 | R | 8.2 | -- | -- | -- | 3.0 | -- | 4.5 | -- | -- | 80 | -- | 13 | 11.8 | -- | 23 | 15 | -- | -- | -- | -- |
| | 21 | R | 7.5 | -- | -- | 245 | 4.5 | -- | 0.2 | -- | -- | 80 | 11 | 18 | 3.5 | -- | 23 | 13 | 0.03 | -- | -- | -- |
| | 33 | R | 7.6 | -- | -- | 270 | 3.5 | -- | 0.6 | -- | -- | 100 | 5 | 14 | 1.8 | 58 | 8 | 8 | 0.03 | -- | -- | -- |
| JULY 13 | 9 | F | 8.2 | -- | 360 | 210 | 4.5 | -- | 2.8 | -- | -- | 72 | 7 | 54 | 3.4 | 40 | 25 | 18 | -- | -- | -- | -- |
| | 21 | F | 7.9 | -- | 460 | 208 | 4.0 | 0.25 | 3.0 | 3.25 | -- | 95 | 0 | 31 | 3.5 | 36 | 20 | 20 | -- | -- | -- | -- |
| | 21 | R | 8.1 | -- | -- | 275 | 3.5 | -- | 0.6 | -- | -- | 100 | 6 | 20 | 2.0 | -- | 49 | 23 | -- | -- | -- | -- |
| | 33 | R | 7.9 | -- | 420 | 300 | 4.0 | 0 | 2.2 | 2.2 | -- | 100 | 12 | 16 | 1.5 | 32 | 48 | 12 | -- | -- | -- | -- |
| JULY 14 | 9 | F | 8.1 | -- | 410 | 257 | 3.0 | -- | 1.1 | -- | -- | 80 | 14 | 25 | 5.1 | 45 | 22 | 18 | -- | -- | -- | -- |
| | 21 | F | 7.9 | -- | 380 | 275 | 4.0 | -- | 0.9 | -- | -- | 88 | 18 | 21 | 4.7 | 41 | 26 | 18 | -- | -- | -- | -- |
| | 21 | R | 8.1 | -- | -- | 275 | 4.0 | -- | 0.3 | -- | -- | 80 | 25 | 18 | 3.3 | 36 | 33 | 20 | -- | -- | -- | -- |
| | 33 | R | 8.0 | -- | 380 | 318 | 4.0 | -- | 0.6 | -- | -- | 88 | 7 | 24 | 2.9 | 44 | 50 | 15 | -- | -- | -- | -- |
| JULY 20 | 9 | F | 8.0 | 636 | 360 | 224 | 5.0 | 0.02 | 2.42 | 2.44 | -- | 84 | 9 | 38 | 1.6 | 36 | 8 | 31 | -- | -- | -- | -- |
| | 21 | F | 7.9 | 613 | 400 | 244 | 5.0 | 0.02 | 2.21 | 2.23 | -- | 82 | 5 | 36 | 2.5 | 39 | 7 | 22 | -- | -- | -- | -- |
| | 21 | R | 7.9 | 696 | 460 | 256 | 5.0 | 0.01 | 0.23 | 0.24 | -- | 108 | 5 | 25 | 1.5 | 32 | 3 | 19 | -- | -- | -- | -- |
| | 33 | R | 7.9 | 976 | 500 | 300 | 3.0 | 0.02 | 1.60 | 1.62 | -- | 110 | 7 | 23 | 1.5 | 37 | 4 | 17 | -- | -- | -- | -- |
| JULY 21 | 9 | F | 8.0 | -- | -- | 172 | 4.0 | -- | 1.28 | -- | -- | 54 | 9 | 37 | 1.8 | 35 | -- | 26 | -- | -- | -- | -- |
| | 21 | F | 8.0 | -- | -- | 140 | 5.0 | -- | 0.72 | -- | -- | 40 | 10 | 34 | 1.5 | 40 | -- | 18 | -- | -- | -- | -- |
| | 21 | R | 7.9 | -- | -- | -- | 4.0 | -- | 0.18 | -- | -- | -- | -- | 22 | 1.7 | 30 | -- | 21 | -- | -- | -- | -- |
| | 33 | R | 7.8 | -- | -- | -- | 4.0 | -- | 0.38 | -- | -- | -- | -- | 20 | 0.7 | 35 | -- | 13 | -- | -- | -- | -- |
| JULY 27 | 9 | F | 7.7 | -- | 400 | 208 | 4.0 | -- | 3.18 | -- | 0.35 | 78 | 5 | 39 | 2.0 | 42 | 21 | 20 | -- | -- | -- | -- |
| | 21 | F | 7.7 | 353 | 470 | 268 | 4.0 | -- | 2.28 | -- | 0.11 | 98 | 7 | 17 | 1.0 | 42 | 20 | 22 | -- | -- | -- | -- |
| | 33 | R | 7.9 | 372 | 500 | 164 | 3.0 | -- | 1.26 | -- | -- | 64 | 1 | 36 | 2.0 | 36 | -- | 14 | -- | -- | -- | -- |
| JULY 28 | 9 | F | 8.0 | -- | 500 | 204 | 4.0 | -- | 1.47 | -- | -- | 64 | 11 | 32 | 1.3 | 38 | 21 | 12 | -- | -- | -- | -- |
| | 21 | F | 7.9 | -- | 520 | 244 | 4.0 | -- | 1.06 | -- | -- | 88 | 6 | 28 | 1.7 | 38 | 31 | 10 | -- | -- | -- | -- |
| | 21 | R | 8.0 | -- | -- | 275 | 3.0 | -- | 0.25 | -- | -- | 92 | 11 | 20 | 1.0 | 27 | -- | 19 | -- | -- | -- | -- |
| | 33 | R | 7.8 | -- | 500 | 300 | 3.0 | -- | 0.29 | -- | -- | 95 | 15 | 17 | 1.1 | 38 | -- | 7 | -- | -- | -- | -- |

TABLE B-6--CONTINUED

| DATE | POINT SAMPLER | | pH | TDS | COND. @ 25°C | TOTAL HARDNESS | TOC | NITROGEN as N | | | PO₄-P | Ca | Mg* | Na | K | Cl | SO₄ | SiO₂ | B | GREASE | ALK. as CaCO₃ | TOTAL COLIFORM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEPTH in. | LOCATION | | | | | | KJELDAHL | $NO_2$+ $NO_3$ | TOTAL | | | | | | | | | | | | |
| | | | | mg/ℓ | µmhos/cm | mg/ℓ | | | | | | | | | | | | | | | | no./100mℓ |
| AUG 3 | 9 | F | 8.2 | -- | -- | 168 | -- | 0.05 | 5.45 | 5.50 | 0.49 | 60 | 4 | 44 | 1.7 | 50 | 32 | 22 | -- | -- | 200 | -- |
| | 21 | F | 8.2 | -- | -- | 184 | -- | 0.02 | 3.48 | 3.50 | 0.22 | 63 | 4 | 37 | 1.6 | 46 | 20 | 21 | -- | -- | 220 | -- |
| | 21 | R | 8.2 | -- | -- | 160 | -- | 0.00 | 1.04 | 1.04 | 0.18 | 58 | 4 | 18 | 0.5 | 44 | 12 | 19 | -- | -- | 255 | -- |
| | 33 | R | 7.8 | -- | -- | 135 | -- | 0.00 | 2.78 | 2.78 | 0.05 | 45 | 6 | 16 | 0.5 | 44 | 8 | 13 | -- | -- | 215 | -- |
| AUG 4 | 9 | F | 8.3 | -- | -- | -- | -- | 0.00 | 4.37 | 4.37 | -- | -- | -- | 37 | 1.2 | 46 | -- | 22 | -- | -- | 197 | -- |
| | 21 | F | 8.2 | -- | -- | -- | -- | 0.00 | 3.93 | 3.93 | -- | -- | -- | 36 | 1.4 | 44 | 14 | 21 | -- | -- | 212 | -- |
| | 21 | R | 8.2 | -- | -- | -- | -- | 0.00 | 0.25 | 0.25 | -- | -- | -- | 17 | 0.8 | 34 | -- | 18 | -- | -- | 150 | -- |
| | 33 | R | 8.1 | -- | -- | -- | -- | 0.00 | 0.95 | 0.95 | -- | -- | -- | 15 | 0.4 | 44 | 7 | 16 | -- | -- | 320 | -- |
| AUG 10 | 9 | F | 8.1 | -- | 440 | 136 | -- | 0.07 | 5.60 | 5.67 | 0.93 | 50 | 3 | 43 | 2.2 | 50 | 28 | 28 | -- | -- | 180 | -- |
| | 21 | F | 7.9 | -- | 400 | 184 | -- | 0.01 | 4.87 | 4.88 | 0.31 | 64 | 6 | 40 | 1.7 | 47 | 19 | 22 | -- | -- | 212 | -- |
| | 21 | R | 8.1 | -- | 400 | 120 | -- | 0.01 | 1.40 | 1.41 | -- | 45 | 2 | 18 | 0.6 | 48 | 12 | 21 | -- | -- | 160 | -- |
| | 33 | R | 8.1 | -- | 420 | 108 | -- | 0.00 | 2.84 | 2.84 | 0.03 | 37 | 4 | 16 | 0.5 | 48 | 8 | 14 | -- | -- | 190 | -- |
| AUG 11 | 9 | F | 8.2 | -- | -- | -- | -- | 0.01 | 4.40 | 4.41 | -- | -- | -- | -- | 1.2 | 40 | -- | 24 | -- | -- | 212 | -- |
| | 21 | F | 8.2 | -- | -- | -- | -- | 0.00 | 4.52 | 4.52 | 0.05 | -- | -- | -- | 1.3 | 42 | -- | 20 | -- | -- | 252 | -- |
| | 21 | R | 8.2 | -- | -- | -- | -- | 0.00 | 0.53 | 0.53 | -- | -- | -- | -- | 1.2 | 38 | -- | 20 | -- | -- | 240 | -- |
| | 33 | R | 8.3 | -- | -- | -- | -- | 0.00 | 1.97 | 1.97 | -- | -- | -- | -- | 0.4 | 42 | -- | 15 | -- | -- | 246 | -- |
| AUG 17 | 9 | F | 7.9 | -- | 400 | 162 | 12 | 0.22 | 4.68 | 4.90 | 0.18 | 59 | 4 | 45 | 2.0 | 48 | 26 | 24 | -- | -- | 190 | 101 |
| | 21 | F | 7.9 | -- | 370 | 184 | 9 | 0.03 | 4.15 | 4.18 | 0.15 | 62 | 7 | 41 | 1.5 | 50 | 21 | 20 | -- | -- | 206 | 113 |
| | 21 | R | 8.1 | -- | 480 | 168 | 8 | 0.01 | 2.84 | 2.85 | 0.02 | 60 | 4 | 18 | 0.6 | 53 | 18 | 15 | -- | -- | 280 | 117 |
| | 33 | R | 8.1 | -- | 500 | 308 | 9 | 0.00 | 4.03 | 4.03 | 0.04 | 110 | 8 | 18 | 0.8 | 52 | 14 | 12 | -- | -- | 260 | 144 |
| AUG 24 | 9 | F | 7.8 | -- | -- | 192 | -- | 0.16 | 4.26 | 4.42 | -- | 70 | 4 | 50 | 0.9 | 46 | 27 | 19 | -- | -- | 206 | -- |
| | 21 | F | 8.1 | -- | -- | 220 | -- | 0.00 | 4.30 | 4.30 | -- | 80 | 5 | 45 | 1.3 | 46 | 34 | 18 | -- | -- | 230 | -- |
| | 21 | R | 7.9 | -- | -- | 232 | -- | 0.02 | 2.66 | 2.68 | -- | 72 | 13 | 20 | 0.3 | 52 | 12 | 12 | -- | -- | 262 | |
| | 33 | R | 8.0 | -- | -- | 254 | -- | 0.00 | 3.95 | 3.95 | -- | 82 | 10 | 20 | 0.5 | 48 | 12 | 12 | -- | -- | 278 | -- |
| AUG 25 | 9 | F | 7.7 | -- | -- | -- | -- | 0.21 | 3.60 | 3.81 | -- | -- | -- | 49 | 1.1 | 46 | 20 | 20 | -- | -- | 225 | -- |
| | 21 | F | 8.2 | -- | -- | -- | -- | 0.10 | 3.30 | 3.40 | -- | -- | -- | 45 | 1.0 | 42 | 17 | 19 | -- | -- | 246 | -- |
| | 21 | R | 7.8 | -- | -- | -- | -- | 0.07 | 1.22 | 1.29 | -- | -- | -- | 20 | 0.8 | 48 | 12 | 18 | -- | -- | 205 | -- |
| | 33 | R | 8.1 | -- | -- | -- | -- | 0.01 | 3.95 | 3.96 | -- | -- | -- | 19 | 0.6 | 43 | 10 | 17 | -- | -- | 249 | |
| SEPT 8 | 9 | F | 8.0 | 358 | 380 | 220 | 12 | 0.45 | 3.75 | 4.20 | -- | 70 | 11 | 47 | 2.9 | 40 | 23 | 29 | -- | -- | -- | 84 |
| | 21 | F | 7.9 | 397 | 420 | 150 | 12 | 0.03 | 4.25 | 4.28 | -- | 48 | 7 | 47 | 1.2 | 38 | 20 | 16 | -- | -- | -- | 112 |
| | 21 | R | 7.8 | 446 | 420 | 250 | 10 | 0.01 | 2.75 | 2.76 | -- | 74 | 16 | 26 | 0.8 | 51 | 14 | 13 | -- | -- | -- | 153 |
| | 33 | R | 8.0 | 456 | 460 | 345 | 6 | 0.00 | 5.45 | 5.45 | -- | 114 | 15 | 21 | 0.5 | 54 | 15 | 10 | -- | -- | -- | 140 |
| SEPT 14 | 9 | F | 7.5 | 388 | 430 | 170 | 10 | 0.59 | 3.78 | -- | -- | 56 | 7 | 52 | 2.5 | 45 | 28 | 24 | -- | -- | -- | 106 |
| | 21 | F | 7.9 | 415 | 440 | 200 | 9 | 0.19 | 3.45 | -- | -- | 70 | 6 | 48 | 1.4 | 45 | 23 | 19 | -- | -- | -- | 108 |
| | 21 | R | 8.0 | 404 | 550 | 335 | 7 | 0.01 | 2.02 | -- | -- | 110 | 15 | 23 | 0.6 | 50 | 18 | 12 | -- | -- | -- | 143 |
| | 33 | R | 7.9 | 459 | 600 | 335 | 6 | 0.00 | 5.52 | -- | -- | 113 | 13 | 21 | 0.5 | 54 | 18 | 11 | -- | -- | -- | 145 |
| SEPT 21 | 9 | F | 7.8 | 384 | 460 | 155 | 10 | 0.82 | 6.10 | 6.92 | -- | 54 | 5 | 57 | 2.2 | 48 | 24 | 25 | -- | -- | -- | 70 |
| | 21 | F | 7.7 | 309 | 520 | 210 | 7 | 0.12 | 6.10 | 6.22 | -- | 75 | 6 | 54 | 1.2 | 47 | 22 | 14 | -- | -- | -- | 80 |
| | 21 | R | 7.8 | -- | 500 | 270 | 7 | 0.03 | 2.14 | 2.17 | -- | 86 | 13 | 33 | 0.5 | 49 | 15 | 13 | -- | -- | -- | 55 |
| | 33 | R | 7.9 | 367 | 620 | 360 | 6 | 0.00 | 8.00 | 8.00 | -- | 122 | 14 | 26 | 0.7 | 55 | 15 | 11 | -- | -- | -- | 85 |
| SEPT 28 | 9 | F | 7.7 | 353 | 480 | 145 | 10 | 0.45 | 4.97 | 5.42 | -- | 50 | 5 | 54 | 2.3 | 48 | 26 | 30 | -- | -- | -- | -- |
| | 21 | F | 7.8 | 392 | 500 | 200 | 10 | 0.21 | 5.22 | 5.43 | -- | 68 | 7 | 57 | 1.5 | 50 | 24 | 20 | -- | -- | -- | -- |
| | 21 | R | 7.8 | -- | 600 | 335 | 7 | 0.02 | 3.45 | 3.47 | -- | 110 | 15 | 29 | 0.5 | 53 | 20 | 13 | -- | -- | -- | -- |
| | 33 | R | 7.9 | 473 | 680 | 350 | 6 | 0.00 | 6.05 | 6.85 | -- | 118 | 13 | 30 | 0.5 | 56 | 22 | 10 | -- | -- | -- | -- |

TABLE B-6--CONTINUED

| DATE | POINT SAMPLER | | pH | TDS | COND. @ 25°C | TOTAL HARDNESS | TOC | NITROGEN as N | | | PO$_4$-P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | ALK. as CaCO$_3$ | TOTAL COLIFORM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEPTH in. | LOCATION | | mg/ℓ | µmhos/cm | | | KJELDAHL | NO$_2$+NO$_3$ | TOTAL | | | | | | | | | | | | |
| | | | | | | mg/ℓ | | | | | | | | | | | | | | | | no./100mℓ |
| OCT 5 | 9 | F | 8.0 | 414 | 520 | 199 | 10 | 0.31 | 5.87 | 6.18 | -- | 68 | 7 | 56 | 1.9 | 40 | 21 | 22 | -- | -- | -- | -- |
| | 21 | F | 8.0 | 397 | 580 | 208 | 9 | 0.05 | 6.06 | 6.10 | -- | 69 | 8 | 53 | 1.0 | 42 | 17 | 23 | -- | -- | -- | -- |
| | 21 | R | 7.9 | -- | -- | 174 | 6 | 0.02 | 1.83 | 1.85 | -- | 60 | 6 | 31 | 0.5 | 54 | 16 | 17 | -- | -- | -- | -- |
| | 33 | R | 8.0 | 500 | 630 | 324 | 5 | 0.00 | 6.35 | 6.35 | -- | 114 | 10 | 28 | 0.5 | 50 | 14 | 14 | -- | -- | -- | -- |
| OCT 12 | 9 | F | 7.8 | 391 | 500 | 189 | 12 | 0.44 | 4.50 | 4.94 | -- | 60 | 10 | 56 | 1.9 | 44 | 32 | 26 | -- | -- | -- | -- |
| | 21 | F | 7.9 | 514 | 550 | 213 | 8 | 0.16 | 6.63 | 6.79 | -- | 70 | 9 | 56 | 0.9 | 44 | 30 | 22 | -- | -- | -- | -- |
| | 21 | R | 7.9 | -- | -- | 175 | 5 | 0.01 | 3.74 | 3.75 | -- | -- | -- | 33 | 0.5 | 52 | 18 | 14 | -- | -- | -- | -- |
| | 33 | R | 8.0 | 359 | 520 | 216 | 5 | 0.00 | 6.60 | 6.60 | -- | 71 | 10 | 30 | 0.5 | 52 | 18 | 11 | -- | -- | -- | -- |
| OCT 19 | 9 | F | 7.8 | 417 | 500 | 182 | 11 | 0.19 | 800 | 8.19 | -- | 64 | 6 | 57 | 1.7 | 48 | 27 | 23 | -- | -- | -- | -- |
| | 21 | F | 8.1 | -- | 540 | 206 | 8 | 0.08 | 8.10 | 8.18 | -- | 68 | 9 | 56 | 1.0 | 48 | 21 | 22 | -- | -- | -- | -- |
| | 21 | R | 7.9 | -- | -- | 180 | 5 | 0.01 | 4.17 | 4.18 | -- | 61 | 7 | 38 | 0.5 | 58 | 17 | 13 | -- | -- | -- | -- |
| | 33 | R | 8.0 | -- | 550 | 208 | 4 | 0.00 | 6.15 | 6.15 | -- | 78 | 3 | 35 | 0.5 | 54 | 14 | 11 | -- | -- | -- | -- |
| OCT 26 | 9 | F | 7.8 | -- | 550 | 177 | -- | 0.31 | 6.90 | 7.21 | -- | 64 | 4 | 56 | 1.5 | 46 | 22 | 24 | -- | -- | -- | -- |
| | 21 | F | 7.7 | -- | 600 | 189 | -- | 0.10 | 6.70 | 6.80 | -- | 70 | 3 | 54 | 0.9 | 48 | 31 | 22 | -- | -- | -- | -- |
| | 21 | R | 7.8 | -- | 630 | 177 | -- | 0.00 | 10.80 | 10.80 | -- | -- | -- | 36 | 0.4 | 56 | 14 | 17 | -- | -- | -- | -- |
| | 33 | R | 7.9 | 441 | 780 | 206 | -- | 0.00 | 5.90 | 5.90 | -- | 68 | 9 | 33 | 0.6 | 52 | 12 | 12 | -- | -- | -- | -- |
| NOV 2 | 9 | F | 7.9 | 404 | 500 | 173 | 15 | 0.34 | 3.42 | 3.76 | -- | 56 | 8 | 54 | 2.0 | 42 | 25 | 26 | -- | -- | -- | 66 |
| | 21 | F | 7.9 | 441 | 520 | 208 | 9 | 0.19 | 7.50 | 7.69 | -- | 64 | 11 | 56 | 1.2 | 44 | 24 | 22 | -- | -- | -- | 78 |
| | 21 | R | 7.8 | -- | 560 | 244 | 5 | 0.05 | 2.11 | 2.16 | -- | 70 | 17 | 37 | 0.5 | 48 | 17 | 20 | -- | -- | -- | 84 |
| | 33 | R | 7.9 | 512 | 600 | 336 | 6 | 0.07 | 3.90 | 3.97 | -- | 111 | 15 | 38 | 0.5 | 52 | 16 | 11 | -- | -- | -- | 90 |
| NOV 16 | 9 | F | 7.8 | 401 | 500 | 184 | 5 | 1.40 | 5.30 | 6.70 | -- | 58 | 10 | 72 | 2.7 | 40 | 28 | 25 | -- | -- | -- | 52 |
| | 21 | F | 7.7 | 431 | 500 | 203 | 5 | 0.48 | 9.30 | 9.78 | -- | 68 | 8 | 75 | 1.0 | 44 | 25 | 18 | -- | -- | -- | 55 |
| | 21 | R | 7.8 | -- | 550 | 226 | 3 | 0.05 | 10.40 | 10.45 | -- | 72 | 11 | 58 | 0.5 | 48 | 18 | 15 | -- | -- | -- | 70 |
| | 33 | R | 7.9 | 497 | 600 | 328 | 3 | 0.00 | 9.70 | 9.70 | -- | 91 | 13 | 53 | 0.7 | 52 | 18 | 11 | -- | -- | -- | 79 |
| NOV 30 | 9 | F | 8.0 | 423 | 480 | 190 | 12 | 0.80 | 11.20 | 12.00 | -- | 57 | 12 | 55 | 2.3 | 48 | 30 | 77 | -- | -- | -- | 55 |
| | 21 | F | 8.0 | 399 | 490 | 199 | 8 | 0.15 | 14.90 | 15.05 | -- | 62 | 11 | 58 | 0.9 | 64 | 28 | 49 | -- | -- | -- | 58 |
| | 21 | R | 8.1 | -- | 550 | -- | 5 | 0.05 | 14.50 | 14.55 | -- | -- | -- | 40 | 0.8 | 59 | 20 | -- | -- | -- | -- | 71 |
| | 33 | R | 8.0 | 600 | 600 | 304 | 5 | 0.01 | 12.10 | 12.11 | -- | 100 | 13 | 41 | 0.8 | 57 | 17 | 38 | -- | -- | -- | 78 |
| DEC 27 | 9 | F | 8.1 | 549 | 550 | 168 | 9 | 1.10 | 4.62 | 5.72 | -- | 58 | 6 | 90 | 1.9 | 100 | 31 | 28 | -- | -- | -- | -- |
| | 21 | F | 8.1 | 562 | 620 | 211 | 8 | 0.42 | 13.70 | 14.12 | -- | 74 | 6 | 79 | 0.8 | 85 | 28 | 18 | -- | -- | -- | -- |
| | 21 | R | 8.0 | -- | -- | -- | -- | 0.07 | 6.30 | 6.37 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 33 | R | 8.1 | 630 | 700 | 275 | 5 | 0.02 | 7.85 | 7.87 | -- | 94 | 7 | 80 | 1.3 | 117 | 18 | 14 | -- | -- | -- | -- |
| (1973) | | | | | | | | | | | | | | | | | | | | | | |
| JAN 11 | 9 | F | 7.6 | -- | 530 | 168 | 12 | 0.90 | 7.75 | 8.65 | -- | 55 | 8 | 54 | 3.0 | 67 | 27 | 35 | -- | -- | -- | 65 |
| | 21 | F | 7.7 | -- | 580 | 187 | 10 | 0.21 | 7.30 | 7.51 | -- | 68 | 4 | 56 | 1.2 | 60 | 24 | 28 | -- | -- | -- | 72 |
| | 21 | R | 7.9 | -- | 600 | 320 | 7 | 0.05 | 13.50 | 13.55 | -- | -- | -- | 36 | 0.4 | 58 | 21 | 27 | -- | -- | -- | 75 |
| | 33 | R | 7.9 | -- | 750 | 256 | 5 | 0.00 | 9.90 | 9.90 | -- | -- | -- | 49 | 1.4 | 68 | 38 | 27 | -- | -- | -- | 80 |
| JAN 26 | 9 | F | 7.7 | 376 | 460 | 170 | 10 | 0.61 | 13.00 | 13.61 | -- | 58 | 6 | 52 | 3.2 | 52 | 22 | 33 | -- | -- | -- | 50 |
| | 21 | F | 7.8 | 350 | 600 | 204 | 10 | 0.10 | 14.40 | 14.50 | -- | 74 | 5 | 59 | 1.2 | 52 | 21 | 23 | -- | -- | -- | 55 |
| | 21 | R | 8.0 | -- | -- | -- | 5 | 0.10 | 9.50 | 9.60 | -- | -- | -- | 39 | 0.8 | -- | -- | 30 | -- | -- | -- | 55 |
| | 33 | R | 8.1 | -- | 600 | 290 | 5 | 0.00 | 10.10 | 10.10 | -- | 90 | 16 | 49 | 2.0 | 64 | 20 | 26 | -- | -- | -- | 60 |

## TABLE B-6--CONTINUED

| DATE | POINT SAMPLER |  | pH | TDS | COND. @ 25°C | TOTAL | TOC | NITROGEN as N |  |  | $PO_4$- | Ca | Mg⁑ | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | ALK. | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | DEPTH in. | LOCATION |  | mg/ℓ | µmhos/cm | HARDNESS |  | KJELDAHL | $NO_2$+ $NO_3$ | TOTAL | P |  |  |  |  |  |  |  |  |  | as $CaCO_3$ | COLIFORM no./100mℓ |
|  |  |  |  |  |  | ---- | ---- | ---- | ---- | ---- | ---- | ---- | mg/ℓ | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |  |
| FEB 15 | 9 | F | 7.7 | 400 | 500 | 180 | 11 | 0.21 | 10.10 | 10.31 | -- | 59 | 8.1 | 48 | 3.5 | 50 | 30 | 34 | -- | -- | -- | -- |
|  | 21 | F | 7.8 | 386 | 480 | 192 | 8 | 0.10 | 9.72 | 9.82 | -- | 69 | 4.6 | 53 | 1.0 | 52 | 21 | 30 | -- | -- | -- | -- |
|  | 21 | R | 7.8 | -- | 520 | -- | -- | 0.05 | 4.30 | 4.35 | -- | -- | -- | 41 | 1.0 | -- | -- | 34 | -- | -- | -- | -- |
|  | 33 | R | 8.0 | -- | 600 | 204 | 4 | 0.01 | 5.30 | 5.31 | -- | 68 | 8.3 | 35 | 2.0 | 54 | 17 | 39 | -- | -- | -- | -- |
| MAR 1 | 9 | F | 7.8 | 435 | 450 | 178 | 12 | 2.10 | 13.00 | 15.10 | -- | 64 | 3.9 | 60 | 2.5 | 54 | 41 | 43 | -- | -- | -- | 75 |
|  | 21 | F | 7.7 | 471 | 500 | 202 | 11 | 1.10 | 14.60 | 15.70 | -- | 76 | 2.9 | 72 | 0.5 | 58 | 15 | 23 | -- | -- | -- | 70 |
|  | 21 | R | 7.7 | -- | -- | 260 | 5 | 0.60 | 4.35 | 4.95 | -- | 90 | 8.5 | 56 | 0.5 | 65 | -- | 21 | -- | -- | -- | 78 |
|  | 33 | R | 7.8 | 485 | 620 | 250 | 6 | 0.05 | 8.65 | 8.70 | -- | 96 | 2.4 | 57 | 1.5 | 60 | 38 | 13 | -- | -- | -- | 85 |
| APR 5 | 9 | F | 7.6 | 422 | 480 | 154 | 12 | 4.80 | 11.40 | 16.20 | -- | 58 | 2.2 | 58 | 3.6 | 58 | 39 | 35 | -- | -- | -- | 68 |
|  | 21 | F | 7.6 | 466 | 520 | 192 | 7 | 1.10 | 10.80 | 11.90 | -- | 72 | 2.9 | 70 | 1.5 | 62 | 40 | 21 | -- | -- | -- | 70 |
| APR 26 | 9 | F | 7.8 | -- | 500 | 160 | 10 | 2.8 | -- | -- | -- | 61 | -- | 56 | 2.6 | 68 | 51 | 30 | -- | -- | -- | -- |
|  | 21 | F | 7.8 | -- | 550 | 210 | 7 | 1.0 | -- | -- | -- | 78 | -- | 65 | 0.6 | 75 | 30 | 20 | -- | -- | -- | -- |
| MAY 10 | 9 | F | 7.3 | 420 | 450 | 190 | 10 | 1.50 | 6.20 | 7.70 | -- | 66 | -- | 59 | 2.2 | 70 | 31 | 35 | -- | -- | -- | 85 |
|  | 21 | F | 7.4 | 475 | 500 | 210 | 10 | 0.25 | 5.80 | 6.05 | -- | 81 | -- | 67 | 0.8 | 68 | 20 | 25 | -- | -- | -- | 80 |
| JUNE 8 | 9 | F | 7.3 | -- | -- | -- | -- | -- | 4.29 | -- | -- | 42 | -- | 59 | 2.0 | 43 | -- | -- | -- | -- | -- | -- |
|  | 21 | F | 7.2 | -- | -- | -- | -- | -- | 5.02 | -- | -- | 56 | -- | 68 | 0.6 | 52 | -- | -- | -- | -- | -- | -- |
|  | 33 | R | 7.5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

NOTE: DUE TO THE VARYING QUANTITY OF SAMPLE FOR EACH LOCATION, SAMPLES WERE GENERALLY COMPOSITED BY USING THE AVAILABLE INDIVIDUAL SAMPLE QUANTITY RATHER THAN FOLLOWING UNIFORM ALIQUOT ADDITIONS AT EACH SAMPLE DEPTH. (in. x 2.54 = cm.)

⁑ CALCULATED BY THE EQUIVALENT WEIGHT DIFFERENCE BETWEEN TOTAL HARDNESS AND CALCIUM.

‡ LOCATED IN THE FURROW OF THE SUGARCANE FIELD.

† LOCATED IN THE RIDGE OF THE SUGARCANE FIELD.

## TABLE B-7. QUALITY CONSTITUENTS OF BARE SOIL LYSIMETER PERCOLATE

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARD-NESS | NITROGEN as N | | | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | NH$_3$-N | NO$_2$+ NO$_3$ | TOTAL | | | | | | | | |
| | | | | mg/ℓ | | | | | | | | | | | |
| (1973) | | | | | | | | | | | | | | | |
| AUG 6 | 7.1 | 514 | 380 | 65 | 0.11 | 15.20 | 15.31 | 0.07 | 11 | 9 | 91 | 1.1 | 86 | 27 | 14 |
| AUG 7 | 6.7 | 336 | 310 | 70 | 0.75 | 16.40 | 17.15 | 0.04 | 7 | 13 | 37 | 1.5 | 61 | 23 | 6 |
| AUG 8 | 6.8 | 408 | 350 | 45 | 0.78 | 5.88 | 6.66 | 0.04 | 6 | 7 | 55 | 1.5 | 76 | 25 | 12 |
| AUG 13 | 7.1 | 302 | 350 | 40 | 2.13 | 11.59 | 13.72 | 0.05 | 4 | 7 | 48 | 0.2 | 98 | 25 | 16 |
| AUG 23 | 7.4 | 232 | 360 | 60 | 0.56 | 7.04 | 7.60 | -- | 13 | 7 | 72 | 1.0 | 103 | 40 | 23 |
| NOV 7 | 7.1 | -- | 305 | -- | ND | 0.46 | .46 | 0.05 | 5 | -- | 48 | 2.2 | 55 | -- | 25 |
| NOV 9 | 6.5 | 286 | 320 | 92 | ND | 9.78 | 9.78 | 0.05 | 5 | 19 | 57 | 1.9 | 58 | -- | 24 |
| NOV 12 | 6.6 | 314 | 300 | 88 | ND | 9.88 | 9.88 | 0.04 | 5 | 18 | 42 | 0.8 | 48 | 32 | 22 |
| NOV 14 | 6.3 | 284 | 360 | 96 | ND | 9.05 | 9.05 | 0.03 | -- | -- | -- | -- | 50 | 32 | 20 |
| NOV 16 | 6.3 | 308 | 300 | 92 | ND | 10.23 | 10.23 | 0.03 | -- | -- | -- | -- | 40 | 31 | 21 |
| NOV 19 | 7.2 | 260 | 335 | 88 | ND | 7.92 | 7.92 | 0.15 | 6 | 18 | 39 | 1.2 | 43 | 33 | 22 |
| NOV 20 | 7.0 | 296 | 315 | -- | ND | 9.03 | 9.03 | 0.04 | 4 | -- | 36 | 0.9 | 43 | 49 | 20 |
| NOV 21 | 7.3 | -- | 320 | 96 | ND | 11.47 | 11.47 | 0.14 | 11 | 17 | 30 | 0.9 | 53 | 35 | 20 |
| NOV 23 | 6.8 | 374 | 310 | 120 | ND | 12.10 | 12.10 | 0.14 | 7 | 25 | 30 | 1.1 | 53 | 34 | 18 |
| NOV 26 | 7.0 | 258 | 330 | 108 | ND | 12.36 | 12.36 | 0.03 | 9 | 21 | 30 | 0.9 | 50 | 34 | 21 |
| NOV 28 | 7.1 | 320 | 320 | 104 | ND | 15.40 | 15.40 | 0.02 | 10 | 19 | 27 | 1.1 | 50 | 33 | 20 |
| DEC 3 | 7.0 | 170 | 340 | 108 | ND | 15.40 | 15.40 | 0.05 | 13 | 18 | 27 | 0.9 | 43 | 36 | 16 |
| DEC 5 | 6.4 | 244 | 345 | 100 | ND | 18.03 | 18.03 | 0.05 | 14 | 16 | 29 | 0.9 | 45 | 35 | 15 |
| DEC 6 | 7.4 | 248 | 350 | 108 | ND | 18.04 | 18.04 | 0.05 | 14 | 18 | 32 | 1.1 | 45 | 28 | 15 |
| DEC 7 | 7.1 | 290 | 345 | 100 | ND | 14.02 | 14.02 | 0.06 | 9 | 19 | 14 | 0.5 | 48 | 36 | 15 |
| DEC 10 | 7.5 | 240 | 355 | 116 | ND | 19.38 | 19.38 | 0.14 | 17 | 18 | 32 | 1.1 | 43 | 35 | 16 |
| DEC 11 | 6.7 | 280 | 340 | 100 | 0.03 | 14.01 | 14.04 | 0.05 | 18 | 13 | 56 | 2.2 | 48 | 28 | 16 |
| DEC 12 | 6.9 | 220 | 345 | 100 | ND | 12.74 | 12.74 | ND | 14 | 16 | 33 | 1.1 | 45 | 28 | 16 |
| DEC 17 | 7.1 | 284 | 360 | 128 | ND | 25.91 | 25.91 | ND | 14 | 23 | 28 | 1.1 | 42 | 47 | 15 |
| DEC 18 | 7.2 | 372 | 350 | 120 | 0.06 | 20.28 | 20.34 | ND | 15 | 20 | 25 | 0.9 | 42 | 37 | 14 |
| DEC 19 | 7.2 | 390 | 400 | 128 | 0.04 | 29.73 | 29.77 | ND | 16 | 21 | 22 | 0.9 | 40 | 33 | 14 |
| DEC 20 | 6.7 | 424 | 460 | 158 | 0.06 | 27.34 | 27.40 | ND | 24 | 24 | 32 | 0.9 | 40 | 34 | 12 |
| DEC 22 | 7.2 | 270 | 380 | 132 | 0.04 | 26.34 | 26.38 | ND | 23 | 18 | 31 | 1.5 | 42 | 35 | 14 |
| DEC 24 | 7.2 | 270 | 380 | 170 | 0.06 | 13.55 | 13.61 | ND | 19 | 30 | 23 | 1.1 | 44 | 33 | 13 |
| DEC 28 | 7.7 | 320 | 370 | 170 | ND | 23.84 | 23.84 | ND | 25 | 26 | 30 | 1.1 | 46 | 34 | 14 |
| DEC 31 | 6.4 | 296 | 390 | 128 | 0.05 | 23.30 | 23.35 | ND | 25 | 16 | 30 | 1.1 | 46 | 50 | 12 |
| (1974) | | | | | | | | | | | | | | | |
| JAN 2 | 6.5 | 412 | 380 | 132 | 0.10 | 26.21 | 26.31 | ND | 26 | 16 | 28 | 0.9 | 44 | 27 | 11 |
| JAN 3 | 7.1 | 254 | 395 | 136 | 0.28 | 22.33 | 22.61 | ND | 27 | 17 | 29 | 1.3 | 45 | 33 | 10 |
| JAN 4 | 7.3 | 284 | 380 | 124 | 0.13 | 21.82 | 21.95 | ND | 25 | 15 | 28 | 1.1 | 45 | 35 | 11 |
| JAN 7 | 7.5 | 256 | 360 | 124 | 0.10 | 20.10 | 20.20 | 0.10 | 24 | 16 | 30 | 1.3 | 45 | 35 | 12 |
| JAN 11 | 7.5 | 244 | 345 | 132 | 0.12 | 22.22 | 22.34 | ND | 25 | 17 | 28 | 1.1 | 46 | 36 | 12 |
| JAN 14 | 7.3 | 296 | 430 | 132 | ND | 23.99 | 23.99 | ND | 27 | 16 | 29 | 1.1 | 48 | 23 | 12 |
| JAN 16 | 7.3 | 354 | 450 | 132 | 0.60 | 35.27 | 35.87 | ND | 27 | 16 | 28 | 1.1 | 48 | 24 | 13 |
| JAN 18 | 6.5 | 254 | 450 | 120 | 0.35 | 22.53 | 22.88 | ND | 27 | 13 | 29 | 1.1 | 48 | 26 | 13 |
| JAN 21 | 6.7 | 326 | 445 | 120 | ND | 21.00 | 21.00 | ND | 25 | 14 | 28 | 1.1 | 50 | 26 | 14 |
| APR 19 | -- | 256 | 325 | 96 | ND | 11.74 | 11.75 | 0.039 | 16 | 14 | 20 | 1.3 | 32 | 15 | 7 |
| APR 22 | -- | 186 | 255 | 80 | 0.04 | 10.63 | 10.67 | ND | 13 | 12 | 14 | 1.3 | 24 | 19 | 9 |
| APR 22 | -- | -- | -- | 80 | 0.04 | 11.18 | 11.22 | -- | 18 | 9 | 17 | 1.2 | 26 | -- | 9 |
| APR 25 | -- | 150 | 240 | 84 | 0.06 | 12.71 | 12.77 | 0.062 | 12 | 13 | 14 | 1.3 | 20 | 18 | -- |
| APR 29 | -- | 194 | 250 | 76 | 0.07 | 14.14 | 14.21 | ND | 12 | 11 | 15 | 1.1 | 18 | 17 | 7 |
| APR 30 | 6.3 | -- | -- | 80 | -- | 13.99 | -- | -- | 9 | 8 | 21 | 12 | -- | -- | -- |
| MAY 1 | 6.7 | 186 | 240 | 72 | 0.25 | 12.56 | 12.81 | 0.042 | 11 | 15 | 13 | 0.9 | 20 | 14 | 13 |
| MAY 2 | 6.8 | 186 | 245 | 76 | ND | 12.60 | 12.60 | ND | 14 | 10 | 13 | 13 | 26 | 15 | 8 |
| MAY 3 | -- | 210 | 245 | 80 | ND | 10.41 | 10.41 | ND | 13 | 12 | 13 | 13 | 24 | 17 | 8 |

TABLE B-7--CONTINUED

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N |  |  | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | NH$_3$-N | NO$_2$+ NO$_3$ | TOTAL |  |  |  |  |  |  |  |  |
|  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |
| MAY 6 | 6.7 | 214 | 240 | 76 | 0.02 | 12.52 | 12.54 | ND | 12 | 11 | 13 | 1.1 | 24.0 | 23 | 8 |
| MAY 9 | 6.7 | -- | 360 | 88 | ND | 12.43 | 12.43 | ND | 15 | 12 | 28 | 1.3 | 40.0 | 12 | 7 |
| MAY 10 | 6.9 | -- | 300 | 80 | 0.03 | 9.92 | 9.95 | ND | 14 | 11 | 19 | 1.3 | 40.0 | 13 | - |
| JUL 25 | -- | --- | -- | -- | 0.43 | 22.50 | 22.93 | ND | 33 | -- | -- | 1.6 | -- | -- | 8 |
| JUL 30 | -- | -- | 330 | 110 | ND | 22.00 | 22.00 | 0.011 | 34 | 6 | 20 | 1.2 | 44.2 | -- | 9 |
| JUL 31 | -- | -- | 310 | 112 | ND | 22.50 | 22.50 | 0.010 | 36 | 5 | 21 | 1.2 | 44.7 | -- | 9 |
| AUG 2 | -- | -- | 310 | 114 | ND | 23.00 | 23.00 | 0.033 | 36 | 6 | 24 | 1.2 | 46.4 | -- | 9 |
| AUG 5 | -- | -- | 310 | 106 | ND | 20.50 | 20.50 | 0.005 | 32 | 6 | 22 | 1.2 | 44.2 | -- | 9 |
| AUG 6 | -- | -- | 260 | 102 | ND | 17.00 | 17.00 | 0.010 | 30 | 7 | 19 | 1.2 | 38.4 | -- | 8 |
| AUG 7 | -- | -- | 330 | 108 | ND | 22.00 | 22.00 | 0.010 | 35 | 5 | 25 | 1.4 | 49.8 | -- | 8 |
| AUG 12 | -- | -- | 280 | 110 | ND | 18.50 | 18.50 | 0.005 | 31 | 8 | 21 | 1.2 | 42.4 | -- | 9 |
| AUG 15 | -- | -- | 320 | 104 | ND | 21.50 | 21.50 | 0.006 | 31 | 6 | 26 | 1.4 | 48.5 | -- | -- |
| AUG 16 | -- | -- | 340 | 98 | 0.50 | 18.00 | 18.50 | 0.007 | 26 | 8 | 28 | 1.2 | 51.6 | -- | 9 |
| AUG 21 | -- | -- | 310 | 96 | 0.09 | 16.50 | 16.59 | 0.005 | 28 | 6 | 26 | 1.2 | 47.2 | -- | 9 |
| AUG 22 | -- | -- | 250 | 90 | ND | 15.00 | 15.00 | 0.008 | 30 | 4 | 17 | 1.2 | 38.3 | -- | 9 |
| AUG 23 | -- | -- | -- | -- | -- | 20.50 | 20.50 | -- | -- | -- | -- | -- | -- | -- | 8 |
| AUG 26 | -- | -- | 300 | 97 | 0.02 | 17.50 | 17.52 | 0.006 | 28 | 7 | 25 | 1.2 | 47.2 | -- | 9 |
| AUG 29 | -- | -- | 310 | 97 | 0.02 | 18.00 | 18.02 | 0.003 | 27 | 7 | 26 | 1.2 | 47.2 | -- | 9 |
| SEP 3 | -- | -- | 310 | 93 | 0.06 | 17.50 | 17.56 | 0.003 | 28 | 6 | 27 | 1.2 | 47.7 | -- | 9 |
| SEP 9 | -- | -- | 430 | 132 | ND | 29.00 | 29.00 | 0.009 | 42 | 7 | 37 | 1.8 | 56.9 | -- | 8 |
| SEP 10 | -- | -- | 350 | 110 | ND | 19.50 | 19.50 | 0.007 | 30 | 9 | 29 | 1.3 | 42.5 | -- | 9 |
| SEP 13 | -- | -- | 400 | 120 | ND | 26.50 | 26.50 | 0.012 | 35 | 8 | 35 | 1.6 | 54.0 | -- | 8 |
| SEP 18 | -- | -- | 370 | 106 | ND | 23.00 | 23.00 | 0.006 | 47 | -- | 34 | 1.4 | 48.2 | -- | 8 |
| SEP 19 | -- | -- | 420 | 116 | ND | 27.00 | 27.00 | 0.003 | 43 | 2 | 36 | 1.5 | 49.7 | -- | 9 |
| SEP 20 | -- | -- | 540 | 142 | ND | 35.00 | 35.00 | 0.007 | 42 | 9 | 40 | 2.2 | 50.6 | -- | 8 |
| SEP 23 | -- | -- | 540 | 130 | ND | 38.50 | 38.50 | 0.036 | 43 | 6 | 48 | 2.7 | 54.5 | -- | 8 |
| OCT 5 | -- | -- | 460 | 130 | ND | 31.00 | 31.00 | 0.007 | 36 | 10 | 46 | 2.3 | 54.0 | -- | 8 |
| OCT 9 | -- | -- | 430 | 118 | 0.22 | 27.00 | 27.22 | 0.003 | 35 | 7 | 38 | 2.2 | 47.9 | -- | 8 |
| OCT 10 | -- | -- | 460 | 132 | 0.28 | 32.50 | 32.88 | 0.003 | 36 | 10 | 40 | 2.2 | 50.7 | -- | 2 |
| OCT 14 | -- | -- | 440 | 140 | ND | 35.50 | 35.50 | 0.007 | 38 | 11 | 48 | 2.4 | 54.6 | -- | 8 |
| OCT 16 | -- | -- | 450 | 124 | ND | 30.00 | 30.00 | 0.004 | 38 | 7 | 47 | 2.2 | 51.7 | -- | 9 |
| OCT 17 | -- | -- | 450 | 114 | -- | 30.00 | 30.00 | 0.005 | 38 | 5 | 49 | 2.3 | 51.7 | -- | 9 |
| OCT 21 | -- | -- | 450 | 114 | -- | 27.50 | 27.50 | -- | -- | -- | -- | 0.9 | 47.9 | -- | 9 |
| OCT 28 | -- | -- | 470 | 116 | ND | 27.50 | 27.50 | ND | 30 | 10 | 35 | 1.7 | 50.7 | -- | 9 |
| NOV 4 | -- | -- | 400 | 92 | ND | 24.50 | 24.50 | 0.022 | 30 | 4 | 48 | 2.2 | 50.2 | -- | 9 |
| NOV 7 | -- | -- | 410 | 114 | ND | 24.00 | 24.00 | 0.008 | 31 | 9 | 39 | 1.0 | 48.3 | -- | 9 |
| NOV 18 | -- | -- | 370 | 106 | ND | 25.00 | 25.00 | 0.008 | -- | -- | 34 | 1.3 | 48.4 | -- | 9 |
| NOV 22 | -- | -- | 500 | 114 | ND | 27.50 | 27.50 | -- | 27 | 11 | 45 | 1.3 | 51.3 | -- | 7 |
| NOV 26 | -- | -- | 400 | 118 | ND | 29.00 | 29.00 | 0.013 | 27 | 12 | 38 | 1.2 | 48.3 | -- | 8 |
| DEC 6 | -- | -- | 440 | 116 | -- | 29.00 | -- | -- | 29 | 11 | 40 | 1.4 | 50.2 | -- | 7 |
| (1975) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 13 | -- | -- | -- | 106 | -- | -- | -- | -- | 27 | 10 | 35 | 1.8 | 42.4 | -- | -- |
| JAN 13 | -- | -- | -- | 74 | -- | -- | -- | -- | 17 | 8 | 26 | 2.1 | 30.2 | -- | -- |
| JAN 14 | -- | -- | -- | 84 | -- | -- | -- | -- | 22 | 7 | 27 | 2.1 | 31.1 | -- | -- |
| JAN 15 | -- | -- | -- | 106 | -- | -- | -- | -- | 29 | 8 | 36 | 2.1 | 38.7 | -- | -- |
| JAN 16 | -- | -- | -- | 102 | -- | -- | -- | -- | 26 | 9 | 38 | 1.7 | 41.5 | -- | -- |
| JAN 20 | -- | -- | -- | 104 | -- | -- | -- | ND | 29 | 7 | 35 | 1.4 | 47.1 | -- | -- |
| FEB 1 | -- | -- | -- | 86 | -- | -- | -- | ND | 28 | 4 | 32 | 1.4 | 33.0 | -- | -- |
| FEB 3 | -- | -- | -- | 84 | -- | -- | -- | ND | 28 | 3 | 34 | 1.6 | 29.2 | -- | -- |
| FEB 7 | -- | -- | -- | 88 | -- | -- | -- | ND | 26 | 6 | 30 | 1.4 | 33.0 | -- | -- |

# TABLE B-8. QUALITY CONSTITUENTS OF LYSIMETER D PERCOLATE

| DATE | pH | TDS | COND. @ 25°C μmhos/cm | TOTAL HARD-NESS | NITROGEN as N | | | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $NH_3$-N | $NO_2$+ $NO_3$ | TOTAL | | | | | | | | |
| | | mg/ℓ | | mg/ℓ | | | | | | | | | | | |
| (1973) | | | | | | | | | | | | | | | |
| JUN 15 | 7.5 | -- | 340 | 62 | 0.10 | 17.92 | 18.02 | -- | -- | -- | 34 | 2.3 | 84 | -- | -- |
| JLY 2 | -- | -- | 450 | 101 | -- | 6.56 | -- | 0.041 | -- | -- | 33 | 1.7 | 98 | 6 | 13 |
| JLY 10 | 7.6 | 406 | 480 | 226 | -- | 9.30 | -- | 0.048 | 21 | 42 | 24 | 2.0 | 86 | -- | 18 |
| JLY 12 | 7.3 | 387 | 420 | 206 | -- | 5.22 | -- | 0.026 | 15 | 41 | 24 | 2.3 | 98 | 10 | 15 |
| JLY 24 | 7.7 | 394 | 500 | 187 | 0.53 | 7.63 | 8.16 | 0.051 | 29 | 28 | 31 | 1.8 | 98 | 21 | 13 |
| SEP 5 | 7.1 | 808 | 510 | 390 | 0.26 | 37.09 | 37.35 | 0.13 | 54 | 62 | 34 | 3.0 | 110 | 26 | 15 |
| SEP 19 | 7.2 | -- | -- | 500 | 0.32 | 56.35 | 56.67 | 0.10 | 110 | 54 | 38 | 2.7 | 130 | 27 | 21 |
| OCT 4 | 7.1 | 966 | 655 | 480 | 1.20 | 48.96 | 50.16 | 0.05 | -- | -- | 43 | 3.4 | 115 | 24 | -- |
| OCT 11 | 7.3 | 1046 | 700 | 528 | ND | 44.49 | 44.49 | 0.02 | 60 | 92 | 47 | 3.6 | 123 | 19 | 5 |
| OCT 15 | 7.2 | 1060 | 940 | 640 | 0.95 | 59.71 | 60.66 | 0.08 | 97 | 97 | 50 | 4.4 | 143 | 23 | 55 |
| OCT 17 | 6.8 | 958 | 800 | 610 | ND | 57.06 | 57.06 | 0.05 | 102 | 86 | 44 | 2.4 | 135 | 13 | 9 |
| OCT 18 | 7.1 | 316 | 740 | 568 | ND | 36.58 | 36.58 | 0.03 | 60 | 102 | 41 | 2.3 | 138 | 12 | 25 |
| OCT 19 | 7.5 | 862 | 580 | 490 | 0.56 | 31.91 | 32.47 | 0.05 | 70 | 77 | 35 | 1.4 | 123 | 11 | ND |
| OCT 25 | 7.8 | 754 | 640 | 420 | ND | 9.19 | 9.19 | 0.01 | 54 | 69 | 35 | 1.0 | 113 | 12 | 1 |
| NOV 7 | 7.3 | 714 | 580 | 392 | ND | 19.89 | 19.89 | 0.02 | 60 | 59 | 21 | 0.9 | 100 | 10 | 1 |
| NOV 9 | 7.4 | 696 | 565 | 388 | ND | 17.84 | 17.84 | 0.03 | 60 | 58 | 27 | 0.9 | 113 | 10 | 9 |
| NOV 12 | 7.6 | 550 | 640 | 380 | ND | 11.03 | 11.03 | 0.18 | 52 | 61 | 27 | 1.8 | 113 | 12 | 10 |
| NOV 14 | 7.7 | 606 | 645 | 356 | ND | 8.64 | 8.64 | 0.13 | 76 | 41 | -- | -- | 108 | 11 | 10 |
| NOV 16 | 7.7 | 552 | 620 | 336 | ND | 7.46 | 7.46 | 0.13 | 55 | 48 | 27 | 0.9 | 105 | 15 | 4 |
| NOV 19 | 8.0 | 576 | -- | 276 | ND | 5.00 | 5.00 | 0.20 | -- | -- | -- | -- | 108 | 13 | 5 |
| DEC 3 | 7.4 | 428 | 490 | 308 | ND | 1.37 | 1.37 | 0.16 | 79 | 27 | 36 | 1.3 | 95 | 11 | 1 |
| DEC 6 | 7.6 | 410 | 480 | 288 | ND | 0.68 | 0.68 | 0.14 | 84 | 19 | 33 | 1.0 | 98 | 10 | 6 |
| DEC 21 | 7.4 | 348 | 410 | 292 | ND | 1.56 | 1.56 | 0.12 | 84 | 20 | 28 | 1.0 | -- | 12 | 1 |
| DEC 24 | 7.5 | 414 | 420 | 292 | ND | 0.56 | 0.56 | 0.10 | 73 | 27 | 30 | 1.0 | -- | 9 | 1 |
| DEC 28 | 7.6 | 70 | 385 | 288 | 0.99 | 0.11 | 1.10 | ND | 85 | 18 | 32 | 0.7 | 82 | 8 | ND |
| DEC 31 | 7.8 | 342 | 440 | 296 | 0.99 | 0.12 | 1.11 | ND | 75 | 26 | 27 | 1.1 | 76 | 7 | ND |
| (1974) | | | | | | | | | | | | | | | |
| JAN 2 | 7.7 | 330 | 410 | 288 | 0.87 | 0.24 | 1.11 | ND | 78 | 23 | 24 | 0.5 | 66 | 7 | 8 |
| JAN 3 | 7.4 | 394 | 495 | 288 | 0.83 | 0.09 | 0.92 | ND | 79 | 22 | 24 | 0.5 | 68 | 17 | 9 |
| JAN 4 | 7.5 | 250 | 480 | 280 | 0.83 | 0.04 | 0.87 | ND | 80 | 20 | 23 | 0.5 | 62 | 6 | 17 |
| JAN 7 | 7.4 | 360 | 630 | 272 | 0.75 | 0.03 | 0.78 | 0.33 | 72 | 22 | 24 | 0.5 | 68 | 6 | 17 |
| JAN 11 | 7.6 | 280 | 630 | 288 | 0.71 | 0.02 | 0.73 | 0.15 | 73 | 26 | 24 | 0.5 | 68 | 7 | 2 |
| JAN 14 | 7.4 | 314 | 630 | 260 | 0.81 | 0.02 | 0.83 | ND | 75 | 18 | 24 | 0.5 | 60 | 6 | 2 |
| JAN 16 | 7.3 | 318 | 580 | 248 | 0.64 | 0.01 | 0.65 | ND | 79 | 12 | 22 | 0.4 | 50 | 6 | 1 |
| JAN 21 | 7.2 | 224 | 590 | 248 | 0.62 | 0.01 | 0.63 | ND | 83 | 10 | 23 | 0.4 | 56 | 7 | 1 |
| JAN 22 | 7.6 | 282 | 560 | 240 | 0.47 | 0.02 | 0.49 | ND | 69 | 16 | 22 | 0.4 | 46 | 7 | 1 |
| JAN 31 | 7.9 | 250 | 550 | 244 | 0.46 | 0.04 | 0.50 | ND | 73 | 15 | 23 | 0.5 | 50 | 8 | ND |
| FEB 4 | 7.1 | -- | 535 | 236 | 0.40 | 0.02 | 0.42 | ND | 56 | 23 | 19 | 0.5 | 38 | 6 | ND |
| FEB 11 | 7.5 | -- | 520 | 240 | 0.23 | 0.02 | 0.25 | ND | 58 | 23 | 23 | 0.5 | 40 | 8 | ND |
| FEB 27 | 7.4 | -- | 550 | 260 | 0.59 | 0.02 | 0.61 | -- | 70 | 21 | 21 | 0.7 | 38 | 9 | ND |
| MAR 8 | 7.8 | -- | 530 | 244 | ND | 0.02 | 0.02 | ND | 68 | 18 | 20 | 0.4 | 38 | 8 | ND |
| MAR 14 | 7.6 | -- | 540 | 240 | ND | 0.01 | 0.01 | ND | 69 | 16 | 20 | 0.4 | 34 | 7 | 52 |
| MAR 20 | 7.7 | 336 | 480 | 240 | 0.40 | 0.01 | 0.41 | ND | 70 | 16 | 21 | 0.4 | -- | 9 | 6 |
| MAR 21 | 7.7 | 312 | 500 | 240 | 0.32 | 0.01 | 0.33 | ND | 70 | 16 | 18 | 0.4 | -- | 7 | ND |
| APR 5 | 7.2 | 324 | 540 | 256 | 0.14 | 0.60 | 0.74 | 0.01 | 71 | 19 | 15 | 0.5 | 34 | 8 | 1 |

TABLE B-8--CONTINUED

| DATE | pH | TDS | COND. @ 25°C μmhos/ cm | TOTAL HARD-NESS | NITROGEN as N | | | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $NH_3$-N | $NO_2$+ $NO_3$ | TOTAL | | | | | | | | |
| | | mg/ℓ | | | | | | | mg/ℓ | | | | | | |
| (1974) | | | | | | | | | | | | | | | |
| APR 11 | 7.4 | 322 | 550 | 256 | ND | 0.03 | 0.03 | 0.01 | 74 | 17 | 15 | 0.5 | 34 | 7 | 1 |
| APR 22 | 8.1 | 314 | 520 | 252 | ND | 0.02 | 0.02 | ND | 70 | 19 | 18 | 0.6 | 28 | 8 | 1 |
| APR 25 | 7.9 | 312 | 500 | 244 | ND | 0.02 | 0.02 | ND | 64 | 20 | 18 | 0.6 | -- | -- | 2 |
| MAY 9 | 6.9 | 176 | 290 | 120 | -- | 0.01 | -- | 0.023 | 27 | 13 | 12 | 2.7 | -- | -- | 2 |
| MAY 10 | 7.3 | 230 | 315 | 176 | 0.15 | ND | 0.15 | 0.016 | 40 | 19 | 13 | 1.5 | 26 | 10 | 3 |
| MAY 20 | 7.2 | 266 | 432 | 200 | 0.06 | ND | 0.06 | 0.016 | 46 | 10 | 18 | 1.3 | 26 | 10 | 1 |
| MAY 25 | 7.4 | 230 | 440 | 208 | 0.16 | 0.02 | 0.18 | 0.016 | 46 | 11 | 18 | 1.3 | 24 | -- | 2 |
| JUN 3 | 7.7 | 308 | 530 | 256 | 0.02 | 0.03 | 0.05 | 0.016 | 60 | 26 | 19 | 0.9 | 32 | 9 | 1 |
| JUN 20 | 7.6 | 310 | 540 | 248 | 0.18 | 0.07 | 0.25 | 0.016 | 60 | 24 | 19 | 0.9 | -- | 10 | 1 |
| JUN 26 | 6.8 | 312 | 530 | 264 | ND | ND | ND | 0.016 | 62 | 27 | 19 | 0.9 | -- | -- | 3 |
| JLY 2 | 6.6 | 370 | 550 | 272 | 0.14 | 0.03 | 0.17 | 0.023 | 60 | 30 | 19 | 0.8 | -- | 11 | 2 |
| JLY 10 | 6.7 | 360 | 520 | 268 | 0.16 | 0.04 | 0.20 | 0.020 | 58 | 30 | 17 | 1.1 | -- | 11 | 3 |
| JLY 18 | -- | -- | -- | -- | -- | 0.03 | -- | -- | -- | -- | -- | -- | -- | 11 | -- |
| AUG 2 | 7.8 | -- | 460 | 258 | 0.11 | 0.06 | 0.17 | 0.019 | 98 | 3.2 | 18 | 1.0 | 26 | 10 | -- |
| AUG 14 | -- | -- | 440 | 234 | ND | 0.02 | 0.02 | 0.012 | 90 | 2.2 | 17 | 1.0 | 25 | 10 | -- |
| AUG 15 | -- | -- | 440 | 244 | ND | 0.02 | 0.02 | 0.007 | 86 | 7.0 | 17 | 1.0 | 21 | 10 | -- |
| AUG 16 | -- | -- | 450 | 240 | ND | 0.01 | 0.01 | 0.010 | 90 | 3.6 | 16 | 1.0 | 24 | 10 | -- |
| AUG 30 | -- | -- | 490 | 268 | 1.30 | 0.06 | 1.36 | 0.027 | 98 | 5.6 | 20 | 1.0 | 24 | 10 | -- |
| SEP 4 | -- | -- | 540 | 272 | 0.08 | 0.05 | 0.13 | 0.106 | 100 | 5.3 | 20 | 2.1 | 25 | 10 | -- |
| SEP 9 | -- | -- | 540 | 270 | 0.05 | 0.14 | 0.19 | 0.058 | 97 | 6.7 | 20 | 1.8 | 24 | 9 | -- |
| SEP 10 | -- | -- | 520 | 268 | ND | 0.15 | 0.15 | 0.008 | 100 | 4.4 | 21 | 0.7 | 23 | 10 | -- |
| SEP 20 | -- | -- | 560 | 270 | ND | 0.02 | 0.02 | 0.014 | 100 | 4.9 | 19 | 0.9 | 28 | 9 | -- |
| SEP 23 | -- | -- | 520 | 244 | ND | 0.01 | 0.01 | 0.007 | 96 | 1.0 | 20 | 0.6 | 28 | 7 | -- |
| OCT 4 | -- | -- | 550 | 264 | 0.16 | 0.26 | 0.42 | 0.001 | 96 | 5.9 | 16 | 1.3 | 27 | 8 | -- |
| OCT 29 | -- | -- | 500 | 266 | 0.16 | 0.10 | 0.26 | ND | 98 | 5.1 | 17 | 2.5 | 24 | 10 | -- |
| NOV 11 | -- | -- | 600 | 268 | ND | 0.04 | 0.04 | 0.022 | 80 | 16.5 | 17 | 0.8 | 25 | 10 | -- |
| NOV 27 | -- | -- | 510 | 256 | ND | 0.02 | 0.02 | -- | 78 | 14.8 | 22 | 1.0 | 24 | 9 | -- |
| (1975) | | | | | | | | | | | | | | | |
| JAN 14 | -- | -- | -- | 210 | -- | -- | -- | -- | 62 | 13.4 | 17 | 1.8 | 35 | -- | -- |
| JAN 14 | -- | -- | -- | 220 | -- | -- | -- | -- | 64 | 14.6 | 18 | 1.8 | 34 | -- | -- |
| JAN 15 | -- | -- | -- | 230 | -- | -- | -- | -- | 66 | 15.8 | 17 | 1.3 | 33 | -- | -- |
| FEB 7 | -- | -- | -- | 120 | -- | -- | -- | -- | 48 | -- | 12 | 4.7 | 30 | -- | -- |
| FEB 11 | -- | -- | -- | 188 | -- | -- | -- | -- | 67 | 5.0 | 15 | 2.0 | 30 | -- | -- |

## TABLE B-9. QUALITY CONSTITUENTS OF LYSIMETER E PERCOLATE

| DATE | pH | TDS<br>mg/ℓ | COND. @ 25°C µmhos/ cm | TOTAL HARD- NESS | NITROGEN as N<br>$NH_3$-N | <br>$NO_2$+ $NO_3$ | <br>TOTAL | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JUN 14 | 7.4 | -- | 350 | 158 | 0.25 | 21.00 | 21.25 | -- | -- | -- | 41 | 8.0 | 70 | -- | -- |
| JLY 2 | -- | 374 | 440 | 187 | -- | 6.59 | -- | 0.033 | -- | -- | 33 | 1.7 | 86 | 14 | 14 |
| JLY 10 | 7.2 | -- | 470 | 254 | -- | 12.04 | 12.04 | 0.048 | 20 | 50 | 31 | 2.0 | 83 | 10 | 17 |
| JLY 12 | 7.4 | 453 | 420 | 259 | -- | 4.22 | -- | 0.024 | 33 | 43 | 29 | 2.0 | 91 | 10 | -- |
| JLY 24 | 7.4 | 538 | 580 | 269 | 1.39 | 7.31 | 8.70 | 0.047 | 44 | 39 | 34 | 1.5 | 83 | 14 | 11 |
| JLY 25 | 7.1 | -- | -- | 326 | 0.12 | 9.56 | 9.68 | 0.08 | 72 | 36 | 32 | 1.8 | 93 | 12 | 16 |
| JLY 26 | 7.4 | 722 | -- | 302 | 0.09 | 8.46 | 8.55 | 0.05 | 61 | 36 | 31 | 1.5 | 122 | 8 | 15 |
| JLY 31 | 7.3 | 650 | 460 | 300 | 0.04 | 7.16 | 7.20 | 0.06 | 42 | 48 | 46 | 3.8 | 112 | 11 | 15 |
| AUG 3 | 7.1 | 730 | 510 | 275 | 0.09 | 15.56 | 15.65 | 0.03 | 72 | 23 | 30 | 1.5 | 112 | 9 | 13 |
| AUG 6 | 7.1 | 610 | 500 | 315 | 0.09 | 14.80 | 14.89 | -- | 68 | 35 | 30 | 1.5 | 130 | 9 | 14 |
| AUG 7 | 7.6 | 642 | 490 | 245 | -- | 7.72 | -- | 0.04 | 33 | 40 | 29 | 2.2 | 120 | 8 | 14 |
| AUG 8 | 7.1 | 802 | 530 | 345 | 0.17 | 7.92 | 8.09 | 0.05 | 79 | 36 | 29 | 1.5 | 139 | 8 | 14 |
| AUG 13 | 7.0 | 630 | -- | 275 | 0.41 | 10.72 | 11.13 | 0.09 | 42 | 41 | 26 | 2.2 | -- | 8 | 14 |
| AUG 14 | -- | 726 | 412 | 330 | 0.63 | -- | -- | 0.04 | -- | -- | -- | -- | 132 | 8 | 11 |
| AUG 22 | 7.3 | 716 | 550 | 320 | 0.12 | 21.48 | 21.60 | -- | 54 | 45 | 26 | 2.0 | 155 | -- | 16 |
| AUG 23 | 7.3 | 762 | 540 | 315 | 0.12 | 8.83 | 8.95 | -- | 50 | 46 | 26 | 2.0 | 155 | -- | 17 |
| SEP 5 | 7.6 | 746 | 580 | 385 | 0.53 | 21.20 | 21.73 | 0.05 | 60 | 57 | 37 | 2.0 | 118 | 13 | 17 |
| SEP 12 | 7.2 | 652 | 620 | 380 | 0.33 | 18.58 | 18.91 | 0.03 | 84 | 41 | 34 | 1.2 | 100 | 14 | 12 |
| OCT 4 | 7.6 | 806 | 545 | 430 | 0.75 | 25.18 | 25.93 | 0.03 | 92 | 49 | 37 | 1.4 | 95 | 13 | 6 |
| OCT 11 | 6.8 | 610 | 740 | 384 | ND | 20.99 | 20.99 | 0.03 | 55 | 60 | 36 | 1.8 | 103 | 13 | 9 |
| OCT 15 | 7.6 | 522 | 580 | 380 | 0.30 | 26.29 | 26.59 | 0.05 | 54 | 60 | 44 | 1.4 | 95 | 13 | 9 |
| OCT 17 | 6.8 | 598 | 600 | 378 | 0.55 | 27.81 | 28.36 | 0.03 | 54 | 59 | 44 | 2.1 | 85 | 11 | 6 |
| OCT 18 | 7.7 | 680 | -- | 328 | ND | 19.07 | 19.07 | 0.01 | 55 | 47 | 35 | 1.5 | 115 | 12 | 8 |
| OCT 19 | 7.5 | 748 | 560 | 380 | 0.35 | 20.71 | 21.06 | 0.03 | 54 | 60 | 36 | 2.1 | 110 | 12 | 2 |
| OCT 25 | 7.7 | 760 | 560 | 350 | ND | 21.31 | 21.31 | 0.01 | 53 | 53 | 38 | 2.1 | 95 | 12 | 8 |
| NOV 7 | 6.8 | 558 | 555 | 320 | ND | 18.41 | 18.41 | 0.02 | 60 | 42 | 47 | 1.5 | 75 | 10 | 12 |
| NOV 9 | 7.1 | 578 | 640 | 348 | ND | 26.25 | 26.25 | 0.02 | 51 | 54 | 57 | 2.3 | 98 | 13 | 14 |
| NOV 12 | 7.3 | 676 | 640 | 344 | ND | 17.84 | 17.84 | 0.13 | 60 | 47 | 34 | 1.5 | 108 | 12 | 13 |
| NOV 14 | 7.2 | 654 | 720 | 356 | ND | 26.25 | 26.25 | 0.08 | 50 | 56 | 39 | 1.4 | 100 | 12 | 13 |
| NOV 16 | 7.2 | 590 | 580 | 364 | ND | 19.99 | 19.99 | 0.11 | 55 | 55 | 36 | 1.5 | 108 | 11 | 9 |
| NOV 19 | 7.6 | 666 | 600 | 364 | ND | 13.50 | 13.50 | 0.03 | 55 | 55 | 39 | 1.8 | 103 | 12 | 13 |
| DEC 3 | 7.4 | -- | -- | -- | ND | 18.90 | 18.90 | 0.26 | -- | -- | -- | -- | 150 | 14 | 77 |
| DEC 6 | 7.4 | 666 | 660 | 328 | ND | 14.99 | 14.99 | 0.12 | 76 | 34 | 40 | 2.0 | 113 | 13 | 18 |
| DEC 21 | 7.3 | 580 | 620 | 312 | ND | 23.48 | 23.48 | 0.13 | 68 | 35 | 56 | 1.3 | 74 | 10 | 16 |
| DEC 24 | 7.2 | 614 | 640 | 312 | ND | 7.82 | 7.82 | 0.13 | 76 | 30 | 48 | 1.5 | 92 | 12 | 11 |
| DEC 28 | 7.9 | 550 | 610 | 312 | 0.90 | 20.38 | 21.28 | ND | 75 | 30 | 44 | 1.5 | 98 | 11 | 9 |
| DEC 31 | 7.8 | 520 | 660 | 332 | 1.06 | 21.00 | 22.06 | ND | 75 | 35 | 47 | 1.3 | 92 | 10 | 7 |
| (1974) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 2 | 7.5 | 560 | 660 | 352 | 0.89 | 23.10 | 23.99 | ND | 80 | 37 | 45 | 1.1 | 78 | 9 | 16 |
| JAN 3 | 7.6 | 534 | 650 | 336 | 1.26 | 21.27 | 22.53 | ND | 78 | 34 | 44 | 1.3 | 86 | 10 | 14 |
| JAN 4 | 7.4 | 530 | 680 | 332 | 1.22 | 18.23 | 19.45 | ND | 89 | 27 | 43 | 1.3 | 94 | 8 | 14 |
| JAN 7 | 7.5 | -- | 800 | 304 | 1.30 | 16.56 | 17.86 | ND | 86 | 22 | 40 | 1.3 | 88 | 9 | 16 |
| JAN 11 | 7.6 | 500 | 840 | 320 | 1.26 | 21.11 | 22.37 | ND | 88 | 24 | 44 | 1.3 | 82 | 9 | 7 |
| JAN 14 | 7.4 | 450 | 820 | 304 | 0.76 | 13.68 | 14.44 | ND | 84 | 23 | 45 | 1.1 | 76 | 8 | 9 |
| JAN 16 | 7.3 | 330 | 800 | 296 | 0.79 | 10.88 | 11.67 | ND | 79 | 24 | 41 | 1.1 | 74 | 9 | 8 |
| JAN 21 | 7.6 | 392 | 780 | 312 | 0.86 | 7.98 | 8.84 | ND | 91 | 21 | 41 | 1.1 | 76 | 9 | 11 |
| JAN 22 | 7.7 | 436 | 750 | 300 | 0.77 | 10.26 | 11.03 | ND | 85 | 21 | 44 | 1.5 | 74 | 10 | 4 |
| JAN 31 | 7.7 | 450 | 710 | 280 | 0.08 | 8.26 | 8.34 | ND | 63 | 30 | 44 | 1.1 | 58 | 11 | 9 |
| FEB 4 | 7.2 | 402 | 720 | 256 | 0.27 | 7.85 | 8.12 | ND | 48 | 33 | 48 | 0.5 | 58 | 9 | 7 |

## TABLE B-9--CONTINUED

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARD-NESS | NITROGEN as N | | | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $NH_3$-N | $NO_2$+ $NO_3$ | TOTAL | | | | | | | | |
| | | | | | | | | | mg/ℓ | | | | | | |
| (1974) | | | | | | | | | | | | | | | |
| FEB 11 | 7.7 | -- | 680 | 256 | 0.11 | 3.91 | 4.02 | ND | 60 | 26 | 47 | 1.1 | 60 | 10 | 6 |
| FEB 27 | 7.2 | -- | 630 | 244 | 0.52 | 1.14 | 1.66 | ND | 69 | 17 | 45 | 0.9 | 44 | 9 | 11 |
| MAR 8 | 7.7 | -- | 700 | 264 | ND | 0.99 | 0.99 | ND | 74 | 19 | 39 | 0.9 | 70 | 9 | 7 |
| MAR 14 | 7.6 | -- | 680 | 252 | ND | 0.50 | 0.50 | ND | 74 | 16 | 42 | 0.8 | 56 | 8 | 9 |
| MAR 20 | 7.5 | 410 | 690 | 260 | 0.55 | 0.51 | 1.06 | ND | 74 | 18 | 41 | 0.9 | 58 | 9 | 13 |
| MAR 21 | 7.6 | 428 | 670 | 264 | 0.79 | 0.57 | 1.36 | ND | 76 | 18 | 38 | 1.6 | 64 | 9 | 13 |
| APR 5 | 7.0 | 380 | 680 | 272 | 0.64 | 0.13 | 0.77 | 0.01 | 76 | 20 | 46 | 0.9 | 40 | 9 | 10 |
| APR 11 | 7.4 | 394 | 670 | 280 | ND | 0.46 | 0.46 | ND | 78 | 21 | 46 | 1.0 | 52 | 9 | 9 |
| APR 22 | 7.4 | 426 | 710 | 280 | ND | 0.25 | 0.25 | 0.01 | 79 | 20 | 47 | 1.0 | 42 | 10 | 7 |
| APR 25 | 7.6 | 400 | 650 | 284 | ND | 0.37 | 0.37 | ND | 79 | 21 | 44 | 1.0 | -- | -- | 9 |
| MAY 9 | 7.3 | 360 | 580 | 224 | -- | 0.77 | -- | 0.004 | 63 | 16 | 43 | 1.0 | -- | -- | -- |
| MAY 10 | 7.5 | 400 | 680 | 280 | 0.24 | 0.29 | 0.53 | 0.016 | 72 | 24 | 50 | 1.3 | 38 | 12 | 13 |
| MAY 20 | 7.2 | 416 | 700 | 288 | 0.12 | 0.35 | 0.47 | 0.010 | 67 | 29 | 47 | 1.3 | 44 | 12 | 13 |
| JUN 3 | 7.2 | 380 | 670 | 272 | 0.11 | 1.92 | 2.03 | ND | 62 | 28 | 48 | 1.3 | 40 | 11 | 11 |
| JUN 15 | 6.9 | -- | -- | -- | -- | 1.56 | -- | -- | -- | -- | -- | -- | -- | 42 | -- |
| JUN 20 | 7.4 | 388 | 690 | 240 | 0.05 | 1.45 | 1.50 | ND | 62 | 21 | 52 | 1.3 | -- | 11 | 15 |
| JUN 26 | 7.1 | 354 | 600 | 236 | ND | -- | ND | ND | 26 | 42 | 52 | 1.3 | -- | -- | 9 |
| JLY 2 | 6.7 | 446 | 660 | 248 | 0.10 | 2.64 | 2.74 | 0.023 | 62 | 23 | 56 | 1.1 | -- | 10 | 13 |
| JLY 15 | 6.9 | 384 | -- | 272 | 0.17 | 1.52 | 1.69 | 0.026 | 62 | 28 | 56 | 1.1 | -- | -- | 14 |
| JLY 18 | -- | -- | -- | -- | -- | 0.72 | -- | -- | -- | -- | -- | -- | -- | 12 | -- |
| AUG 4 | -- | -- | 580 | 240 | ND | 0.93 | 0.93 | 0.003 | 94 | 1.2 | 47 | 1.2 | 16 | 13 | -- |
| AUG 14 | -- | -- | -- | 260 | 0.31 | 0.98 | 1.29 | 0.002 | 86 | 10.9 | 54 | 1.2 | -- | 12 | -- |
| AUG 15 | -- | -- | 580 | 260 | ND | 0.44 | 0.44 | 0.003 | 82 | 13.4 | 55 | 1.2 | 53 | 13 | -- |
| AUG 16 | -- | -- | 680 | 290 | ND | 0.24 | 0.24 | 0.002 | 98 | 10.9 | 49 | 1.2 | 6 | 13 | -- |
| AUG 30 | -- | -- | 650 | 282 | 0.33 | 0.45 | 0.78 | 0.006 | 98 | 9.0 | 58 | 1.2 | 16 | 12 | -- |
| SEP 9 | -- | -- | 690 | 244 | 0.07 | 0.24 | 0.31 | 0.036 | 90 | 4.6 | 50 | 1.3 | 55 | 12 | -- |
| SEP 10 | -- | -- | 680 | 256 | ND | 0.90 | 0.90 | 0.007 | 90 | 7.5 | 56 | 1.3 | 60 | 10 | -- |
| SEP 20 | -- | -- | 600 | 260 | ND | 1.00 | 1.00 | 0.006 | 91 | 7.9 | 39 | 2.2 | 58 | 10 | -- |
| SEP 23 | -- | -- | 650 | 254 | ND | 0.14 | 0.14 | 0.019 | 92 | 5.8 | 55 | 1.1 | 59 | 10 | -- |
| OCT 4 | -- | -- | 680 | 248 | 0.07 | 0.63 | 0.70 | ND | 92 | 4.4 | 60 | 1.5 | 84 | 9 | -- |
| OCT 29 | -- | -- | 660 | 254 | 0.16 | 0.56 | 0.72 | ND | 92 | 5.9 | 48 | 1.7 | 51 | 10 | -- |
| NOV 11 | -- | -- | 660 | 204 | -- | 4.40 | -- | 0.040 | 60 | 13.1 | 56 | 1.3 | -- | 10 | -- |
| NOV 27 | -- | -- | 620 | 236 | ND | 1.00 | 1.00 | -- | 74 | 12.6 | 55 | 1.0 | 70 | 10 | -- |
| (1975) | | | | | | | | | | | | | | | |
| JAN 14 | -- | -- | -- | 182 | -- | -- | -- | -- | 60 | 7.8 | 63 | 1.4 | 65 | -- | -- |
| JAN 14 | -- | -- | -- | 180 | -- | -- | -- | -- | 59 | 7.9 | 63 | 2.8 | 67 | -- | -- |
| JAN 15 | -- | -- | -- | 170 | -- | -- | -- | -- | 50 | 10.9 | 54 | 1.0 | 70 | -- | -- |
| FEB 5 | -- | -- | -- | 128 | -- | -- | -- | 0.010 | 43 | 5.0 | 38 | 0.9 | 31 | -- | -- |
| FEB 7 | -- | -- | -- | 180 | -- | -- | -- | ND | 67 | 3.0 | 50 | 0.9 | 52 | -- | -- |
| FEB 11 | -- | -- | -- | 164 | -- | -- | -- | ND | 62 | 2.2 | 51 | 0.9 | 61 | -- | -- |

## TABLE B-10. WAIAHOLE DITCH IRRIGATION WATER QUALITY

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N KJELDAHL | NITROGEN as N $NO_2$+$NO_3$ | NITROGEN as N TOTAL | TOTAL P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | TOTAL COLIFORMS no./100mℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AREA ADJACENT TO OSC SUGARCANE FIELD NO. 240 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (1972) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JUN 7 | 8.3 | -- | 84 | -- | -- | -- | 1.5 | 0.10 | 0.03 | 0.13 | -- | -- | -- | 9.5 | 0.6 | 13 | 3 | 23 | 0.02 | -- | -- |
| JUL 6 | 8.6 | -- | 91 | 28 | -- | -- | 3.0 | 0.80 | 0.30 | 1.10 | -- | 5 | 4 | 7.5 | 0.5 | 48 | 5 | 22 | 0.10 | 12.6 | -- |
| JUL 27 | 8.3 | 86 | 116 | 30 | 84 | 1.1 | 3.5 | 0.09 | 0.02 | 0.11 | 0.06 | 7 | 3 | 10.0 | 0.7 | 14 | 10 | 25 | -- | -- | -- |
| AUG 17 | 6.9 | -- | 100 | 30 | -- | -- | 3.5 | 0.38 | 0.02 | 0.40 | 0.08 | 5 | 4 | 9.5 | 0.6 | 15 | 6 | 25 | -- | -- | -- |
| AUG 17 | 8.5 | -- | 90 | 31 | -- | -- | 3.0 | 0.10 | 0.09 | 0.19 | -- | 5 | 4 | 7.0 | 0.6 | 14 | 6 | 25 | -- | -- | -- |
| SEP 21 | 8.3 | -- | 98 | 36 | -- | -- | 1.0 | 0.06 | 0.04 | 0.10 | -- | 6 | 5 | 8.0 | 0.6 | 12 | 3 | 23 | -- | -- | -- |
| OCT 12 | 8.0 | 102 | 100 | 29 | 12 | 1.4 | 2.0 | 0.01 | 0.01 | 0.02 | 0.10 | 5 | 4 | 9.0 | 0.5 | 12 | 6 | 18 | -- | -- | -- |
| NOV 16 | 8.2 | -- | 95 | 31 | -- | -- | 1.5 | 0.01 | 0.12 | 0.13 | -- | 6 | 4 | 10.0 | 0.5 | 12 | 5 | 26 | -- | -- | -- |
| DEC 7 | 8.1 | -- | 90 | 30 | -- | -- | 2.0 | 0.02 | 0.02 | 0.04 | -- | 5 | 4 | 7.0 | 0.5 | 14 | 2 | 29 | -- | -- | -- |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JAN 26 | 8.3 | -- | 90 | 22 | -- | -- | 1.0 | 0.11 | 0.09 | 0.20 | -- | 5 | 2.3 | 8.0 | 0.8 | 12 | 2 | 28 | -- | -- | -- |
| MAR 1 | 8.2 | -- | 100 | 36 | -- | -- | 1.0 | 0.10 | 0.14 | 0.24 | -- | 6 | 5.1 | 9.0 | 0.6 | 12 | 3 | 27 | -- | -- | -- |
| APR 5 | 8.6 | 242 | 100 | 48 | 200 | <1.0 | 1.0 | 0.08 | 0.01 | 0.09 | 0.10 | 8 | 6.8 | 7.0 | 0.4 | 12 | 4 | 24 | -- | -- | -- |
| MAY 10 | 8.8 | -- | 100 | -- | -- | -- | -- | 0.05 | 0.003 | 0.05 | -- | -- | -- | 6.5 | 0.8 | -- | -- | -- | -- | -- | -- |
| AREA ADJACENT TO OSC SUGARCANE FIELD NO. 246 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FEB 15 | 8.0 | -- | 105 | 45 | -- | -- | 1.0 | 0.10 | 0.03 | 0.13 | -- | 7 | 6.7 | 10.0 | 0.5 | 12 | 4 | 23 | -- | -- | -- |
| FEB 27 | 7.7 | -- | 100 | 48 | -- | -- | 1.0 | 0.10 | 0.14 | 0.24 | -- | 7 | 7.4 | 9.0 | 0.7 | 12 | 4 | 24 | -- | -- | -- |
| MAR 14 | 7.6 | -- | 100 | 45 | -- | -- | 2.0 | 0.12 | 0.12 | 0.24 | -- | 7 | 6.7 | 10.0 | 0.7 | 11 | 3 | 23 | -- | -- | -- |
| APR 4 | 6.7 | 242 | 95 | 48 | 200 | <1.0 | 2.0 | 0.12 | 0.03 | 0.15 | 0.10 | 8 | 6.8 | 7.0 | 0.6 | 12 | 4 | 24 | -- | -- | -- |
| MAY 2 | 8.7 | -- | 95 | 20 | -- | -- | -- | 0.006 | 0.10 | 0.11 | -- | 3 | 3.1 | 6.0 | 1.1 | 15 | 3 | 25 | -- | -- | -- |
| MAY 3 | 8.7 | 75 | 100 | 21 | 15 | 1.1 | -- | -- | 0.05 | -- | 0.04 | 4 | 2.7 | 5.5 | 0.8 | 15 | 5 | 25 | -- | -- | -- |
| MAY 16 | 8.4 | -- | 105 | 29 | -- | -- | -- | 0.05 | 0.003 | 0.05 | -- | 3 | 5.2 | 6.5 | 0.7 | 15 | 5 | 21 | -- | -- | -- |
| MAY 17 | 8.8 | -- | 100 | 29 | -- | -- | -- | -- | 0.002 | -- | -- | 3 | 5.2 | 6.0 | 0.6 | 15 | 4 | 20 | -- | -- | -- |
| MAY 31 | 9.0 | 142 | 100 | 38 | 44 | 1.7 | -- | -- | -- | -- | 0.07 | 6 | -- | 6.5 | 0.6 | 15 | 5 | 22 | -- | -- | -- |

TABLE B-10--CONTINUED

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | $BOD_5$ | TOC | NITROGEN as N KJELDAHL | NITROGEN as N $NO_2$+$NO_3$ | NITROGEN as N TOTAL | $PO_4$-P | Ca | $Mg^x$ | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | TOTAL COLIFORMS no./100mℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| JUN 12 | 8.6 | -- | 96 | 34 | -- | -- | 1.0 | -- | 0.05 | -- | -- | 4 | 5.8 | 7 | 1.2 | 12 | -- | 27 | -- | -- | 10 |
| JUN 26 | 8.9 | 115 | 100 | 34 | -- | -- | 1.0 | -- | 0.02 | -- | -- | 12 | -- | -- | -- | 22 | 8 | 26 | -- | -- | -- |
| JUL 9 | 7.9 | 100 | 80 | 34 | -- | -- | -- | -- | 0.02 | -- | 0.02 | 10 | -- | 7 | 12.2 | 25 | 7.4 | 19 | -- | -- | -- |
| JUL 23 | 7.7 | 116 | 104 | 19 | -- | -- | -- | -- | 0.09 | -- | 0.21 | 6 | -- | 9 | 0.7 | 17 | 7.2 | 13 | -- | -- | -- |
| JUL 24 | 8.5 | 104 | 92 | 10 | -- | -- | -- | -- | 0.04 | -- | 0.15 | 4 | -- | 8 | 0.7 | 17 | 6.8 | 12 | -- | -- | -- |
| AUG 6 | 7.1 | -- | 192 | 5 | -- | -- | -- | 2.74 | 0.13 | 2.87 | 0.22 | 6 | -- | 9 | 0.7 | 20 | 11.9 | 22 | -- | -- | -- |
| AUG 7 | 7.5 | 16 | 80 | 10 | -- | -- | -- | 0.17 | ND | 0.17 | 0.08 | 6 | -- | 7 | 0.6 | 15 | 6.9 | 25 | -- | -- | -- |
| AUG 8 | 8.0 | 158 | 80 | 5 | -- | -- | -- | 0.22 | ND | 0.22 | 0.05 | 6 | -- | 8 | 2.0 | 17 | 6.9 | 23 | -- | -- | -- |
| AUG 20 | 7.6 | -- | 96 | 25 | -- | -- | -- | 0.17 | 0.13 | 0.30 | 0.14 | 9 | -- | 9 | ND | 15 | 1.5 | 28 | -- | -- | -- |
| AUG 21 | 8.3 | -- | 92 | 15 | -- | -- | -- | 0.22 | 0.02 | 0.24 | -- | 9 | -- | 10 | ND | 15 | 4.0 | 27 | -- | -- | -- |
| SEP 4 | 7.9 | -- | 104 | 30 | -- | -- | -- | 0.10 | 0.17 | 0.27 | 0.11 | 9 | -- | 10 | 1.0 | 10 | 4.6 | 28 | -- | -- | -- |
| SEP 4 | -- | -- | 96 | 35 | -- | -- | -- | 0.10 | 0.10 | 0.20 | -- | 8 | -- | 10 | ND | 10 | 3.9 | 28 | -- | -- | -- |
| SEP 17 | 7.7 | -- | 96 | 40 | -- | -- | -- | 0.06 | 0.20 | 0.26 | 0.20 | 13 | 1.8 | 6 | 0.4 | 13 | 14.5 | 28 | -- | -- | -- |
| SEP 18 | 8.1 | -- | 100 | 38 | -- | -- | -- | 0.06 | 0.15 | 0.21 | 0.16 | 13 | 1.2 | 6 | 0.2 | 10 | 12.5 | 28 | -- | -- | -- |
| OCT 3 | 8.2 | -- | 88 | 33 | -- | -- | -- | 0.06 | 0.01 | 0.07 | 0.11 | 12 | 0.6 | 6 | 0.5 | 13 | 11.3 | 26 | -- | -- | -- |
| OCT 16 | 7.5 | -- | -- | 35 | -- | -- | -- | 0.17 | 0.21 | 0.38 | 0.13 | 8 | 3.6 | 6 | 1.9 | 13 | -- | 24 | -- | -- | -- |
| NOV 6 | 7.3 | -- | 96 | 28 | -- | -- | -- | -- | 0.19 | -- | 0.15 | 2 | 5.6 | 10 | 1.4 | 13 | -- | 30 | -- | -- | -- |
| DEC 19 | 6.8 | -- | 102 | -- | -- | -- | -- | 0.19 | 0.03 | 0.22 | 0.25 | 8 | -- | 15 | 2.7 | 12 | 20.5 | 21 | -- | -- | -- |
| (1974) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FEB 21 | 7.1 | -- | -- | -- | -- | -- | -- | 0.06 | 0.01 | 0.07 | -- | 5 | -- | 9 | 0.9 | 8 | -- | 22 | -- | -- | -- |
| FEB 22 | 7.4 | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- | -- | 6 | -- | -- | -- | 12 | -- | 22 | -- | -- | -- |
| FEB 25 | 7.6 | -- | -- | -- | -- | -- | -- | 0.06 | ND | 0.06 | -- | -- | -- | 9 | 0.9 | 12 | -- | 24 | -- | -- | -- |
| APR 3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 12 | 13.0 | -- | -- | -- | -- |
| APR 4 | 7.6 | -- | -- | 24 | -- | -- | -- | 0.11 | ND | 0.11 | -- | 5 | 1.0 | 7 | 1.1 | 12 | 23.7 | 17 | -- | -- | -- |
| MAY 6 | 7.5 | -- | 100 | 32 | -- | -- | -- | 0.22 | 0.02 | 0.24 | -- | 6 | 4.1 | 10 | 0.9 | -- | -- | -- | -- | -- | -- |
| MAY 7 | 8.2 | -- | 106 | 30 | -- | -- | -- | 0.28 | 0.01 | 0.29 | -- | 5 | 4.3 | 10 | 0.9 | -- | -- | -- | -- | -- | -- |
| MAY 8 | 8.3 | -- | 104 | 30 | -- | -- | -- | ND | 0.01 | 0.01 | -- | 5 | -- | 10 | 1.1 | -- | -- | -- | -- | -- | -- |

TABLE B-10--CONTINUED

| DATE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N |  |  | PO$_4$-P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  | KJELDAHL | NO$_2$+NO$_3$ | TOTAL |  |  |  |  |  |  |  |  |  |  |  |
|  |  | mg/ℓ | cm | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | no./100mℓ |
| (1974) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MAY 21 | 7.4 | -- | 98 | 28 | -- | -- | -- | ND | 0.01 | 0.01 | -- | 5 | 3.8 | 8 | 0.9 | -- | -- | 24 | -- | -- | -- |
| MAY 22 | 8.4 | -- | 94 | 26 | -- | -- | -- | ND | 0.02 | 0.02 | -- | 5 | 3.8 | 10 | 0.9 | -- | -- | 22 | -- | -- | -- |
| JUN 12 | 8.2 | 50 | 97 | 28 | -- | -- | -- | 0.17 | ND | 0.17 | 0.038 | 4 | 4.4 | 8 | 0.9 | -- | 13.0 | 23 | -- | -- | -- |
| JUN 13 | 8.0 | 90 | 102 | 30 | -- | -- | -- | 0.06 | ND | 0.06 | 0.056 | 5 | 4.3 | 8 | 0.9 | -- | 15.8 | 25 | -- | -- | -- |
| JUN 25 | 7.9 | 72 | -- | 28 | -- | -- | -- | 1.40 | 0.19 | 1.59 | 0.070 | 4 | -- | 8 | 4.0 | -- | 9.0 | -- | -- | -- | -- |
| JUN 26 | 8.2 | 70 | -- | 20 | -- | -- | -- | 1.12 | 0.05 | 1.17 | 0.061 | 3 | -- | 8 | 2.7 | -- | 15.0 | -- | -- | -- | -- |
| JUL 9 | 8.0 | 110 | -- | 28 | -- | -- | -- | ND | 0.07 | 0.07 | -- | 4 | -- | 8 | 1.1 | -- | 16.8 | -- | -- | -- | -- |
| JUL 30 | 7.8 | -- | -- | -- | -- | -- | -- | -- | 0.02 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| JUL 31 | 7.9 | -- | -- | -- | -- | -- | -- | -- | 0.02 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| AUG 13 | -- | -- | 116 | 32 | -- | -- | -- | 0.13 | 0.34 | 0.47 | 0.086 | -- | -- | 10 | 0.8 | 14.5 | -- | 27 | -- | -- | -- |
| AUG 27 | -- | -- | -- | 33 | -- | -- | -- | 0.11 | 0.03 | 0.14 | 0.055 | -- | -- | 9 | 1.0 | -- | -- | 27 | -- | -- | -- |
| SEP 17 | -- | -- | 102 | 34 | -- | -- | -- | 0.04 | 0.01 | 0.05 | 0.019 | -- | -- | 16 | 1.3 | 14.5 | -- | 27 | -- | -- | -- |
| NOV 6 | -- | -- | 100 | 34 | -- | -- | -- | 0.18 | 0.01 | 0.19 | 0.014 | 5 | 5.2 | 3 | 0.4 | 13.4 | -- | 25 | -- | -- | -- |
| NOV 7 | -- | -- | 96 | 36 | -- | -- | -- | 0.80 | 0.15 | 0.95 | 0.208 | 5 | 5.7 | 3 | 1.0 | 14.4 | -- | 25 | -- | -- | -- |

* ND = NONDETECTABLE.

# TABLE B-11. QUALITY CONSTITUENTS FROM CERAMIC POINT SAMPLERS OF OSC FIELD NO. 246 TEST PLOTS

| DATE | SAMPLE | pH | TDS | COND.@ 25°C µmhos/cm | TOTAL HARD-NESS | NITROGEN as N | | | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/ℓ | | | $NH_3$-N | $NO_2$+ $NO_3$ | TOTAL | | mg/ℓ | | | | | | |
| (1973) | | | | | | | | | | | | | | | | |
| JULY 10 | 10B-2 | 6.7 | -- | 500 | 144 | 0.80 | 36.80 | 37.60 | 0.024 | 44 | 8.3 | 80 | 0.4 | 127.2 | 11 | 9.0 |
| | 10B-4 | 6.6 | -- | 600 | 298 | 0.45 | 82.50 | 82.95 | 0.024 | 100 | 11.7 | 64 | 0.9 | 102.7 | 10 | 13.2 |
| | 10B-6 | 6.6 | -- | 800 | 379 | 0.55 | 114.60 | 115.15 | 0.023 | 100 | 31.3 | 93 | 0.7 | 112.5 | 8 | 13.0 |
| | 10B-8 | 6.8 | -- | 600 | 230 | 0.10 | 41.60 | 41.70 | 0.019 | 100 | -- | 85 | 2.6 | 161.4 | 14 | 12.2 |
| | 10B-10 | 7.0 | -- | 540 | 245 | 0.00 | 53.40 | 53.40 | 0.029 | 71 | 16.4 | 64 | 0.7 | 110.1 | 15 | 8.0 |
| | 11C-2 | 6.6 | 414 | 380 | 91 | 0.05 | 34.70 | 34.75 | 0.026 | 26 | 6.3 | 52 | 1.5 | 73.4 | 18 | 12.6 |
| | 11C-4 | 6.8 | 316 | 280 | 70 | 1.00 | 21.10 | 22.10 | 0.045 | 28 | -- | 49 | 0.4 | 63.6 | 13 | 5.2 |
| | 11C-6 | 6.8 | -- | 280 | 53 | 1.00 | 13.90 | 14.90 | 1.052 | 15 | 3.8 | 45 | 0.0 | 53.8 | 29 | 11.3 |
| | 11C-8 | 7.2 | -- | 500 | 156 | 0.25 | 29.70 | 29.95 | 0.997 | 39 | 14.2 | 72 | 0.4 | 85.6 | 22 | 10.8 |
| | 11C-10 | 7.1 | -- | 460 | 125 | 0.25 | 29.50 | 29.75 | 0.039 | 46 | 2.4 | 72 | 0.4 | 100.3 | -- | 9.4 |
| JULY 24 | 10B-2 | 6.8 | 632 | 480 | 120 | 0.10 | 42.10 | 42.20 | 0.041 | 38 | 6.1 | 75 | 1.1 | -- | 14 | 12.0 |
| | 10B-4 | 6.7 | -- | 680 | 259 | 0.10 | 83.30 | 83.40 | 0.026 | 81 | 13.7 | 72 | 0.7 | -- | 11 | 11.0 |
| | 10B-6 | 6.7 | -- | 800 | 312 | 0.05 | 84.50 | 84.55 | 0.039 | 93 | 19.3 | 86 | 1.5 | -- | 11 | 16.2 |
| | 10B-8 | 7.1 | -- | 660 | 230 | 0.05 | 49.10 | 49.15 | 0.031 | 78 | 8.5 | 86 | 1.5 | -- | 13 | 11.1 |
| | 10B-10 | 7.3 | -- | 580 | 182 | 0.25 | 52.30 | 52.55 | 0.024 | 60 | 7.8 | 56 | 0.9 | 105.2 | 15 | 8.8 |
| | 11C-2 | 7.0 | -- | 350 | 91 | 0.10 | 20.30 | 20.40 | 0.036 | 21 | 9.4 | 47 | 1.5 | 73.4 | -- | 13.8 |
| | 11C-4 | 6.0 | -- | 290 | 43 | 0.35 | 11.70 | 12.05 | 0.026 | 14 | 1.9 | 39 | 0.7 | 55.0 | 19 | 9.1 |
| | 11C-6 | 7.3 | 274 | 305 | 34 | 0.80 | 5.78 | 6.58 | 1.093 | 8 | 3.4 | 43 | 1.3 | 52.6 | 15 | 20.7 |
| | 11C-8 | 7.6 | -- | 515 | 130 | 0.05 | 25.70 | 25.75 | 0.450 | 32 | 12.2 | 69 | 0.7 | 90.5 | -- | 12.7 |
| | 11C-10 | 7.5 | -- | 440 | 96 | 0.10 | 16.20 | 16.30 | 0.052 | 23 | 9.4 | 65 | 0.7 | 93.0 | 25 | 10.2 |
| | 20C-1 | 7.4 | -- | 390 | 72 | 0.15 | 16.90 | 17.05 | 0.065 | 18 | 6.6 | 59 | 1.3 | 75.8 | 20 | 11.8 |
| | 20C-2 | 7.1 | -- | 315 | 43 | 0.25 | 9.26 | 9.51 | 0.031 | 19 | -- | 42 | 2.0 | 66.0 | 23 | 9.1 |
| | 20C-3 | 7.4 | -- | 360 | 58 | 0.10 | 3.36 | 3.46 | 0.036 | 16 | 4.4 | 60 | 0.7 | 88.1 | 20 | 12.8 |
| | 20C-4 | 7.3 | -- | 330 | 58 | 0.15 | 5.27 | 5.42 | 0.039 | 15 | 5.0 | 42 | 1.1 | 73.4 | 22 | 13.8 |
| | 20C-5 | 7.5 | -- | 520 | 77 | 0.20 | 11.70 | 11.90 | 0.183 | 31 | -- | 83 | 0.7 | 122.3 | 19 | 10.1 |
| | 20C-6 | 7.1 | 300 | 355 | 48 | 0.07 | 10.50 | 10.57 | 0.034 | 17 | 1.3 | 46 | 1.1 | 80.7 | 22 | 11.7 |
| | 20C-7 | 7.3 | -- | 285 | 38 | 1.00 | 7.78 | 8.78 | 0.045 | 11 | 2.6 | 53 | 1.3 | 66.0 | 19 | 16.1 |
| | 20C-8 | 7.2 | -- | 305 | 48 | 1.00 | 10.60 | 11.60 | 0.038 | 14 | 3.2 | 43 | 0.7 | 63.6 | 22 | 14.8 |
| | 20C-9 | 7.3 | -- | 435 | 38 | 0.10 | 9.07 | 9.17 | 0.082 | 22 | -- | 65 | 0.7 | 100.3 | 25 | 10.7 |
| | 20C-10 | 6.9 | 340 | 335 | 43 | 0.25 | 15.10 | 15.35 | 0.040 | 14 | 1.9 | 53 | 0.9 | 61.2 | 22 | 16.2 |
| | 21B-1 | 7.3 | -- | 415 | 106 | 0.15 | 7.36 | 7.51 | 0.984 | 24 | 11.1 | 60 | 0.9 | 100.3 | 23 | 16.6 |
| | 21B-2 | 7.0 | 630 | 540 | 197 | 0.07 | 43.40 | 43.47 | 0.042 | 61 | 10.8 | 67 | 0.7 | 127.2 | 14 | 9.9 |
| | 21B-3 | 7.2 | 228 | 310 | 58 | 0.10 | 8.88 | 8.98 | 0.081 | 15 | 5.0 | 42 | 0.7 | 63.6 | 23 | 11.2 |
| | 21B-4 | 7.1 | 295 | 320 | 48 | 0.05 | 19.20 | 19.25 | 0.028 | 17 | 1.3 | 46 | 0.0 | 63.6 | 22 | 10.0 |
| | 21B-6 | 7.0 | 552 | 480 | 130 | 0.05 | 54.10 | 54.15 | 0.026 | 41 | 6.7 | 60 | 0.0 | 66.0 | 14 | 7.1 |
| | 21B-7 | 7.1 | 391 | 440 | 110 | 1.00 | 19.50 | 20.50 | 0.036 | 30 | 8.5 | 53 | 0.7 | 107.6 | 16 | 9.1 |
| | 21B-8 | 7.0 | 444 | 465 | 115 | 1.15 | 27.30 | 28.80 | 0.033 | 33 | 7.9 | 50 | 0.3 | 93.0 | 15 | 12.0 |
| | 21B-9 | 7.1 | 306 | 360 | 58 | 1.05 | 14.50 | 15.55 | 1.287 | 16 | 4.4 | 53 | 1.6 | 66.0 | 23 | 25.4 |
| | 21B-10 | 7.3 | -- | 400 | 82 | 3.50 | 37.10 | 40.60 | 0.065 | 26 | 4.1 | 50 | 0.0 | 88.1 | 19 | 10.1 |
| | F45 | 7.3 | 292 | 290 | 101 | 0.15 | 15.40 | 15.55 | 0.312 | 24 | 10.0 | 15 | 0.1 | 36.7 | 14 | 7.8 |
| | F46 | 7.1 | 564 | 325 | 250 | 0.05 | 65.10 | 65.15 | 0.053 | 66 | 20.7 | 19 | 0.0 | 32.0 | 12 | 7.7 |
| | F47 | 7.2 | 242 | 275 | 105 | 2.50 | 2.99 | 5.49 | 3.312 | 22 | 12.2 | 17 | 0.0 | 56.3 | 22 | 11.6 |
| | F48 | 7.1 | 144 | 175 | 39 | 4.25 | 9.51 | 13.76 | 1.216 | 12 | 2.2 | 14 | 0.0 | 29.4 | 19 | 11.8 |
| | F49 | 7.1 | 94 | 135 | 34 | 3.10 | 2.25 | 5.35 | 0.530 | 9 | 2.8 | 9 | 0.0 | 17.1 | 17 | 10.0 |
| | F50 | 7.0 | 186 | 210 | 58 | 5.10 | 9.15 | 14.25 | 0.073 | 19 | 2.6 | 14 | 0.0 | 26.9 | 24 | 5.3 |
| | F51 | 7.0 | 298 | 400 | 53 | 0.55 | 8.13 | 8.68 | 0.057 | 18 | 1.9 | 38 | 1.8 | 58.7 | 26 | 11.1 |
| | F52 | 6.7 | 400 | 420 | 67 | 0.40 | 29.57 | 29.97 | 0.416 | 34 | -- | 47 | 0.0 | 68.5 | 28 | 7.7 |
| | F53 | 7.2 | 332 | 390 | 106 | 0.20 | 17.35 | 17.55 | 0.775 | 29 | 8.1 | 42 | 0.3 | 70.9 | 37 | 12.6 |
| | F54 | 6.9 | 192 | 360 | 77 | 0.10 | 17.43 | 12.53 | -- | 17 | 8.4 | 48 | 2.2 | 56.3 | 28 | 26.1 |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $NH_3$-N | $NO_2$+ $NO_3$ | TOTAL | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
| | | | | | mg/ℓ | | | | | | | | | | | |
| (1973) JULY 24 | 19A-1 | 6.8 | 146 | 210 | 48 | 0.95 | 3.74 | 4.69 | 0.532 | 10 | 5.6 | 22 | 0.9 | 42 | 37 | 9 |
| | 19A-2 | 6.9 | 120 | 170 | 43 | 1.00 | 2.99 | 3.99 | 0.098 | 12 | 3.2 | 14 | 0.0 | 47 | 12 | 10 |
| | 19A-3 | 6.9 | 215 | 245 | 72 | 2.50 | 11.30 | 13.80 | 0.044 | 22 | 4.1 | 13 | 0.0 | 47 | 10 | 8 |
| | 19A-4 | 6.9 | 114 | 155 | 29 | 2.10 | 5.83 | 7.93 | 0.033 | 13 | -- | 11 | 0.0 | 32 | 12 | 7 |
| | 19A-5 | 6.9 | 50 | 155 | 19 | 0.05 | 3.33 | 3.38 | 0.101 | 10 | -- | 14 | 0.0 | 33 | 10 | 7 |
| | 19A-6 | 6.7 | 212 | 170 | 29 | 0.05 | 2.53 | 2.58 | 0.042 | 13 | — | 12 | 1.1 | 34 | 10 | 6 |
| | 19A-7 | 6.8 | 126 | 170 | 19 | 0.10 | 4.92 | 5.02 | 0.036 | 11 | -- | 16 | 0.0 | 44 | 8 | 8 |
| | 19A-8 | 6.6 | 241 | 410 | 163 | 0.10 | 33.44 | 33.54 | 0.034 | 53 | 7.4 | 19 | 2.5 | 78 | 8 | 7 |
| | 19A-9 | 7.1 | 294 | 300 | 91 | 0.15 | 6.36 | 6.51 | 0.072 | — | — | 20 | 0.0 | 86 | 8 | 6 |
| | 19A-10 | 5.3 | 896 | 660 | 1022 | 0.15 | 56.58 | 56.73 | 0.031 | 100 | 188.0 | 18 | 27.2 | 166 | 6 | 7 |
| AUG 6 | 20C-1 | 7.2 | -- | 380 | -- | 0.33 | 19.60 | 19.93 | -- | 8 | — | 53 | 0.7 | 68 | 17 | 17 |
| | 20C-2 | 6.9 | -- | 300 | 45 | 0.24 | 20.70 | 20.94 | 0.020 | 6 | 7.3 | 46 | 0.2 | 63 | 19 | 16 |
| | 20C-3 | 7.3 | -- | 330 | -- | 0.16 | 3.27 | 3.43 | -- | 6 | -- | 60 | 0.2 | 78 | 18 | 15 |
| | 20C-4 | 7.1 | -- | 330 | -- | 0.26 | 7.85 | 8.11 | 0.020 | 6 | -- | 49 | 0.9 | 65 | 21 | 17 |
| | 20C-5 | 7.6 | -- | 420 | -- | 1.01 | 9.12 | 10.13 | -- | 12 | -- | 76 | 0.2 | 110 | -- | 10 |
| | 20C-6 | 7.0 | 340 | 340 | 60 | 0.12 | 14.40 | 14.52 | 0.020 | 8 | 9.7 | 51 | 0.2 | 83 | 19 | 11 |
| | 20C-7 | 7.1 | -- | 280 | -- | 0.67 | 9.12 | 9.79 | -- | 5 | -- | 53 | 0.9 | 60 | 18 | 18 |
| | 20C-8 | 6.9 | -- | 290 | 40 | 0.15 | 12.40 | 12.55 | 0.020 | 5 | 6.7 | 46 | 0.7 | 55 | 22 | 19 |
| | 20C-9 | 7.1 | -- | 350 | -- | 0.12 | 19.70 | 19.82 | -- | 8 | -- | 93 | 0.2 | 83 | 23 | 17 |
| | 20C-10 | 6.8 | 266 | 310 | 40 | 0.15 | 15.70 | 15.85 | 0.420 | 7 | 5.5 | 51 | 0.9 | 58 | 24 | 25 |
| | 21B-1 | 7.0 | -- | 380 | 75 | 0.16 | 5.46 | 5.62 | 1.010 | 8 | 13.4 | 54 | 0.7 | 85 | 22 | 25 |
| | 21B-2 | 6.7 | 388 | 460 | 135 | 0.03 | 30.80 | 30.83 | 0.030 | 19 | 21.3 | 55 | 0.2 | 98 | 15 | 13 |
| | 21B-3 | 6.8 | -- | 260 | 35 | 0.31 | 7.90 | 8.21 | 0.020 | 5 | 5.5 | 41 | 0.7 | 55 | 21 | 19 |
| | 21B-4 | 6.7 | 213 | 280 | 30 | 0.26 | 15.90 | 16.16 | 0.030 | 6 | 3.6 | 46 | 0.7 | 58 | 21 | 12 |
| | 21B-6 | 6.6 | 436 | 360 | 100 | 0.13 | 41.60 | 41.73 | 0.020 | 14 | 15.8 | 55 | 0.7 | 65 | 19 | 9 |
| | 21B-7 | 6.6 | 279 | 530 | 55 | 0.18 | 24.50 | 24.68 | 0.020 | 9 | 7.9 | 45 | 1.3 | 80 | 17 | 14 |
| | 21B-8 | 6.6 | 218 | 400 | 105 | 0.09 | 28.70 | 28.79 | 0.020 | 15 | 16.4 | 54 | 1.1 | 93 | 14 | 14 |
| | 21B-9 | 6.8 | 147 | 350 | 55 | 0.59 | 15.40 | 15.99 | 1.040 | 6 | 9.7 | 50 | 2.0 | 63 | 22 | 32 |
| | 21B-10 | 6.7 | 352 | 350 | 65 | 0.05 | 21.70 | 21.75 | 0.040 | 9 | 10.3 | 46 | 0.9 | 55 | 22 | 16 |
| | 19A-1 | 6.8 | 9 | 115 | 15 | 0.31 | 6.35 | 6.66 | 0.040 | 3 | 1.8 | 10 | 0.9 | 23 | 9 | 8 |
| | 19A-2 | 6.9 | 37 | 145 | 25 | 0.25 | 6.26 | 6.51 | 0.020 | 5 | 3.0 | 12 | 0.7 | 38 | 8 | 7 |
| | 19A-3 | 7.0 | 72 | 150 | 40 | 0.19 | 13.10 | 13.29 | 0.020 | 6 | 6.1 | 9 | 0.7 | 38 | 8 | 8 |
| | 19A-4 | 6.8 | 9 | 110 | 25 | 0.18 | 12.40 | 12.58 | 0.010 | 4 | 3.6 | 8 | 0.7 | 24 | 11 | 8 |
| | 19A-5 | 6.4 | 69 | 160 | 25 | 0.11 | 9.60 | 9.71 | 0.060 | 6 | 2.4 | 14 | 0.9 | 30 | 8 | 7 |
| | 19A-6 | 6.5 | 44 | 130 | 25 | 0.08 | 7.52 | 7.60 | 0.020 | 5 | 3.0 | 11 | 1.5 | 28 | 9 | 8 |
| | 19A-7 | 6.6 | 108 | 115 | 5 | 0.08 | 4.70 | 4.78 | 0.020 | 4 | --- | 12 | 0.9 | 33 | 8 | 7 |
| | 19A-8 | 6.8 | 189 | 215 | 65 | 0.17 | 1.41 | 1.58 | 0.010 | 10 | 9.7 | 14 | 1.1 | 28 | 8 | 7 |
| | 19A-9 | 5.9 | 177 | 205 | 55 | 0.09 | 9.85 | 9.94 | 0.020 | 8 | 8.5 | 14 | 0.9 | 48 | 8 | 10 |
| | 19A-10 | 7.0 | 341 | 280 | 110 | 0.25 | 21.80 | 22.05 | 0.010 | 17 | 16.4 | 10 | 5.2 | 38 | 6 | 10 |
| | 11C-2 | 7.0 | -- | 400 | 70 | 0.02 | 18.10 | 18.12 | -- | 10 | 10.9 | 75 | 1.3 | 70 | 19 | 17 |
| | 11C-4 | 7.1 | -- | 280 | 30 | 0.06 | 13.00 | 13.06 | -- | 6 | 3.6 | 46 | 0.9 | 58 | 18 | 13 |
| | 11C-6 | 7.2 | -- | 270 | 80 | -- | 5.84 | -- | -- | 4 | 17.0 | 49 | 2.2 | 55 | 29 | 24 |
| | 11C-8 | 7.4 | — | 360 | 105 | 0.15 | 14.90 | 15.05 | -- | 12 | 18.2 | 63 | 2.0 | 73 | 24 | 19 |
| | 11C-10 | 7.5 | -- | 380 | — | 0.30 | 13.80 | 14.10 | -- | 8 | -- | 63 | 1.1 | 75 | 23 | 14 |
| | 10B-2 | 6.9 | 482 | 400 | 95 | 0.29 | 33.80 | 34.09 | 0.020 | 14 | 14.5 | 62 | 1.3 | 83 | 16 | 18 |
| | 10B-4 | 6.9 | -- | 500 | 205 | 0.21 | 69.25 | 69.46 | 0.010 | 31 | 31.0 | 71 | 0.9 | 78 | 14 | 14 |
| | 10B-6 | 6.8 | -- | 540 | 245 | 0.23 | 56.70 | 56.93 | 0.020 | 39 | 35.8 | 80 | 1.3 | 90 | 15 | 23 |
| | 10B-8 | 7.0 | -- | 460 | 170 | 0.24 | 40.10 | 40.34 | 0.020 | 23 | 27.3 | 70 | 2.2 | 123 | 15 | 18 |
| | 10B-10 | 7.4 | -- | 440 | 160 | 0.04 | 34.90 | 34.94 | 0.020 | 19 | 27.3 | 57 | 1.3 | 90 | 17 | 13 |
| | F45 | 6.5 | -- | 210 | 65 | 0.69 | 15.40 | 16.09 | 0.020 | 9 | 10.3 | 13 | 0.9 | 30 | 18 | 12 |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/ cm | TOTAL HARD-NESS | NITROGEN as N | | | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $NH_3$-N | $NO_2$+ $NO_3$ | TOTAL | | mg/ℓ | | | | | | |
| (1973)<br>AUG 6 | F46 | 6.8 | 200 | 185 | 75 | 0.54 | 23.50 | 24.04 | 0.02 | 10 | 12.2 | 10 | 0.9 | 23 | 17 | 13 |
| | F47 | 6.7 | 204 | 190 | 70 | 0.89 | 18.22 | 19.11 | 1.28 | 9 | 11.5 | 12 | 1.3 | 30 | 18 | 14 |
| | F48 | 6.7 | 128 | 220 | 30 | 1.26 | 16.53 | 17.79 | 1.07 | 3 | 5.5 | 12 | 1.7 | 25 | 20 | 14 |
| | F49 | 6.4 | 88 | 95 | 20 | 0.03 | 2.74 | 2.77 | 0.72 | 3 | 3.0 | 8 | 0.9 | 15 | 15 | 15 |
| | F50 | 6.6 | 96 | 140 | 35 | 1.50 | 3.12 | 4.62 | 0.03 | 5 | 5.5 | 11 | 0.9 | 18 | 25 | 8 |
| | F51 | 6.5 | -- | 260 | 40 | 0.47 | 6.03 | 6.50 | 0.02 | 8 | 4.9 | 38 | 0.9 | 63 | 27 | 15 |
| | F52 | 6.3 | -- | 360 | -- | 0.19 | 29.60 | 29.79 | -- | 12 | -- | 45 | 1.3 | 53 | -- | 18 |
| | F53 | 6.6 | -- | 320 | 70 | 1.15 | 18.10 | 19.25 | 0.07 | 10 | 10.9 | 40 | 0.9 | 58 | 27 | 20 |
| AUG 21 | F45 | 6.6 | -- | -- | -- | -- | 33.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F46 | 6.9 | -- | -- | -- | -- | 45.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F47 | 7.1 | -- | -- | -- | -- | 4.57 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F48 | 7.0 | -- | -- | -- | -- | 31.71 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F49 | 6.6 | -- | -- | -- | -- | 31.83 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F50 | 6.5 | -- | -- | -- | -- | 34.48 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F51 | 6.3 | -- | -- | -- | -- | 7.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | 7.0 | -- | -- | -- | -- | 9.92 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | 6.7 | -- | -- | -- | -- | 29.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | 6.6 | -- | -- | -- | -- | 25.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | 7.0 | -- | -- | -- | -- | 13.41 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | 7.1 | -- | -- | -- | -- | 8.69 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | 6.3 | -- | -- | -- | -- | 26.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | 6.9 | -- | -- | -- | -- | 14.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | 6.7 | -- | -- | -- | -- | 17.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | 6.8 | -- | -- | -- | -- | 30.44 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-10 | 5.5 | -- | -- | -- | -- | 69.43 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A* | -- | 306 | 210 | 135 | 0.36 | -- | -- | -- | 18 | 21.9 | 18 | 1.0 | 68 | 5 | 9 |
| | 19A† | -- | 590 | 280 | 225 | -- | -- | -- | -- | 25 | 39.5 | 20 | 14.0 | 143 | 2 | 10 |
| | F45-50‡ | -- | -- | 440 | 225 | -- | -- | -- | -- | 26 | 38.9 | 20 | 2.0 | 118 | 12 | -- |
| AUG 22 | 21B-1 | 7.2 | -- | -- | -- | -- | 7.68 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | 7.0 | -- | -- | -- | -- | 28.99 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | 7.1 | -- | -- | -- | -- | 3.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | 6.9 | -- | -- | -- | -- | 8.68 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | 7.1 | -- | -- | -- | -- | 27.42 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | 6.9 | -- | -- | -- | -- | 10.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | 7.0 | -- | -- | -- | -- | 16.51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | 7.1 | -- | -- | -- | -- | 9.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-10 | 7.0 | -- | -- | -- | -- | 15.51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 7.6 | -- | -- | -- | -- | 11.81 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 7.3 | -- | -- | -- | -- | 14.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.5 | -- | -- | -- | -- | 4.34 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 7.2 | -- | -- | -- | -- | 10.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 7.6 | -- | -- | -- | -- | 8.48 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 7.1 | -- | -- | -- | -- | 8.29 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 7.3 | -- | -- | -- | -- | 4.43 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 7.1 | -- | -- | -- | -- | 8.75 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 7.3 | -- | -- | -- | -- | 6.01 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 7.0 | -- | -- | -- | -- | 12.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-2 | 6.7 | -- | -- | -- | -- | 24.89 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 6.8 | -- | -- | -- | -- | 53.79 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

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*ODD COMPOSITE. †EVEN COMPOSITE. ‡COMPOSITE.

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N | | | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $NH_3$-N | $NO_2$+$NO_3$ | TOTAL | | mg/ℓ | | | | | | |
| (1973)<br>AUG 22 | 10B-6 | 6.8 | -- | -- | -- | -- | 47.83 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | 6.8 | -- | -- | -- | -- | 30.96 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 7.2 | -- | -- | -- | -- | 26.49 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-2 | 7.0 | -- | -- | -- | -- | 11.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 6.9 | -- | -- | -- | -- | 13.42 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 7.0 | -- | -- | -- | -- | 3.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 7.3 | -- | -- | -- | -- | 13.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 7.2 | -- | -- | -- | -- | 6.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F51 | 6.8 | -- | -- | -- | 0.17 | 4.49 | 4.66 | -- | 18 | -- | 32 | ND | 38 | -- | 9 |
| | F52 | 6.7 | -- | -- | -- | -- | 17.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F53 | 6.9 | -- | -- | -- | -- | 16.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B* | -- | 268 | 380 | 65 | -- | -- | -- | -- | 12 | 8.5 | 57 | ND | 90 | 21 | 20 |
| | 21B† | -- | 310 | 386 | 85 | 0.24 | -- | -- | -- | 14 | 12.2 | 53 | 1.0 | 78 | 19 | 15 |
| | 20C* | -- | -- | 400 | 75 | 0.13 | -- | -- | -- | 14 | 9.7 | 59 | 1.0 | 95 | 22 | 15 |
| | 20C† | -- | 256 | 344 | 50 | 0.15 | -- | -- | -- | 11 | 5.5 | 49 | ND | 70 | 25 | 19 |
| | F52-53‡ | -- | 227 | 364 | 70 | -- | -- | -- | -- | 14 | 8.5 | 41 | ND | 53 | 26 | 16 |
| | 10B‡ | -- | 430 | 454 | 135 | 0.22 | -- | -- | -- | 22 | 19.4 | 60 | 1.0 | 83 | 16 | 18 |
| | 11C‡ | -- | 250 | 320 | 50 | 0.33 | -- | -- | -- | 11 | 5.5 | 46 | ND | 60 | 23 | 20 |
| SEPT 4 | F45 | 6.7 | -- | -- | -- | -- | 72.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F46 | 6.3 | -- | -- | -- | -- | 83.85 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F47 | 6.5 | -- | -- | -- | -- | 119.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F48 | 6.5 | -- | -- | -- | -- | 82.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F49 | 6.6 | -- | -- | -- | -- | 84.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F50 | 6.7 | -- | -- | -- | -- | 86.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F51 | 6.8 | -- | -- | -- | -- | 8.56 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-2 | 6.9 | -- | -- | -- | -- | 18.31 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 6.9 | -- | -- | -- | -- | 52.85 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 6.9 | -- | -- | -- | -- | 44.47 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | 7.0 | -- | -- | -- | -- | 18.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 7.2 | -- | -- | -- | -- | 18.66 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-2 | 7.2 | -- | -- | -- | -- | 10.39 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 7.3 | -- | -- | -- | -- | 8.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 7.3 | -- | -- | -- | -- | 1.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 7.3 | -- | -- | -- | -- | 9.51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 7.3 | -- | -- | -- | -- | 4.27 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | 7.2 | -- | -- | -- | -- | 5.01 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | 6.7 | -- | -- | -- | -- | 56.57 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | 6.9 | -- | -- | -- | -- | 49.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | 6.9 | -- | -- | -- | -- | 36.64 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | 7.0 | -- | -- | -- | -- | 10.65 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | 6.4 | -- | -- | -- | -- | 8.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | 6.8 | -- | -- | -- | -- | 6.97 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | 6.7 | -- | -- | -- | -- | 37.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | 7.0 | -- | -- | -- | -- | 14.27 | -- | -- | -- | -- | -- | -- | -- | 1 | -- |
| | 19A-10 | 5.3 | -- | 740 | 345 | -- | 72.73 | -- | -- | 30 | 65.6 | 19 | 48.0 | -- | -- | -- |
| | 20C-1 | 7.0 | -- | -- | -- | -- | 13.01 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 7.0 | -- | -- | -- | -- | 5.73 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.5 | -- | -- | -- | -- | 5.56 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 7.3 | -- | -- | -- | -- | 5.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 7.6 | -- | -- | -- | -- | 2.75 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25 C µmhos/cm | TOTAL HARD- NESS | NITROGEN as N NH3-N | NO2+NO3 | TOTAL | PO4-P | Ca mg/ℓ | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1973) SEPT 4 | 20C-6 | 7.3 | -- | -- | -- | -- | 2.47 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 7.4 | -- | -- | -- | -- | 0.93 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | -- | -- | -- | -- | -- | 6.35 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | -- | -- | -- | -- | -- | 3.84 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | -- | -- | -- | -- | -- | 6.64 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | -- | -- | -- | -- | -- | 3.94 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | -- | -- | -- | -- | -- | 15.65 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | -- | -- | -- | -- | -- | 3.97 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | -- | -- | -- | -- | -- | 4.57 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | -- | -- | -- | -- | -- | 19.45 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | -- | -- | -- | -- | -- | 8.74 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | -- | -- | -- | -- | -- | 12.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | -- | -- | -- | -- | -- | 15.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-10 | -- | -- | -- | -- | -- | 16.47 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F45-51‡ | -- | 672 | 590 | 325 | 0.37 | -- | -- | 0.051 | 27 | 62.6 | 20 | 1.0 | -- | 9 | 11 |
| | 10B‡ | -- | 422 | 460 | 110 | 0.94 | -- | -- | 0.048 | 19 | 15.2 | 53 | 1.0 | -- | 17 | 22 |
| | 11C‡ | -- | 210 | 320 | 55 | 0.61 | -- | -- | 0.256 | 9 | 7.9 | 43 | 1.0 | -- | 20 | 26 |
| | 19A* | -- | 414 | 224 | 90 | 0.39 | -- | -- | 0.025 | 15 | 12.8 | 15 | 1.0 | -- | 4 | 7 |
| | 19A† | -- | 708 | 640 | 300 | 0.39 | -- | -- | 0.022 | 26 | 57.1 | 18 | 13.0 | -- | 3 | 8 |
| | 20C* | -- | 244 | 390 | 85 | 0.47 | -- | -- | 0.118 | 6 | 17.0 | 53 | 1.0 | -- | 20 | 16 |
| | 20C† | -- | 180 | 330 | 60 | 0.68 | -- | -- | 0.042 | 10 | 8.5 | 44 | ND | -- | 22 | 22 |
| | 21B* | -- | 220 | 390 | 70 | 1.31 | -- | -- | 0.272 | 10 | 10.9 | 51 | ND | -- | 19 | 19 |
| | 21B† | -- | 314 | 308 | 75 | 0.54 | -- | -- | 0.480 | 11 | 11.5 | 51 | ND | 70 | 21 | 16 |
| SEPT 17 | F45 | 6.3 | -- | -- | -- | -- | 32.87 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F46 | 6.5 | -- | -- | -- | -- | 48.89 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F47 | 6.4 | -- | -- | -- | -- | 44.42 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F48 | 6.4 | -- | -- | -- | -- | 35.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F49 | 3.2 | 322 | 600 | 115 | -- | 22.45 | -- | 0.454 | 33 | 7.9 | 8 | 0.7 | 35 | 75 | 14 |
| | F50 | 6.2 | -- | -- | -- | -- | 66.36 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F51 | 6.7 | -- | -- | -- | -- | 4.87 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A* | -- | 226 | 200 | 75 | 0.31 | -- | -- | 0.064 | 22 | 4.9 | 11 | 0.5 | 30 | 2 | 9 |
| | 19A† | -- | 238 | 366 | 175 | 0.28 | -- | -- | 0.070 | 40 | 18.2 | 14 | 4.4 | 48 | 1 | 9 |
| | 19A-10 | -- | -- | -- | -- | -- | -- | -- | 0.022 | 55 | -- | 13 | 28.6 | 68 | -- | 10 |
| | F45-51‡ | -- | 494 | 410 | 160 | 0.40 | -- | -- | 0.086 | 55 | 5.5 | 17 | 0.2 | 30 | 10 | 12 |
| SEPT 18 | 20C-1 | 7.8 | -- | -- | -- | -- | 14.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 7.6 | -- | -- | -- | -- | 8.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.8 | -- | -- | -- | -- | 4.42 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 7.1 | -- | -- | -- | -- | 7.83 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 7.5 | -- | -- | -- | -- | 1.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 7.6 | -- | -- | -- | -- | 4.28 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 7.7 | -- | -- | -- | -- | 2.81 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 7.5 | -- | -- | -- | -- | 9.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 7.6 | -- | -- | -- | -- | 7.49 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 7.3 | -- | -- | -- | -- | 6.91 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | 7.4 | -- | -- | -- | -- | 1.35 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | 7.1 | -- | -- | -- | -- | 17.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | 6.8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | 6.8 | -- | -- | -- | -- | 1.95 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | 6.7 | -- | -- | -- | -- | 17.74 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | 6.7 | -- | -- | -- | -- | 6.85 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARD-NESS | NITROGEN as N | | | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NH$_3$-N | NO$_2$+NO$_3$ | TOTAL | | | | | | | | |
| | | | | | mg/ℓ | | | | | | | | | | | |
| (1973) | | | | | | | | | | | | | | | | |
| SEPT 18 | 21B-8 | 6.7 | -- | -- | -- | -- | 9.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | 6.7 | -- | -- | -- | -- | 4.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-10 | 6.8 | -- | -- | -- | -- | 11.47 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | 7.0 | -- | -- | -- | -- | 0.91 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | 6.8 | -- | -- | -- | -- | 20.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | 6.7 | -- | -- | -- | -- | 16.98 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | 6.7 | -- | -- | -- | -- | 24.84 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | 6.6 | -- | -- | -- | -- | 3.62 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | 6.1 | -- | -- | -- | -- | 46.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | 6.3 | -- | -- | -- | -- | 1.62 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | 6.2 | -- | -- | -- | -- | 32.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | 6.5 | -- | -- | -- | -- | 12.62 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-10 | 5.6 | -- | -- | -- | -- | 33.37 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C* | -- | -- | -- | -- | 0.29 | -- | -- | -- | -- | -- | 63 | 0.7 | -- | -- | 18 |
| | 20C† | -- | -- | -- | 68 | 0.36 | -- | -- | -- | -- | -- | 56 | 0.5 | 40 | -- | 23 |
| | 21B* | -- | -- | -- | -- | 1.20 | -- | -- | -- | 21 | -- | 56 | 0.4 | 93 | -- | 21 |
| | 21B† | -- | 280 | 332 | 60 | 0.35 | -- | -- | 0.51 | 22 | 1.2 | 50 | 0.4 | 78 | 26 | 16 |
| SEPT 20 | 10B-2 | 7.0 | -- | -- | -- | -- | 24.83 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 6.9 | -- | -- | -- | -- | 48.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 6.9 | -- | -- | -- | -- | 44.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | 7.1 | -- | -- | -- | -- | 10.87 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 7.2 | -- | -- | -- | -- | 5.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-2 | 7.3 | -- | -- | -- | -- | 4.67 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 6.9 | -- | -- | -- | -- | 10.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 6.8 | -- | -- | -- | -- | 6.89 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 6.8 | -- | -- | -- | -- | 27.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 7.1 | -- | -- | -- | -- | 23.46 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OCT 1 | 10B-2 | 6.9 | -- | -- | -- | -- | 11.37 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 7.0 | -- | -- | -- | -- | 28.69 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 6.7 | -- | -- | -- | -- | 28.44 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | 7.1 | -- | -- | -- | -- | 16.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 7.2 | -- | -- | -- | -- | 14.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-2 | 7.5 | -- | -- | -- | -- | 14.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 7.4 | -- | -- | -- | -- | 12.43 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 7.4 | -- | -- | -- | -- | 3.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 7.5 | -- | -- | -- | -- | 16.36 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 6.4 | -- | -- | -- | -- | 3.73 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 7.2 | -- | -- | -- | -- | 15.32 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 7.1 | -- | -- | -- | -- | 7.96 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.4 | -- | -- | -- | -- | 9.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 6.9 | -- | -- | -- | -- | 8.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 7.5 | -- | -- | -- | -- | 1.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 7.3 | -- | -- | -- | -- | 4.57 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 7.3 | -- | -- | -- | -- | 5.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 6.8 | -- | -- | -- | -- | 13.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 7.2 | -- | -- | -- | -- | 8.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 6.8 | -- | -- | -- | -- | 9.34 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | 7.1 | -- | -- | -- | -- | 7.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | 6.9 | -- | -- | -- | -- | 18.57 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | 7.1 | -- | -- | -- | -- | 3.91 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25 C µmhos/cm | TOTAL HARDNESS | NITROGEN as N $NH_3$-N | NITROGEN as N $NO_2$+ $NO_3$ | NITROGEN as N TOTAL | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | mg/ℓ | cm | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |
| (1973) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| OCT 1 | 21B-4 | 6.9 | -- | -- | -- | -- | 8.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-6 | 6.9 | -- | -- | -- | -- | 9.54 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-7 | 6.9 | -- | -- | -- | -- | 8.73 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-8 | 7.0 | -- | -- | -- | -- | 9.95 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-9 | 6.9 | -- | -- | -- | -- | 5.57 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-10 | 6.9 | -- | -- | -- | -- | 13.37 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B[‡] | -- | -- | 140 | 110 | 1.30 | -- | -- | 0.038 | 30 | 8.5 | 60 | 0.5 | 63 | 33 | 24 |
|  | 11C[‡] | -- | 336 | 282 | 85 | 0.65 | -- | -- | 0.272 | 23 | 6.7 | 54 | 0.3 | 65 | 38 | 19 |
|  | 20C[*] | -- | 390 | 363 | 95 | 0.95 | -- | -- | 0.118 | 25 | 7.9 | 59 | 0.3 | 65 | 31 | 17 |
|  | 20C[†] | -- | 358 | 330 | 80 | 0.75 | -- | -- | 0.064 | -- | -- | 54 | 0.5 | 58 | 34 | 25 |
|  | 21B[*] | -- | 330 | 351 | 83 | 1.20 | -- | -- | 0.166 | 23 | 6.1 | 58 | 0.3 | 70 | 43 | 23 |
|  | 21B[†] | -- | 384 | 344 | 83 | 0.45 | -- | -- | 0.048 | 23 | 6.1 | 58 | 0.4 | 68 | 35 | 22 |
| OCT 3 | F45 | 7.0 | -- | -- | -- | -- | 14.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | F46 | 6.3 | -- | -- | -- | -- | 23.27 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | F47 | 6.9 | -- | -- | -- | -- | 27.71 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | F48 | 6.8 | -- | -- | -- | -- | 16.32 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | F49 | 6.5 | -- | -- | -- | -- | 5.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | F50 | 6.8 | -- | -- | -- | -- | 34.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | F51 | 3.3 | -- | 356 | 60 | 0.55 | 4.93 | 5.48 | -- | 20 | 2.4 | 38 | 0.1 | 40 | 87 | -- |
|  | 19A-1 | 7.0 | -- | -- | -- | -- | 0.56 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-2 | 6.7 | -- | -- | -- | -- | 8.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-3 | 7.3 | -- | -- | -- | -- | 6.53 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-4 | 6.7 | -- | -- | -- | -- | 12.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-5 | 6.8 | -- | -- | -- | -- | 2.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-6 | 6.3 | -- | -- | -- | -- | 20.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-7 | 6.6 | -- | -- | -- | -- | 0.37 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-8 | 2.9 | -- | -- | -- | -- | 10.92 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-9 | 6.5 | -- | -- | -- | -- | 6.37 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-10 | 5.7 | -- | -- | 145 | 0.60 | 22.37 | 22.97 | -- | 31 | 16.4 | 9 | 11.2 | -- | 2 | -- |
|  | F45-50[‡] | -- | 436 | 220 | 135 | 0.90 | -- | -- | 0.278 | 36 | 10.9 | 11 | 0.4 | 30 | 6 | 15 |
|  | 19A[*] | -- | -- | 126 | 50 | 1.10 | -- | -- | 0.086 | 18 | 1.2 | 9 | 0.1 | 23 | 7 | 11 |
|  | 19A[†] | -- | 312 | 268 | 100 | 0.70 | -- | -- | 0.061 | 25 | 9.1 | 10 | 2.9 | 38 | 26 | 10 |
| OCT 15 | 10B-2 | 6.7 | -- | -- | -- | -- | 11.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-4 | 3.3 | -- | -- | 130 | 0.95 | 38.32 | 39.27 | -- | -- | -- | 72 | 0.3 | -- | -- | -- |
|  | 10B-6 | 7.0 | -- | -- | -- | -- | 28.86 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-8 | 3.1 | -- | -- | 100 | 0.95 | 19.73 | 20.68 | -- | 27 | 7.9 | 64 | 1.2 | -- | -- | -- |
|  | 10B-10 | 7.2 | -- | -- | -- | -- | 16.26 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-2 | 7.5 | -- | -- | -- | -- | 12.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-4 | 7.1 | -- | -- | -- | -- | 10.49 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-6 | 7.3 | -- | -- | -- | -- | 5.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-8 | 7.1 | -- | -- | -- | -- | 8.45 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-10 | 3.6 | -- | -- | 65 | 1.20 | 4.02 | 5.22 | -- | -- | -- | 62 | 0.7 | -- | -- | -- |
|  | 20C-1 | 7.2 | -- | -- | -- | -- | 20.31 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-2 | 7.1 | -- | -- | -- | -- | 12.34 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-3 | 7.5 | -- | -- | -- | -- | 9.45 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-4 | 7.3 | -- | -- | -- | -- | 10.82 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-5 | 7.6 | -- | -- | -- | -- | 5.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-6 | 3.1 | -- | -- | 83 | 1.70 | 6.17 | 7.87 | -- | 24 | 5.6 | 66 | 0.7 | -- | -- | -- |
|  | 20C-7 | 7.3 | -- | -- | -- | -- | 10.18 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-8 | 7.1 | -- | -- | -- | -- | 14.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS | COND. @ 25°C µmhos/cm | TOTAL HARD-NESS | NITROGEN as N | | TOTAL | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/ℓ | | | $NH_3$-N | $NO_2$+$NO_3$ | | | mg/ℓ | | | | | | |
| (1973) | | | | | | | | | | | | | | | | |
| OCT 15 | 20C-9 | 7.1 | -- | -- | -- | -- | 8.34 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 6.7 | -- | -- | -- | -- | 11.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | 7.1 | -- | -- | -- | -- | 10.79 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | 7.0 | -- | -- | -- | -- | 18.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | 7.0 | -- | -- | -- | -- | 11.46 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | 7.0 | -- | -- | -- | -- | 10.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | 7.0 | -- | -- | -- | -- | 13.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | 7.0 | -- | -- | -- | -- | 7.63 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | 7.1 | -- | -- | -- | -- | 20.51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | 7.0 | -- | -- | -- | -- | 12.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-10 | 6.9 | -- | -- | -- | -- | 15.69 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-2,6,10‡ | -- | 360 | 302 | 100 | 1.40 | -- | -- | 0.051 | 26 | 8.5 | 63 | 0.9 | 60 | 17 | 23 |
| | 11C-2,4,6,8‡ | -- | 530 | -- | 83 | 0.95 | -- | -- | 0.316 | 22 | 6.8 | 61 | 0.7 | 28 | 30 | 23 |
| | 20C* | -- | 316 | 123 | 105 | 1.05 | -- | -- | 0.054 | 29 | 7.9 | 68 | 0.3 | 63 | 15 | 14 |
| | 20C† | -- | 292 | 260 | 73 | 1.35 | -- | -- | 0.045 | 22 | 4.4 | 59 | 0.7 | 58 | 16 | 23 |
| | 21B* | -- | 276 | 300 | 75 | 2.20 | -- | -- | 0.086 | 22 | 4.9 | 63 | 0.5 | 63 | 12 | 20 |
| | 21B† | -- | 392 | 300 | 85 | 1.05 | -- | -- | 0.032 | 23 | 6.7 | 62 | 0.5 | 58 | 11 | 21 |
| OCT 16 | F45 | 7.0 | -- | -- | -- | -- | 10.43 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F46 | 6.9 | -- | -- | -- | -- | 11.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F48 | 6.8 | -- | -- | -- | -- | 10.41 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F49 | 6.7 | -- | -- | -- | -- | 8.45 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F50 | 7.1 | -- | -- | -- | -- | 9.75 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F51 | 7.3 | -- | -- | -- | -- | 5.58 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | 7.2 | -- | -- | -- | -- | 0.33 | -- | -- | -- | -- | -- | -- | 28 | -- | -- |
| | 19A-2 | 7.3 | -- | -- | -- | -- | 3.04 | -- | -- | -- | -- | -- | -- | 28 | -- | -- |
| | 19A-3 | 7.3 | -- | -- | -- | -- | 3.90 | -- | -- | -- | -- | -- | -- | 20 | -- | -- |
| | 19A-4 | 6.9 | -- | -- | -- | -- | 7.52 | -- | -- | -- | -- | -- | -- | 20 | -- | -- |
| | 19A-5 | 7.1 | -- | -- | -- | -- | 1.23 | -- | -- | -- | -- | -- | -- | 13 | -- | -- |
| | 19A-6 | 7.1 | -- | -- | -- | -- | 7.91 | -- | -- | -- | -- | -- | -- | 28 | -- | -- |
| | 19A-7 | 7.2 | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | 18 | -- | -- |
| | 19A-8 | 7.1 | -- | -- | -- | -- | 6.44 | -- | -- | -- | -- | -- | -- | 28 | -- | -- |
| | 19A-9 | 7.1 | -- | -- | -- | -- | 5.15 | -- | -- | -- | -- | -- | -- | 23 | -- | -- |
| | 19A-10 | 6.0 | 256 | -- | 85 | 0.85 | 12.81 | 13.66 | -- | -- | -- | 8 | 7.5 | 36 | ND | 11 |
| | F45-51‡ | -- | 186 | 144 | 85 | 1.03 | -- | -- | 0.198 | 24 | 6.1 | 12 | 0.1 | 23 | 15 | 14 |
| | 19A* | -- | 102 | 104 | 40 | 1.25 | -- | -- | 0.064 | 16 | ND | 10 | ND | 23 | 1 | 11 |
| | 19A† | -- | 140 | -- | 15 | 0.70 | -- | -- | 0.131 | 18 | 2.4 | 9 | 0.7 | 23 | ND | 12 |
| NOV 5 | 10B-2 | 6.5 | -- | -- | -- | -- | 12.18 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 6.1 | -- | -- | -- | -- | 26.56 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 3.2 | -- | 486 | 76 | 2.20 | 11.65 | 13.85 | 0.050 | 10 | 12.4 | 60 | 1.1 | 58 | 96 | 28 |
| | 10B-8 | 6.3 | -- | -- | -- | -- | 12.29 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 2.7 | -- | 1400 | -- | 2.35 | 6.86 | 9.21 | 0.070 | 10 | -- | 57 | 2.9 | 68 | 282 | 19 |
| | 11C-2 | 6.8 | -- | -- | -- | -- | 10.87 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 6.9 | -- | -- | -- | -- | 14.99 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 6.7 | -- | -- | -- | -- | 2.81 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 5.7 | -- | -- | -- | 2.20 | 17.28 | 19.48 | -- | -- | -- | -- | -- | -- | 52 | 19 |
| | 11C-10 | 6.9 | -- | -- | -- | -- | 4.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 6.9 | -- | -- | -- | -- | 20.44 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 6.8 | -- | -- | -- | -- | 13.92 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.6 | -- | -- | -- | -- | 11.51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

*ODD COMPOSITE. †EVEN COMPOSITE. ‡COMPOSITE.

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C μmhos/ cm | TOTAL HARD- NESS | NITROGEN as N NH3- N | NO2+ NO3 | TOTAL | PO4-P | Ca mg/ℓ | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1973) | | | | | | | | | | | | | | | | |
| NOV 5 | 20C-4 | 7.0 | -- | -- | -- | -- | 10.38 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 7.4 | -- | -- | -- | -- | 5.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 7.0 | -- | -- | -- | -- | 4.55 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 3.7 | -- | -- | -- | 2.20 | 10.20 | 12.40 | 0.06 | 8 | -- | 60 | 1.4 | 53 | 59 | 24 |
| | 20C-8 | 6.4 | -- | -- | -- | -- | 14.67 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 6.7 | -- | -- | -- | -- | 9.83 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 6.6 | -- | -- | -- | -- | 12.61 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | 6.7 | -- | -- | -- | -- | 4.67 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | 6.7 | -- | -- | -- | -- | 11.68 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | 6.7 | -- | -- | -- | -- | 12.99 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | 6.6 | -- | -- | -- | -- | 9.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | 6.6 | -- | -- | -- | -- | 12.35 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | 6.6 | -- | -- | -- | -- | 7.02 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | 6.4 | -- | -- | -- | -- | 16.38 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | 6.5 | -- | -- | -- | -- | 10.64 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-10 | 6.6 | -- | -- | -- | -- | 10.35 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-2,4,8‡ | -- | 154 | 396 | 92 | 1.85 | -- | -- | 0.02 | 15 | 13.3 | 57 | 1.0 | 60 | 20 | 21 |
| | 11C-2,4,6,10‡ | -- | 68 | 320 | 68 | 2.00 | -- | -- | 0.09 | 8 | 12.0 | 57 | 2.0 | 55 | 17 | 21 |
| | 20C-1,3,5,9‡ | -- | 146 | 472 | 104 | 2.45 | -- | -- | 0.06 | 25 | 10.1 | 75 | 1.1 | 70 | 25 | 17 |
| | 20C† | -- | 94 | 330 | 80 | 2.65 | -- | -- | 0.05 | 13 | 11.6 | 64 | 1.1 | 63 | 22 | 26 |
| | 21B** | -- | 120 | 360 | 72 | 2.95 | -- | -- | 0.08 | 14 | 9.3 | 62 | 1.1 | 58 | 21 | 25 |
| | 21B† | -- | 270 | 334 | 72 | 4.10 | -- | -- | 0.02 | 14 | 9.3 | 60 | 1.3 | 55 | 25 | 26 |
| NOV 6 | F45 | 6.4 | -- | -- | -- | -- | 2.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F46 | 6.4 | -- | -- | -- | -- | 3.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F48 | 6.5 | -- | -- | -- | -- | 5.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F49 | 6.7 | -- | -- | -- | -- | 3.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F50 | 6.8 | -- | -- | -- | -- | 3.62 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | F51 | 6.7 | -- | -- | -- | -- | 3.74 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | 6.8 | -- | -- | -- | -- | 0.37 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | 6.8 | -- | -- | -- | -- | 1.62 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | 6.7 | -- | -- | -- | -- | 3.39 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | 6.6 | -- | -- | -- | -- | 4.64 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | 6.7 | -- | -- | -- | -- | 1.87 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | 6.5 | -- | -- | -- | -- | 6.52 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | 6.7 | -- | -- | -- | -- | 0.26 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | 6.8 | -- | -- | -- | -- | 2.81 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | 6.7 | -- | -- | -- | -- | 2.87 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-10 | 5.7 | -- | -- | -- | -- | 9.07 | -- | -- | -- | -- | -- | -- | 33 | ND | 12 |
| | 19A** | -- | 24 | 124 | 48 | 2.95 | -- | -- | 0.11 | 11 | 5.0 | 12 | 0.5 | 18 | 5 | 11 |
| | 19A† | -- | ND | 142 | 40 | 1.90 | -- | -- | 0.15 | 6 | 6.1 | 10 | 1.1 | 23 | ND | 13 |
| | F45-51‡ | -- | 6 | 160 | 44 | 3.55 | -- | -- | 0.26 | 13 | 2.8 | 9 | 0.8 | 18 | ND | 17 |
| DEC 17 | 10B-2 | 6.7 | -- | -- | -- | -- | 8.64 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 6.8 | -- | -- | -- | -- | 6.78 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 6.8 | -- | -- | -- | -- | 10.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | 6.9 | -- | -- | -- | -- | 4.61 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 6.9 | -- | -- | -- | -- | 5.22 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 7.4 | -- | -- | -- | -- | 16.43 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 7.8 | -- | -- | -- | -- | 29.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.6 | -- | -- | -- | -- | 15.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 7.3 | -- | -- | -- | -- | 13.95 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS | COND.@ 25°C µmhos/ cm | TOTAL HARD- NESS | NITROGEN as N | | | PO4-P | Ca | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $NH_3$- N | $NO_2$+ $NO_3$ | TOTAL | | | | | | | | |
| | | | mg/ℓ | | | | | | | mg/ℓ | | | | | | |
| (1973) DEC 17 | 20C-5 | 7.4 | -- | -- | -- | -- | 9.82 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 7.6 | -- | -- | -- | -- | 2.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 7.4 | -- | -- | -- | -- | 8.32 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 7.2 | -- | -- | -- | -- | 13.91 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 29C-9 | 7.5 | -- | -- | -- | -- | 4.62 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 7.1 | -- | -- | -- | -- | 11.75 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | 7.0 | -- | -- | -- | -- | 9.34 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | 7.1 | -- | -- | -- | -- | 2.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | 7.1 | -- | -- | -- | -- | 15.96 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | 7.1 | -- | -- | -- | -- | 29.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | 7.0 | -- | -- | -- | -- | 10.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | 7.0 | -- | -- | -- | -- | 4.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | 7.0 | -- | -- | -- | -- | 3.63 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | 7.3 | -- | -- | -- | -- | 6.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-10 | 6.9 | -- | -- | -- | -- | 6.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B‡ | -- | 244 | 260 | 60 | 2.96 | -- | -- | 0.37 | 21 | 1.8 | 52 | 0.7 | 48 | 21 | 21 |
| | 20C* | -- | 388 | 520 | 108 | 5.90 | -- | -- | 2.80 | 33 | 6.2 | 98 | 3.5 | 135 | 37 | 19 |
| | 20C† | -- | 308 | 330 | 80 | 2.59 | -- | -- | 0.28 | 29 | 1.8 | 72 | 1.0 | 54 | 21 | 19 |
| | 21B* | -- | 272 | 236 | 68 | 4.73 | -- | -- | 0.23 | 26 | 0.7 | 59 | 0.7 | 54 | 17 | 20 |
| | 21B† | -- | 396 | 424 | 80 | 5.02 | -- | -- | 1.60 | 22 | 6.1 | 85 | 2.3 | 92 | 30 | 21 |
| DEC 18 | 11C-2 | 7.1 | -- | -- | -- | -- | 3.46 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 7.2 | -- | -- | -- | -- | 11.76 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 6.8 | -- | -- | -- | -- | 1.65 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 6.8 | -- | -- | -- | -- | 7.99 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 7.1 | -- | -- | -- | -- | 1.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C† | -- | 252 | 296 | 64 | 5.94 | -- | -- | 3.32 | 17 | 5.2 | 63 | 1 5 | 60 | 25 | 21 |
| DEC 19 | 19A* | -- | 160 | 188 | 76 | 3.06 | -- | -- | 0.25 | 16 | 8.9 | 16 | 0.4 | 38 | 4 | 8 |
| | 19A† | -- | 140 | 114 | 44 | 2.20 | -- | -- | 0.31 | 19 | -- | 11 | 1.8 | 26 | ND | 10 |
| | F45-51‡ | -- | 218 | 120 | 52 | 2.20 | -- | -- | 0.75 | 20 | 0.5 | 15 | 0.4 | 18 | 15 | 13 |
| (1974) FEB 2 | 11C-2 | 6.9 | -- | -- | -- | -- | 2.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 6.9 | -- | -- | -- | -- | 1.61 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 7.0 | -- | -- | -- | -- | 0.82 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 7.0 | -- | -- | -- | -- | 1.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 7.2 | -- | -- | -- | -- | 0.97 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 6.9 | -- | -- | -- | -- | 4.03 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 7.0 | -- | -- | -- | -- | 1.96 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.1 | -- | -- | -- | -- | 4.01 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 7.1 | -- | -- | -- | -- | 3.41 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 7.1 | -- | -- | -- | -- | 1.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 7.1 | -- | -- | -- | -- | 1.06 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 7.1 | -- | -- | -- | -- | 2.52 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 6.9 | -- | -- | -- | -- | 2.43 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 7.2 | -- | -- | -- | -- | 1.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 7.1 | -- | -- | -- | -- | 2.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C‡ | -- | -- | -- | 36 | 0.81 | -- | -- | 0.003 | 11 | 2.1 | 36 | 0.4 | 32 | 12 | 20 |
| | 20C* | -- | -- | -- | 60 | 0.63 | -- | -- | 0.005 | 19 | 3.1 | 40 | 0.7 | 36 | 22 | 20 |
| | 20C† | -- | -- | -- | 48 | 1.26 | -- | -- | ND | 14 | 3.2 | 37 | 0.9 | 38 | 18 | 26 |
| FEB 21 | 10B-2 | 6.9 | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 6.8 | -- | -- | -- | -- | 1.36 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 6.9 | -- | -- | -- | -- | 0.22 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARD-NESS | NITROGEN as N |  |  | PO4-P | Ca | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | NH3-N | NO2+NO3 | TOTAL |  |  |  |  |  |  |  |  |
|  |  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |
| (1974) FEB 21 | 10B-8 | 7.0 | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-10 | 6.9 | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-1 | 7.1 | -- | -- | -- | -- | 0.78 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-2 | 7.2 | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-3 | 7.1 | -- | -- | -- | -- | 1.29 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-4 | 7.0 | -- | -- | -- | -- | 1.53 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-6 | 7.2 | -- | -- | -- | -- | 0.26 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-7 | 7.1 | -- | -- | -- | -- | 1.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-8 | 7.1 | -- | -- | -- | -- | 0.47 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-9 | 7.1 | -- | -- | -- | -- | 0.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-10 | 7.2 | -- | -- | -- | -- | 0.59 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-1 | 6.9 | -- | -- | -- | -- | 0.45 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-2 | 6.9 | -- | -- | -- | -- | 0.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-3 | 6.8 | -- | -- | -- | -- | 1.76 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-4 | 6.9 | -- | -- | -- | -- | 1.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-5 | 7.0 | -- | -- | -- | -- | 0.55 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-6 | 6.8 | -- | -- | -- | -- | 0.48 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-7 | 6.8 | -- | -- | -- | -- | 0.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-8 | 6.8 | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-9 | 6.7 | -- | -- | -- | -- | 0.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-10 | 6.4 | -- | -- | -- | -- | 1.63 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B‡ | -- | -- | -- | 36 | 0.16 | -- | -- | 0.098 | 6 | 5.1 | 19 | 0.5 | 12 | 28 | 18 |
|  | 19A* | -- | -- | -- | 32 | 0.71 | -- | -- | ND | 8 | 2.9 | 8 | 0.6 | 12 | 5 | 13 |
|  | 19A† | -- | -- | -- | 24 | ND | -- | -- | -- | 7 | 1.6 | 8 | 0.6 | 12 | 6 | 13 |
|  | 21B* | -- | -- | -- | -- | 1.54 | -- | -- | ND | 5 | -- | 23 | 0.5 | 16 | 12 | 17 |
|  | 21B† | -- | -- | -- | 24 | 0.15 | -- | -- | 0.012 | 7 | 1.6 | 19 | 0.7 | 14 | 13 | 20 |
| APR 2 | 11C-2 | 7.4 | -- | -- | -- | -- | 0.44 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-4 | 7.2 | -- | -- | -- | -- | 0.68 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-6 | 7.1 | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-8 | 6.9 | -- | -- | -- | -- | 0.67 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-10 | 7.2 | -- | -- | -- | -- | 0.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-1 | 6.9 | -- | -- | -- | -- | 0.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-2 | 7.3 | -- | -- | -- | -- | 1.47 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-3 | 7.1 | -- | -- | -- | -- | 2.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-4 | 7.2 | -- | -- | -- | -- | 2.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-5 | 7.0 | -- | -- | -- | -- | 0.46 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-6 | 7.2 | -- | -- | -- | -- | 0.65 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-7 | 7.0 | -- | -- | -- | -- | 1.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-8 | 7.0 | -- | -- | -- | -- | 1.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-9 | 7.0 | -- | -- | -- | -- | 0.38 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-10 | 6.8 | -- | -- | -- | -- | 1.35 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C‡ | -- | -- | -- | 48 | 2.47 | -- | -- | 0.074 | 12 | 4.4 | 33 | 0.7 | 32 | 15 | 24 |
|  | 20C* | -- | -- | -- | 64 | 0.93 | -- | -- | 0.081 | 18 | 4.6 | 33 | 0.7 | 36 | 19 | 19 |
|  | 20C† | -- | -- | -- | 60 | 1.34 | -- | -- | 0.140 | 14 | 6.1 | 33 | 0.7 | 36 | 15 | 25 |
| APR 3 | 10B-2 | 7.4 | -- | -- | -- | -- | 0.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-4 | 7.3 | -- | -- | -- | -- | 0.89 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-6 | 7.2 | -- | -- | -- | -- | ND | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-8 | 7.1 | -- | -- | -- | -- | 0.22 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-10 | 7.2 | -- | -- | -- | -- | ND | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-1 | 7.3 | -- | -- | -- | -- | 0.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARD-NESS | NITROGEN as N NH3-N | NITROGEN as N NO2+NO3 | NITROGEN as N TOTAL | PO4-P | Ca | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |
| (1974) APR 3 | 19A-2 | 6.8 | -- | -- | -- | -- | ND | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-3 | 7.1 | -- | -- | -- | -- | 1.63 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-4 | 6.5 | -- | -- | -- | -- | 0.52 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-5 | 7.0 | -- | -- | -- | -- | 1.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-6 | 6.5 | -- | -- | -- | -- | 1.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-7 | 6.9 | -- | -- | -- | -- | 0.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-8 | 6.6 | -- | -- | -- | -- | 0.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-9 | 6.8 | -- | -- | -- | -- | 0.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-10 | 5.9 | -- | -- | -- | -- | 0.67 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-1 | 7.1 | -- | -- | -- | -- | 0.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-2 | 7.1 | -- | -- | -- | -- | 0.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-4 | 6.9 | -- | -- | -- | -- | 0.63 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-6 | 7.0 | -- | -- | -- | -- | 0.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-7 | 7.1 | -- | -- | -- | -- | 0.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-8 | 6.9 | -- | -- | -- | -- | ND | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-9 | 7.0 | -- | -- | -- | -- | 0.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-10 | 6.9 | -- | -- | -- | -- | 0.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B‡ | -- | -- | -- | 44 | 0.69 | -- | -- | 0.032 | 6 | 7.0 | 11 | 0.2 | 12 | 9 | 15 |
|  | 19A* | -- | -- | -- | 48 | 0.80 | -- | -- | 0.033 | 8 | 6.8 | 6 | 0.7 | 14 | 4 | 12 |
|  | 19A† | -- | -- | -- | 28 | 0.15 | -- | -- | 0.085 | 7 | 2.6 | 6 | 1.8 | 14 | 3 | 14 |
|  | 21B* | -- | -- | -- | 40 | 1.05 | -- | -- | 0.055 | 7 | 5.5 | 17 | 0.3 | 14 | 10 | 15 |
|  | 21B† | -- | -- | -- | 36 | 0.40 | -- | -- | 0.054 | 6 | 5.1 | 13 | 0.3 | 12 | 7 | 14 |
| MAY 6 | 10B-2 | 6.8 | -- | -- | -- | -- | 0.35 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-4 | 6.9 | -- | -- | -- | -- | 0.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-6 | 7.0 | -- | -- | -- | -- | 0.45 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-8 | 7.1 | -- | -- | -- | -- | 0.34 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-10 | 7.3 | -- | -- | -- | -- | 0.35 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-1 | 6.8 | -- | -- | -- | -- | 0.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-2 | 6.8 | -- | -- | -- | -- | 0.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-3 | 7.0 | -- | -- | -- | -- | 0.53 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-4 | 6.7 | -- | -- | -- | -- | 0.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-5 | 3.4 | -- | -- | 28 | -- | 0.86 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-6 | 6.2 | -- | -- | -- | -- | 0.92 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-7 | 6.7 | -- | -- | -- | -- | 0.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-8 | 7.0 | -- | -- | -- | -- | 0.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-9 | 7.0 | -- | -- | -- | -- | 0.67 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-10 | 6.6 | -- | -- | -- | -- | 0.27 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-1 | 7.0 | -- | -- | -- | -- | 0.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-2 | 7.0 | -- | -- | -- | -- | 0.18 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-3 | 7.4 | -- | -- | -- | -- | 0.37 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-4 | 7.2 | -- | -- | -- | -- | 0.27 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-6 | 7.1 | -- | -- | -- | -- | 0.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-7 | 7.0 | -- | -- | -- | -- | 0.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-8 | 7.0 | -- | -- | -- | -- | 0.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-9 | 7.0 | -- | -- | -- | -- | 0.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-10 | 7.1 | -- | -- | 16 | -- | 0.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B‡ | -- | -- | -- | 12 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-1,3,7,9 | -- | -- | -- | 28 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A† | -- | -- | -- | 24 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-1,3,7,9 | -- | -- | -- | 20 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-2,4,6,8 | -- | -- | -- | 24 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N NH3-N | NITROGEN as N NO2+NO3 | TOTAL | PO4-P | Ca | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |
| (1974) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MAY 9 | 11C-2 | 6.9 | -- | -- | -- | -- | 0.95 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-4 | 6.9 | -- | -- | -- | -- | 0.28 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-6 | 6.9 | -- | -- | -- | -- | 0.27 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-8 | 7.0 | -- | -- | -- | -- | 0.75 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-10 | 7.1 | -- | -- | -- | -- | 0.47 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-1 | 3.0 | -- | -- | -- | -- | 2.44 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-2 | 6.5 | -- | -- | -- | -- | 2.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-3 | 6.8 | -- | -- | -- | -- | 2.48 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-4 | 7.1 | -- | -- | -- | -- | 4.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-5 | 6.8 | -- | -- | -- | -- | 0.54 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-6 | 2.7 | -- | -- | 40 | -- | 0.71 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-7 | 3.5 | -- | -- | -- | -- | 1.22 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-8 | 6.4 | -- | -- | -- | -- | 1.56 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-9 | 7.1 | -- | -- | -- | -- | 0.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-10 | 6.9 | -- | -- | -- | -- | 1.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C‡ | — | -- | -- | 36 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-1,7‡ | -- | -- | -- | 60 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-3,5,9‡ | -- | -- | -- | 64 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-2,4,8,10‡ | -- | -- | -- | 52 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MAY 22 | 10B-2 | 7.0 | -- | -- | -- | -- | 0.12 | -- | -- | -- | -- | -- | -- | — | -- | -- |
|  | 10B-4 | 7.1 | -- | -- | -- | -- | 0.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-6 | 7.0 | -- | -- | -- | -- | 0.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-8 | 7.3 | -- | -- | -- | -- | 0.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-10 | 7.1 | -- | -- | -- | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-1 | 6.9 | -- | -- | -- | -- | 0.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-2 | 6.9 | -- | -- | -- | -- | 0.06 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-3 | 7.3 | -- | -- | -- | -- | 0.26 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-4 | 7.2 | -- | -- | -- | -- | 0.46 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-5 | 6.9 | -- | -- | -- | -- | 0.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-6 | 7.2 | -- | -- | -- | -- | 0.44 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-7 | 7.1 | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-8 | 7.3 | -- | -- | -- | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-9 | 6.8 | -- | -- | -- | -- | 0.42 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-10 | 6.8 | -- | -- | -- | -- | 0.42 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-1 | 7.1 | -- | -- | -- | -- | 0.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-2 | 7.2 | -- | -- | -- | -- | 0.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-3 | 7.1 | -- | -- | -- | -- | 0.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-4 | 7.0 | -- | -- | -- | -- | 0.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-6 | 7.3 | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-7 | 7.1 | -- | -- | -- | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-8 | 6.9 | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-9 | 7.0 | -- | -- | -- | -- | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-10 | 7.0 | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B‡ | -- | 40 | 108 | 16 | -- | -- | -- | 0.038 | 4 | 1.5 | 14 | 0.5 | 12 | 4 | 17 |
|  | 19A* | -- | 54 | 98 | 28 | -- | -- | -- | 0.038 | 6 | 3.2 | 8 | 1.2 | 16 | 1 | 13 |
|  | 19A† | -- | 64 | 100 | 24 | -- | -- | -- | 0.121 | 5 | 2.8 | 8 | 2.7 | 16 | 1 | 16 |
|  | 21B* | -- | 80 | 142 | 24 | -- | -- | -- | 0.106 | 5 | 2.8 | 18 | 0.7 | 12 | 9 | 17 |
|  | 21B† | -- | 80 | 150 | 24 | -- | -- | -- | 0.023 | 4 | 3.4 | 13 | 0.8 | 14 | 11 | 19 |

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## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N |  |  | PO$_4$-P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | mg/ℓ | NH$_3$-N | NO$_2$+NO$_3$ | TOTAL |  |  |  |  |  |  |  |  |
| (1974) MAY 23 | 11C-2 | 7.1 | -- | -- | -- | -- | 5.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-4 | 7.2 | -- | -- | -- | -- | 1.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-6 | 7.2 | -- | -- | -- | -- | 0.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-8 | 7.3 | -- | -- | -- | -- | 6.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-10 | 7.4 | -- | -- | -- | -- | 2.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-1 | 6.9 | -- | -- | -- | -- | 16.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-2 | 7.1 | -- | -- | -- | -- | 10.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-3 | 7.1 | -- | -- | -- | -- | 6.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-4 | 7.0 | -- | -- | -- | -- | 7.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-5 | 7.1 | -- | -- | -- | -- | 3.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-6 | 7.1 | -- | -- | -- | -- | 11.36 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-7 | 7.2 | -- | -- | -- | -- | 8.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-8 | 7.2 | -- | -- | -- | -- | 10.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-9 | 7.1 | -- | -- | -- | -- | 6.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 20C-10 | 7.3 | -- | -- | -- | -- | 11.68 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C[‡] | -- | 160 | 246 | 44 | -- | -- | -- | 0.242 | 8 | 5.8 | 34 | 1.1 | 48 | 10 | 24 |
|  | 20C[**] | -- | 174 | 340 | 68 | -- | -- | -- | 0.053 | 14 | 8.0 | 39 | 0.9 | 44 | 17 | 23 |
|  | 20C[†] | -- | 216 | 330 | 60 | -- | -- | -- | 0.075 | 13 | 6.7 | 38 | 1.3 | 42 | 17 | 28 |
| JUNE 12 | 10B-2 | 7.2 | -- | -- | -- | -- | 0.58 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-4 | 6.9 | -- | -- | -- | -- | 0.46 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-6 | 7.0 | -- | -- | -- | -- | 0.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-8 | 7.1 | -- | -- | -- | -- | 0.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B-10 | 7.0 | -- | -- | -- | -- | 0.38 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-1 | 6.7 | -- | -- | -- | -- | 0.76 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-2 | 6.7 | -- | -- | -- | -- | 0.51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-3 | 6.7 | -- | -- | -- | -- | 1.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-4 | 6.7 | -- | -- | -- | -- | 2.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-5 | 6.8 | -- | -- | -- | -- | 1.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-6 | 6.6 | -- | -- | -- | -- | 0.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-7 | 6.8 | -- | -- | -- | -- | 0.41 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-8 | 6.8 | -- | -- | -- | -- | 0.22 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-9 | 6.7 | -- | -- | -- | -- | 1.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 19A-10 | 6.7 | -- | -- | -- | -- | 0.38 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-1 | 6.9 | -- | -- | -- | -- | 0.35 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-2 | 6.9 | -- | -- | -- | -- | 0.38 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-3 | 7.0 | -- | -- | -- | -- | 1.44 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-4 | 6.9 | -- | -- | -- | -- | 0.54 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-6 | 7.0 | -- | -- | -- | -- | 0.42 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-7 | 7.0 | -- | -- | -- | -- | 3.36 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-8 | 6.8 | -- | -- | -- | -- | 0.77 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-9 | 6.9 | -- | -- | -- | -- | 2.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 21B-10 | 7.0 | -- | -- | -- | -- | 0.71 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 10B[‡] | -- | 80 | 122 | 24 | -- | -- | -- | 0.045 | 3 | 3.0 | 18 | 0.8 | -- | 5 | 15 |
|  | 19A[**] | -- | 94 | 103 | 28 | -- | -- | -- | 0.045 | 5 | 3.8 | 8 | 1.2 | -- | 3 | 12 |
|  | 19A[†] | -- | 72 | 100 | 24 | -- | -- | -- | 0.151 | 4 | 3.4 | 9 | 2.3 | -- | 3 | 14 |
|  | 21B[**] | -- | 70 | 148 | 28 | -- | -- | -- | 0.177 | 6 | 3.2 | 19 | 1.1 | -- | 15 | 19 |
|  | 21B[†] | -- | 96 | 120 | 24 | -- | -- | -- | 0.035 | 5 | 2.8 | 13 | 0.8 | -- | 8 | 19 |
| JUNE 14 | 11C-2 | 7.0 | -- | -- | -- | -- | 0.58 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-4 | 7.0 | -- | -- | -- | -- | 0.46 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
|  | 11C-6 | 6.8 | -- | -- | -- | -- | 0.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARD-NESS | NITROGEN as N NH3-N | NITROGEN as N NO2+NO3 | NITROGEN as N TOTAL | PO4-P | Ca | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | mg/ℓ | | | | | | | | | | | |
| (1974) | | | | | | | | | | | | | | | | |
| JUNE 14 | 11C-8 | 7.0 | -- | -- | -- | -- | 0.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 7.3 | -- | -- | -- | -- | 0.38 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 6.8 | -- | -- | -- | -- | 19.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 6.9 | -- | -- | -- | -- | 15.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.0 | -- | -- | -- | -- | 5.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 7.0 | -- | -- | -- | -- | 10.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 7.1 | -- | -- | -- | -- | 4.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 7.0 | -- | -- | -- | -- | 3.36 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 6.9 | -- | -- | -- | -- | 10.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 6.8 | -- | -- | -- | -- | 11.52 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 7.0 | -- | -- | -- | -- | 7.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 6.8 | -- | -- | -- | -- | 17.28 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C‡ | -- | 144 | 240 | 72 | -- | -- | -- | 0.233 | 6 | 13.9 | 34 | 0.8 | -- | 14 | 19 |
| | 20C* | -- | 200 | 324 | 60 | -- | -- | -- | 0.045 | 13 | 6.7 | 40 | 0.8 | — | 14 | 18 |
| | 20C† | -- | 180 | 292 | 52 | -- | -- | -- | 0.038 | 11 | 6.0 | 38 | 0.8 | -- | 15 | 20 |
| JUNE 25 | 10B-2 | 7.1 | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 6.9 | -- | -- | -- | -- | 0.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 6.8 | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | 7.2 | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 7.1 | -- | -- | -- | -- | 0.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | 6.6 | -- | -- | -- | -- | 0.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | 6.6 | -- | -- | -- | -- | 0.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | 6.5 | -- | -- | -- | -- | 0.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | 6.6 | -- | -- | -- | -- | 1.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | 6.7 | -- | -- | -- | -- | 0.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | 6.5 | -- | -- | -- | -- | 0.51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | 6.6 | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | 6.6 | -- | -- | -- | -- | 0.18 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | 6.5 | -- | -- | -- | -- | 0.36 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-10 | 6.2 | -- | -- | -- | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | 6.6 | -- | -- | -- | -- | 0.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | 6.7 | -- | -- | -- | -- | 0.26 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | 6.6 | -- | -- | -- | -- | 0.52 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | 6.5 | -- | -- | -- | -- | 0.57 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | 6.6 | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | 6.7 | -- | -- | -- | -- | 0.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | 6.9 | -- | -- | -- | -- | 0.27 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | 6.8 | -- | -- | -- | -- | 0.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-10 | 6.8 | -- | -- | -- | -- | 0.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B‡ | -- | 80 | 114 | 24 | -- | -- | -- | 0.042 | 4 | 3.4 | 13 | 0.8 | -- | 5 | -- |
| | 19A* | -- | 76 | 116 | 32 | -- | -- | -- | 0.039 | 6 | 4.1 | 8 | 1.2 | -- | 3 | -- |
| | 19A† | -- | 54 | 98 | 24 | -- | -- | -- | 0.151 | 5 | 3.4 | 8 | 2.3 | -- | 5 | -- |
| | 21B* | -- | 80 | 146 | 28 | -- | -- | -- | 0.041 | 6 | 3.2 | 16 | 0.9 | -- | 13 | -- |
| | 21B† | -- | 70 | 128 | 28 | -- | -- | -- | 0.083 | 5 | 3.8 | 13 | 0.9 | -- | 13 | -- |
| JUNE 27 | 11C-2 | 6.7 | -- | -- | -- | -- | 5.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 6.6 | -- | -- | -- | -- | 3.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 6.6 | -- | -- | -- | -- | 3.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 6.5 | -- | -- | -- | -- | 7.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 7.0 | -- | -- | -- | -- | 3.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 6.7 | -- | -- | -- | -- | 16.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N<br>$NH_3$-N | <br>$NO_2$+$NO_3$ | <br>TOTAL | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | mg/ℓ | | | | | mg/ℓ | | | | | | |
| (1974)<br>JUNE 27 | 20C-2 | 6.6 | -- | -- | -- | -- | 16.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 6.9 | -- | -- | -- | -- | 4.96 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 6.7 | -- | -- | -- | -- | 4.96 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 6.8 | -- | -- | -- | -- | 3.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 6.9 | -- | -- | -- | -- | 3.68 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 6.7 | -- | -- | -- | -- | 11.52 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 6.6 | -- | -- | -- | -- | 9.28 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 6.8 | -- | -- | -- | -- | 5.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 6.6 | -- | -- | -- | -- | 9.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C$^{\ddagger}$ | -- | 160 | 260 | 36 | -- | -- | -- | 0.094 | 7 | 4.5 | 34 | 0.7 | -- | 15 | -- |
| | 20C$^{*}$ | -- | 470 | 350 | 64 | -- | -- | -- | 0.065 | 14 | 7.0 | 42 | 0.9 | -- | 30 | -- |
| | 20C$^{\dagger}$ | -- | 102 | 334 | 56 | -- | -- | -- | 0.100 | 12 | 6.3 | 42 | 1.2 | -- | 27 | -- |
| JULY 10 | 10B-2 | 8.0 | -- | -- | -- | -- | 0.03 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 7.8 | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 7.6 | -- | -- | -- | -- | 0.02 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | 7.4 | -- | -- | -- | -- | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 7.4 | -- | -- | -- | -- | 0.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | -- | -- | -- | -- | -- | 0.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | -- | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | -- | -- | -- | -- | -- | 0.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | -- | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | -- | -- | -- | -- | -- | 0.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | 7.3 | -- | -- | 52 | -- | 0.21 | -- | 0.280 | 8 | 7.8 | 13 | 1.8 | -- | 8 | -- |
| | 21B-10 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | 7.3 | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | 7.2 | -- | -- | -- | -- | 0.06 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | 7.0 | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | 6.9 | -- | -- | -- | -- | 0.18 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | 7.0 | -- | -- | -- | -- | 0.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | 7.0 | -- | -- | -- | -- | 0.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | 7.0 | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | 7.0 | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | 7.1 | -- | -- | -- | -- | 0.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-10 | 7.0 | -- | -- | -- | -- | 0.06 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B$^{\ddagger}$ | -- | -- | -- | 16 | -- | -- | -- | 0.060 | 4 | 1.5 | 13 | 0.6 | -- | 4 | -- |
| | 19A$^{*}$ | -- | -- | -- | 28 | -- | -- | -- | 0.070 | 6 | 3.2 | 8 | 1.3 | -- | 2 | -- |
| | 19A$^{\dagger}$ | -- | -- | -- | 28 | -- | -- | -- | 0.270 | 5 | 3.8 | 8 | 1.8 | -- | 3 | -- |
| | 21B$^{*}$ | -- | -- | -- | -- | -- | -- | -- | 0.080 | 8 | -- | 14 | 1.1 | -- | -- | -- |
| | 21B$^{\dagger}$ | -- | -- | -- | -- | -- | -- | -- | 0.190 | 8 | -- | 13 | 1.5 | -- | -- | -- |
| JULY 11 | 11C-2 | 6.6 | -- | -- | -- | -- | 4.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 6.8 | -- | -- | -- | -- | 2.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 6.7 | -- | -- | -- | -- | 1.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 6.6 | -- | -- | -- | -- | 4.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 6.7 | -- | -- | -- | -- | 1.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 6.7 | -- | -- | -- | -- | 14.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 6.7 | -- | -- | -- | -- | 15.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 6.8 | -- | -- | -- | -- | 2.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 6.8 | -- | -- | -- | -- | 4.48 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N NH3-N | NO2+NO3 | TOTAL | PO4-P | Ca | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | mg/ℓ | | | | | | | | | | | |
| (1974) | | | | | | | | | | | | | | | | |
| JULY 11 | 20C-5 | 6.7 | -- | -- | -- | -- | 1.76 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 6.6 | -- | -- | -- | -- | 1.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 6.7 | -- | -- | -- | -- | 3.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 6.7 | -- | -- | -- | -- | 5.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 6.7 | -- | -- | -- | -- | 4.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | 6.6 | -- | -- | -- | -- | 5.44 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C‡ | -- | -- | -- | 40 | -- | -- | -- | 0.220 | 8 | 4.9 | 35 | 0.9 | -- | 14 | -- |
| | 20C* | -- | -- | -- | 68 | -- | -- | -- | 0.100 | 15 | 7.4 | 49 | 0.7 | -- | 22 | -- |
| | 20C† | -- | -- | -- | 60 | -- | -- | -- | 0.110 | 13 | 6.7 | 44 | 0.9 | -- | 21 | -- |
| JULY 31 | 10B-2 | 7.4 | -- | -- | -- | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | 7.3 | -- | -- | -- | -- | 0.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | 7.2 | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | 7.2 | -- | -- | -- | -- | 0.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | 7.3 | -- | -- | -- | -- | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | 7.5 | -- | -- | -- | -- | 0.22 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | 7.5 | -- | -- | -- | -- | 0.06 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | 7.2 | -- | -- | -- | -- | 0.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | 7.0 | -- | -- | -- | -- | 0.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | 7.2 | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | 7.1 | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | 7.1 | -- | -- | -- | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | 7.2 | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | 7.1 | -- | -- | -- | -- | 0.39 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-10 | 7.3 | -- | -- | -- | -- | 0.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | 7.1 | -- | -- | -- | -- | 0.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | 7.2 | -- | -- | -- | -- | 0.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | 7.2 | -- | -- | -- | -- | 0.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | 7.2 | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | 7.1 | -- | -- | -- | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | 7.2 | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | 7.2 | -- | -- | -- | -- | 0.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | 7.1 | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B‡ | -- | -- | -- | 24 | ND | -- | -- | 0.215 | -- | -- | -- | 0.3 | 18 | -- | 18 |
| | 19A* | -- | -- | -- | 28 | ND | -- | -- | 0.103 | -- | -- | -- | 0.5 | 16 | -- | 15 |
| | 19A† | -- | -- | -- | 24 | ND | -- | -- | 0.488 | -- | -- | -- | 1.6 | 20 | -- | 18 |
| | 21B* | -- | -- | -- | 28 | 1.02 | -- | -- | 0.143 | -- | -- | -- | 0.5 | 20 | -- | 18 |
| | 21B† | -- | -- | -- | 24 | ND | -- | -- | 0.118 | -- | -- | -- | 0.5 | 20 | -- | 19 |
| AUG 1 | 11C-2 | 7.1 | -- | -- | -- | -- | 2.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | 7.0 | -- | -- | -- | -- | 6.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | 7.1 | -- | -- | -- | -- | 2.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | 6.9 | -- | -- | -- | -- | 2.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | 7.1 | -- | -- | -- | -- | 1.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | 7.0 | -- | -- | -- | -- | 12.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | 7.0 | -- | -- | -- | -- | 15.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | 7.1 | -- | -- | -- | -- | 1.76 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | 7.2 | -- | -- | -- | -- | 2.88 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | 7.1 | -- | -- | -- | -- | 1.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | 7.0 | -- | -- | -- | -- | 0.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | 7.1 | -- | -- | -- | -- | 2.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | 7.1 | -- | -- | -- | -- | 4.32 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | 7.0 | -- | -- | -- | -- | 2.72 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

## TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C μmhos/ cm | TOTAL HARD- NESS | NITROGEN as N NH3- N | NO2+ NO3 | TOTAL | PO4-P | Ca | Mg | Na | K | Cl | SO4 | SiO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | mg/ℓ | | | | | | | | | | | |
| (1974) | | | | | | | | | | | | | | | | |
| AUG 1 | 20C-10 | 7.0 | -- | -- | -- | -- | 4.96 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C‡ | -- | -- | -- | 36 | 0.10 | -- | -- | 0.383 | -- | -- | -- | 0.5 | 44 | -- | 27 |
| | 20C⁑ | -- | -- | -- | 60 | ND | -- | -- | 0.223 | -- | -- | -- | 1.0 | 52 | -- | 27 |
| | 20C† | -- | -- | -- | 64 | 0.92 | -- | -- | 0.403 | -- | -- | -- | 1.0 | 52 | -- | 26 |
| AUG 14 | 10B-2 | -- | -- | -- | -- | -- | 0.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-4 | -- | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-6 | -- | -- | -- | -- | -- | 0.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-8 | -- | -- | -- | -- | -- | 0.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B-10 | -- | -- | -- | -- | -- | 0.24 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-1 | -- | -- | -- | -- | -- | 0.23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | -- | -- | -- | -- | -- | 0.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | -- | -- | -- | -- | -- | 0.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | -- | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | -- | -- | -- | -- | -- | 0.12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | -- | -- | -- | -- | -- | 0.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | -- | -- | -- | -- | -- | 0.18 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | -- | -- | -- | -- | -- | 0.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | -- | -- | -- | -- | -- | 0.51 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-10 | -- | -- | -- | -- | -- | 0.13 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | -- | -- | -- | -- | -- | 0.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | -- | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | -- | -- | -- | -- | -- | 0.16 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | -- | -- | -- | -- | -- | 0.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | -- | -- | -- | -- | -- | 0.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | -- | -- | -- | -- | -- | 0.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | -- | -- | -- | -- | -- | 0.14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | -- | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10B‡ | -- | -- | -- | 24 | ND | -- | -- | 0.078 | -- | -- | -- | 1.0 | 19 | -- | 19 |
| | 19A⁑ | -- | -- | -- | 28 | ND | -- | -- | 0.100 | -- | -- | -- | 1.6 | 17 | -- | 17 |
| | 19A† | -- | -- | -- | 24 | 0.10 | -- | -- | 0.680 | -- | -- | -- | 0.5 | 18 | -- | 18 |
| | 21B⁑ | -- | -- | -- | 24 | ND | -- | -- | 0.098 | -- | -- | -- | 0.5 | 19 | -- | 18 |
| | 21B† | -- | -- | -- | 28 | ND | -- | -- | 0.068 | -- | -- | -- | 0.5 | 19 | -- | 19 |
| AUG 15 | 11C-2 | -- | -- | -- | -- | -- | 2.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | -- | -- | -- | -- | -- | 5.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | -- | -- | -- | -- | -- | 1.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | -- | -- | -- | -- | -- | 3.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | -- | -- | -- | -- | -- | 1.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | -- | -- | -- | -- | -- | 8.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | -- | -- | -- | -- | -- | 9.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | -- | -- | -- | -- | -- | 1.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | -- | -- | -- | -- | -- | 3.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | -- | -- | -- | -- | -- | 1.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | -- | -- | -- | -- | -- | 0.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | -- | -- | -- | -- | -- | 1.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | -- | -- | -- | -- | -- | 2.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | -- | -- | -- | -- | -- | 3.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | -- | -- | -- | -- | -- | 5.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C‡ | -- | -- | -- | 40 | 0.40 | -- | -- | 0.440 | -- | -- | -- | 1.0 | 49 | -- | 25 |
| | 20C⁑ | -- | -- | -- | 60 | ND | -- | -- | 0.238 | -- | -- | -- | 1.6 | 56 | -- | 23 |
| | 20C† | -- | -- | -- | 56 | ND | -- | -- | 0.165 | -- | -- | -- | 1.0 | 58 | -- | 25 |

TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N | | | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $NH_3$-N | $NO_2$+$NO_3$ | TOTAL | | | | | | | | |
| | | | | | mg/ℓ | | | | | | | | | | | |
| (1974) AUG 29 | 11C-2 | -- | -- | -- | -- | -- | 4.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | -- | -- | -- | -- | -- | 9.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | -- | -- | -- | -- | -- | 3.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | -- | -- | -- | -- | -- | 5.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | -- | -- | -- | -- | -- | 2.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | -- | -- | -- | -- | -- | 9.75 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | -- | -- | -- | -- | -- | 8.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | -- | -- | -- | -- | -- | 2.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | -- | -- | -- | -- | -- | 4.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | -- | -- | -- | -- | -- | 2.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | -- | -- | -- | -- | -- | 1.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | -- | -- | -- | -- | -- | 3.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | -- | -- | -- | -- | -- | 4.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | -- | -- | -- | -- | -- | 3.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | -- | -- | -- | -- | -- | 5.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C‡ | -- | -- | 280 | 35 | 0.36 | -- | -- | 0.163 | -- | -- | 47 | 1.0 | -- | -- | 21 |
| | 20C* | -- | -- | 300 | 56 | 0.18 | -- | -- | 0.104 | -- | -- | 49 | 1.0 | -- | -- | 21 |
| | 20C† | -- | -- | 340 | 57 | 0.14 | -- | -- | 0.069 | -- | -- | 52 | 0.6 | -- | -- | 23 |
| SEPT 18 | 19A-1 | -- | -- | -- | -- | -- | 0.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-2 | -- | -- | -- | -- | -- | 0.03 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-3 | -- | -- | -- | -- | -- | 0.03 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-4 | -- | -- | -- | -- | -- | 0.02 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-5 | -- | -- | -- | -- | -- | 0.21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-6 | -- | -- | -- | -- | -- | 0.02 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-7 | -- | -- | -- | -- | -- | 0.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-8 | -- | -- | -- | -- | -- | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-9 | -- | -- | -- | -- | -- | 0.30 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A-10 | -- | -- | -- | -- | -- | 0.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-1 | -- | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | -- | -- | -- | -- | -- | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | -- | -- | -- | -- | -- | 0.17 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | -- | -- | -- | -- | -- | 0.03 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | -- | -- | -- | -- | -- | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | -- | -- | -- | -- | -- | 0.03 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | -- | -- | -- | -- | -- | 0.03 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | -- | -- | -- | -- | -- | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 19A* | -- | -- | 96 | 30 | 0.17 | -- | -- | 0.020 | -- | -- | 10 | 0.9 | 15 | -- | 11 |
| | 19A† | -- | -- | 90 | 24 | 0.70 | -- | -- | 0.139 | -- | -- | 9 | 1.4 | 16 | -- | 13 |
| | 21B* | -- | -- | 134 | 26 | ND | -- | -- | 0.023 | -- | -- | 20 | 0.5 | 15 | -- | 14 |
| | 21B† | -- | -- | 114 | 22 | 0.12 | -- | -- | 0.026 | -- | -- | 14 | 0.5 | 15 | -- | 14 |
| SEPT 19 | 11C-2 | -- | -- | -- | -- | -- | 3.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | -- | -- | -- | -- | -- | 6.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-6 | -- | -- | -- | -- | -- | 2.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | -- | -- | -- | -- | -- | 4.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | -- | -- | -- | -- | -- | 1.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | -- | -- | -- | -- | -- | 5.25 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | -- | -- | -- | -- | -- | 3.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | -- | -- | -- | -- | -- | 2.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

*ODD COMPOSITE. †EVEN COMPOSITE. ‡COMPOSITE.

TABLE B-11--CONTINUED

| DATE | SAMPLE | pH | TDS mg/ℓ | COND.@ 25°C µmhos/cm | TOTAL HARDNESS | NITROGEN as N<br>$NH_3$-N | <br>$NO_2$+$NO_3$ | <br>TOTAL | $PO_4$-P | Ca | Mg | Na | K | Cl | $SO_4$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | mg/ℓ | | | | | | | | | | | |
| (1974)<br>SEPT 19 | 20C-3 | -- | -- | -- | -- | -- | 2.20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | -- | -- | -- | -- | -- | 2.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | -- | -- | -- | -- | -- | 1.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | -- | -- | -- | -- | -- | 1.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | -- | -- | -- | -- | -- | 3.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | -- | -- | -- | -- | -- | 3.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | -- | -- | -- | -- | -- | 1.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | -- | -- | -- | -- | -- | 3.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C‡ | -- | -- | 280 | 38 | 0.05 | -- | -- | 0.142 | -- | -- | 43 | 0.5 | 50 | -- | 21 |
| | 20C* | -- | -- | 340 | 60 | ND | -- | -- | 0.078 | -- | -- | 49 | 0.5 | 58 | -- | 19 |
| | 20C† | -- | -- | 310 | 46 | ND | -- | -- | 0.054 | -- | -- | 46 | 0.6 | 55 | -- | 20 |
| NOV 2 | 11C-2 | -- | -- | -- | -- | -- | 4.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-4 | -- | -- | -- | -- | -- | 6.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-8 | -- | -- | -- | -- | -- | 5.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C-10 | -- | -- | -- | -- | -- | 3.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-1 | -- | -- | -- | -- | -- | 3.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-2 | -- | -- | -- | -- | -- | 5.80 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-3 | -- | -- | -- | -- | -- | 3.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-4 | -- | -- | -- | -- | -- | 3.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-5 | -- | -- | -- | -- | -- | 4.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-6 | -- | -- | -- | -- | -- | 3.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-7 | -- | -- | -- | -- | -- | 3.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-8 | -- | -- | -- | -- | -- | 5.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-9 | -- | -- | -- | -- | -- | 3.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 20C-10 | -- | -- | -- | -- | -- | 5.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 11C‡ | -- | -- | 280 | 34 | 0.32 | -- | -- | 0.072 | -- | -- | 50 | 0.5 | -- | -- | 15 |
| | 20C* | -- | -- | 320 | 48 | 1.60 | -- | -- | 0.292 | -- | -- | 57 | 1.7 | -- | -- | 20 |
| | 20C† | -- | -- | 264 | 48 | 0.44 | -- | -- | 0.132 | -- | -- | 52 | 1.2 | -- | -- | 20 |
| NOV 6 | 21B-1 | -- | -- | -- | -- | -- | 0.09 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-2 | -- | -- | -- | -- | -- | 0.07 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-3 | -- | -- | -- | -- | -- | 0.33 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-4 | -- | -- | -- | -- | -- | 0.05 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-6 | -- | -- | -- | -- | -- | 0.03 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-7 | -- | -- | -- | -- | -- | 0.04 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-8 | -- | -- | -- | -- | -- | 0.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B-9 | -- | -- | -- | -- | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 21B* | -- | -- | 120 | 28 | 0.82 | -- | -- | 0.056 | 5 | 3.8 | 17 | 1.3 | -- | -- | 10 |
| | 21B† | -- | -- | 110 | 28 | 0.84 | -- | -- | 0.109 | 5 | 3.8 | 17 | 1.3 | -- | -- | 10 |

*ODD COMPOSITE. †EVEN COMPOSITE. ‡COMPOSITE.

TABLE B-12. HYDROLOGIC AND NITROGEN CONDITIONS IN TEST PLOT A, OSC FIELD NO. 246

| | | INPUT | | | | OUTPUT | | | |
|---|---|---|---|---|---|---|---|---|---|
| DATE | RAINFALL | N FERTILIZER APPLICATION[1] | IRRIGATION[2] | | | EVAPORATION[5] | PERCOLATION[6] | | |
| | | | | TOTAL N | | | | TOTAL N | |
| | in./mo | lb/acre | in./mo | mg/ℓ[7] | lb/acre-mo | in./mo | in./mo[7] | mg/ℓ[8] | lb/acre-mo |
| 1973 | | | | | | | | | |
| FEB. | 0.63 | 95 (02/27) | 10 | 0.19 | 0.43 | 4.80 | 5.83 | 0.74[9] | 0.98 |
| MAR. | 1.69 | | 5 | 0.24 | 0.27 | 5.88 | 0.81 | 16.14[10] | 2.96 |
| APR. | 1.13 | | 10 | 0.15 | 0.34 | 5.64 | 5.49 | 16.14[10] | 20.08 |
| MAY | 1.60 | 100 (05/09) | 10 | 0.08 | 0.18 | 6.77 | 4.83 | 32.28 | 35.34 |
| JUNE | 0.58 | 110 (06/20) | 15 | 0.04 | 0.14 | 6.19 | 9.39 | 11.21 | 23.78 |
| JULY | 0.93 | | 10 | 0.14[4] | 0.32 | 6.77 | 4.16 | 20.95 | 19.75 |
| AUG. | 0.89 | 75 (08/08) | 10 | 0.24 | 0.54 | 6.52 | 4.37 | 20.68 | 20.48 |
| SEPT. | 0.99 | | 10 | 0.24 | 0.54 | 5.93 | 5.06 | 37.30 | 42.78 |
| OCT. | 2.51 | | 10 | 0.21 | 0.48 | 5.78 | 6.73 | 11.85 | 18.08 |
| NOV. | 3.14 | | 5 | 0.21[4] | 0.24 | 3.49 | 4.65 | 6.83 | 7.20 |
| DEC. | 5.98 | | 5 | 0.22 | 0.25 | 4.11 | 6.87 | 4.80 | 7.47 |
| 1974 | | | | | | | | | |
| JAN. | 8.69 | | 0 | 0.14[4] | 0.00 | 4.25 | 4.44 | 2.77[4] | 2.79 |
| FEB. | 4.34 | | 5 | 0.06 | 0.07 | 4.08 | 5.26 | 0.74 | 0.88 |
| MAR. | 5.79 | | 0 | 0.08[4] | 0.00 | 4.52 | 1.27 | 0.71[4] | 0.20 |
| APR. | 4.23 | | 5 | 0.11 | 0.12 | 4.93 | 4.30 | 0.68 | 0.66 |
| MAY | 2.84 | | 10 | 0.02 | 0.05 | 5.09 | 7.75 | 0.39 | 0.69 |
| JUNE | 0.97 | | 5 | 0.67 | 0.76 | 5.91 | 0.06 | 0.62 | 0.01 |
| JULY | 2.47 | | 10 | 0.07 | 0.16 | 4.92 | 7.55 | 0.12 | 0.20 |
| AUG. | 0.31 | | 10 | 0.31 | 0.70 | 5.71 | 4.60 | 0.26 | 0.27 |
| SEPT. | 8.78 | | 5 | 0.05 | 0.06 | 5.52 | 8.26 | 0.74 | 1.39 |
| OCT. | 2.81 | | 0 | 0.30[4] | 0.00 | 4.30 | -1.49 | 0.74[11] | -0.25 |
| NOV. | 4.31 | | 5 | 0.57 | 0.65 | 3.30 | 6.01 | 0.74[11] | 1.01 |
| TOTAL | 65.61 | 380 | 155 | | 6.30 | 114.41 | 106.20 | | 206.75 |

[1] N content of rainfall omitted as negligible (5 lb/acre).

[2] Ditch water only; no effluent applied.

[3] Median values.

[4] Interpolated values.

[5] Assumed to be equal to the evaporation rate of Lysimeter E, Table 23; corrected to pan evaporation rates of Field 245, Table 22.

[6] Samples collected by 18- to 21-in. point samplers placed just below tillage pan.

[7] Calculated difference between rainfall, applied irrigation and evaporation.

[8] Mean values.

[9] Assume concentration to be equal to Feb. 1974 value.

[10] Assume concentration to be equal to Sept. 1974 value.

[11] Assume concentration to be equal to May 1974 value.

## TABLE B-13. HYDROLOGIC AND NITROGEN CONDITIONS IN TEST PLOT B OF OSC FIELD NO. 246

| DATE | RAINFALL | INPUT | | | | OUTPUT | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | N FERTILIZER APPLICATION[1] | IRRIGATION[2] | | | EVAPORATION[5] | PERCOLATION[6] | | |
| | | | | TOTAL N | | | | TOTAL N | |
| | in./mo | lb/acre | in./mo | mg/ℓ[3] | lb/acre-mo | in./mo | in./mo[7] | mg/ℓ[8] | lb/acre-mo |
| 1973 | | | | | | | | | |
| FEB. | 0.63 | 95 (02/27) | 10.00 | 0.19 | 0.43 | 4.80 | 5.83 | 0.67[9] | 0.89 |
| MAR. | 1.69 | | 5.00 | 0.24 | 0.27 | 5.88 | 0.81 | 19.40[10] | 3.56 |
| APR. | 1.13 | | 6/3.70 | 0.15/17.4 | 14.79 | 5.64 | 5.19 | 19.40 | 22.82 |
| MAY | 1.60 | 80 (05/09) | 7.40 | 23.2 | 38.91 | 6.77 | 2.23 | 49.17 | 24.85 |
| JUNE | 0.58 | 40 (06/20) | 11.10 | 20.7 | 52.08 | 6.19 | 5.49 | 39.32 | 48.93 |
| JULY | 0.93 | | 7.40 | 18.1 | 30.36 | 6.77 | 1.56 | 5.96 | 2.11 |
| AUG. | 0.89 | | 8.14 | 20.3 | 37.45 | 6.52 | 2.51 | 32.92 | 18.73 |
| SEPT. | 0.99 | | 8.88 | 19.6 | 39.45 | 5.93 | 3.94 | 21.18 | 18.92 |
| OCT. | 2.51 | | 7.77 | 23.2 | 40.86 | 5.78 | 4.50 | 18.59 | 18.96 |
| NOV. | 3.14 | | 3.70 | 22.2 | 18.62 | 3.49 | 3.35 | 16.00 | 12.15 |
| DEC. | 5.98 | | 4.44 | 20.9 | 21.03 | 4.11 | 6.31 | 12.77 | 18.26 |
| 1974 | | | | | | | | | |
| JAN. | 8.69 | | 0.00 | 24.7 | 0.00 | 4.25 | 4.44 | 6.72[4] | 6.76 |
| FEB. | 4.34 | | 4.44 | 0.06 | 0.06 | 4.08 | 4.70 | 0.67 | 0.71 |
| MAR. | 5.79 | | 0.00 | 0.08[4] | 0.00 | 4.52 | 1.27 | 0.72[4] | 0.21 |
| APR. | 4.23 | | 4.44 | 0.11 | 0.11 | 4.93 | 3.74 | 0.78 | 0.66 |
| MAY | 2.84 | | 8.88 | 0.02 | 0.04 | 5.09 | 6.63 | 0.55[4] | 0.83 |
| JUNE | 0.97 | | 4.44 | 0.67 | 0.67 | 5.91 | -0.50 | 0.32[4] | -0.04 |
| JULY | 2.47 | | 8.14 | 0.07 | 0.13 | 4.92 | 5.69 | 0.09 | 0.12 |
| AUG. | 0.31 | | 7.40 | 0.31 | 0.52 | 5.71 | 2.00 | 0.19 | 0.09 |
| SEPT. | 8.78 | | 3.70 | 0.05 | 0.04 | 5.52 | 6.96 | 0.16 | 0.25 |
| OCT. | 2.81 | | 3.70 | 0.30[4] | 0.25 | 4.30 | 2.21 | 0.54[4] | 0.27 |
| NOV. | 4.31 | | 0.00 | 0.57 | 0.00 | 3.30 | 1.01 | 0.90 | 0.21 |
| TOTAL | 65.61 | 215 | 128.67 | | 296.07 | 114.41 | 79.87 | | 200.25 |

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[1] N content of rainfall omitted as negligible (5 lb/acre).

[2] Ditch water only; no effluent applied.

[3] Median values.

[4] Interpolated values.

[5] Assumed to be equal to the evaporation rate of Lysimeter E, Table 23; corrected to pan evaporation rates of Field 245, Table 22.

[6] Samples collected by 18- to 21-in. point samplers placed just below tillage pan.

[7] Calculated difference between rainfall, applied irrigation and evaporation.

[8] Mean values.

[9] Assume concentration to be equal to Feb. 1974 value.

[10] Assume concentration to be equal to Sept. 1974 value.

[11] Assume concentration to be equal to May 1974 value.

TABLE B-14. HYDROLOGIC AND NITROGEN CONDITIONS IN TEST PLOT C OF OSC FIELD NO. 246

| | | INPUT | | | | OUTPUT | | | |
|---|---|---|---|---|---|---|---|---|---|
| DATE | RAINFALL | N FERTILIZER APPLICATION[1] | IRRIGATION[2] | | | EVAPORATION[5] | PERCOLATION[6] | | |
| | | | | TOTAL N | | | | TOTAL N | |
| | in./mo | lb/acre | in./mo | mg/ℓ[3] | lb/acre-mo | in./mo | in./mo[7] | mg/ℓ[8] | lb/acre-mo |
| 1973 | | | | | | | | | |
| FEB. | 0.63 | 95 (02/27) | 10.00 | 0.19 | 0.43 | 4.80 | 5.83 | 2.86[9] | 3.78 |
| MAR. | 1.69 | | 5.00 | 0.24 | 0.27 | 5.88 | 0.81 | 25.98[10] | 4.77 |
| APR. | 1.13 | | 6/3.70 | 0.15/17.4 | 14.79 | 5.64 | 5.19 | 25.98 | 30.56 |
| MAY | 1.60 | 40 (05/09) | 7.40 | 23.2 | 38.91 | 6.77 | 2.23 | 32.93 | 16.65 |
| JUNE | 0.58 | | 11.10 | 20.7 | 52.08 | 6.19 | 5.49 | 27.14 | 33.77 |
| JULY | 0.93 | | 7.40 | 18.1 | 30.36 | 6.77 | 1.56 | 17.67 | 6.25 |
| AUG. | 0.89 | | 8.14 | 20.3 | 37.45 | 6.52 | 2.51 | 12.14 | 6.91 |
| SEPT. | 0.99 | | 8.88 | 19.6 | 39.45 | 5.93 | 3.94 | 9.05 | 8.08 |
| OCT. | 2.51 | | 7.77 | 23.2 | 40.86 | 5.78 | 4.50 | 10.40 | 10.61 |
| NOV. | 3.14 | | 3.70 | 22.2 | 18.62 | 3.49 | 3.35 | 13.05 | 9.91 |
| DEC. | 5.98 | | 4.44 | 20.9 | 21.03 | 4.11 | 6.31 | 13.74 | 19.65 |
| 1974 | | | | | | | | | |
| JAN. | 8.69 | | 0.00 | 24.7 | 0.00 | 4.25 | 4.44 | 8.30[4] | 8.35 |
| FEB. | 4.34 | | 4.44 | 17.3 | 17.41 | 4.08 | 4.70 | 2.86 | 3.05 |
| MAR. | 5.79 | | 0.00 | 20.1 | 0.00 | 4.52 | 1.27 | 2.83[4] | 0.81 |
| APR. | 4.23 | | 4.44 | 24.6 | 24.76 | 4.93 | 3.74 | 2.80 | 2.37 |
| MAY | 2.84 | | 8.88 | 26.7 | 53.74 | 5.09 | 6.63 | 4.25[4] | 6.39 |
| JUNE | 0.97 | | 4.44 | 19.3 | 19.42 | 5.91 | -0.50 | 6.43[4] | -0.73 |
| JULY | 2.47 | | 8.14 | 16.8 | 31.00 | 4.92 | 5.69 | 4.59 | 5.92 |
| AUG. | 0.31 | | 7.40 | 13.3 | 22.31 | 5.71 | 2.00 | 4.62 | 2.09 |
| SEPT. | 8.78 | | 3.70 | 13.3 | 11.15 | 5.52 | 6.96 | 3.20 | 5.05 |
| OCT. | 2.81 | | 3.70 | 16.1 | 13.50 | 4.30 | 2.21 | 4.20[4] | 2.10 |
| NOV. | 4.31 | | 0.00 | 17.8 | 0.00 | 3.30 | 1.01 | 5.20 | 1.19 |
| TOTAL | 65.61 | 135 | 128.67 | | 487.54 | 114.41 | 79.87 | | 187.53 |

[1] N content of rainfall omitted as negligible (5 lb/acre).

[2] Ditch water only; no effluent applied.

[3] Median values.

[4] Interpolated values.

[5] Assumed to be equal to the evaporation rate of Lysimeter E, Table 23; corrected to pan evaporation rates of Field 245, Table 22.

[6] Samples collected by 18- to 21-in. point samplers placed just below tillage pan.

[7] Calculated difference between rainfall, applied irrigation and evaporation.

[8] Mean values.

[9] Assume concentration to be equal to Feb. 1974 value.

[10] Assume concentration to be equal to Sept. 1974 value.

[11] Assume concentration to be equal to May 1974 value.

## APPENDIX C. METHODS OF SAMPLE CONCENTRATION FOR VIRAL ASSAY

Five different methods were adopted or modified for this project:

1. Polyelectrolyte 60 (PE-60). The batch (Wallis et al. 1971) and sandwich (Wallis and Melnick 1970) techniques of using the synthetic, insoluble PE-60 (Monsanto Co.) which selectively adsorbs viruses from the water medium was used. The PE-60 was subsequently recovered and the adsorbed viruses eluted with a small volume of borate buffer (pH 9.0).

2. Polymer Two-Phase. A modification of the polymer two-phase separation method of Shuval et al. (1969) was used. Briefly, sodium dextran sulfate 500, polyethylene glycol 6000 and NaCl were dissolved in the water sample and allowed to separate overnight. The enteroviruses migrate preferentially to the dextran sulfate phase which comprises only 1:150 of the total volume, resulting in the effective concentration of the viruses.

3. Aluminum Hydroxide [$Al(OH)_3$]. A modification of the Al(OH) methods as described by Wallis and Melnick (1967) was used. Briefly, the performed $Al(OH)_3$ is added to the water sample and selectively adsorbs viruses from the water medium. The $Al(OH)_3$ is subsequently recovered and the adsorbed viruses eluted with a small volume of borate buffer (pH 9.0).

4. Protamine Sulfate. A modification of the method of England (1972) was used. Briefly, protamine sulfate was added to the water sample to precipitate the viruses from the water medium. The precipitate was then recovered by filtering the entire sample through an AP-20 pad and the precipitate dissolved to recover the viruses by the addition of 1 M NaCl.

5. Cellulose Membrane. The method as described by Wallis et al. (1967) was used. Briefly, $MgCl_2$ was added to the water sample which had been adjusted to pH 5.0 to 5.5 and the entire sample filtered through a 0.45μ cellulose membrane (Millipore Corp.). Under these conditions the cellulose membrane adsorbs viruses. The adsorbed viruses can then be eluted with a small volume of borate buffer (pH 9.0).

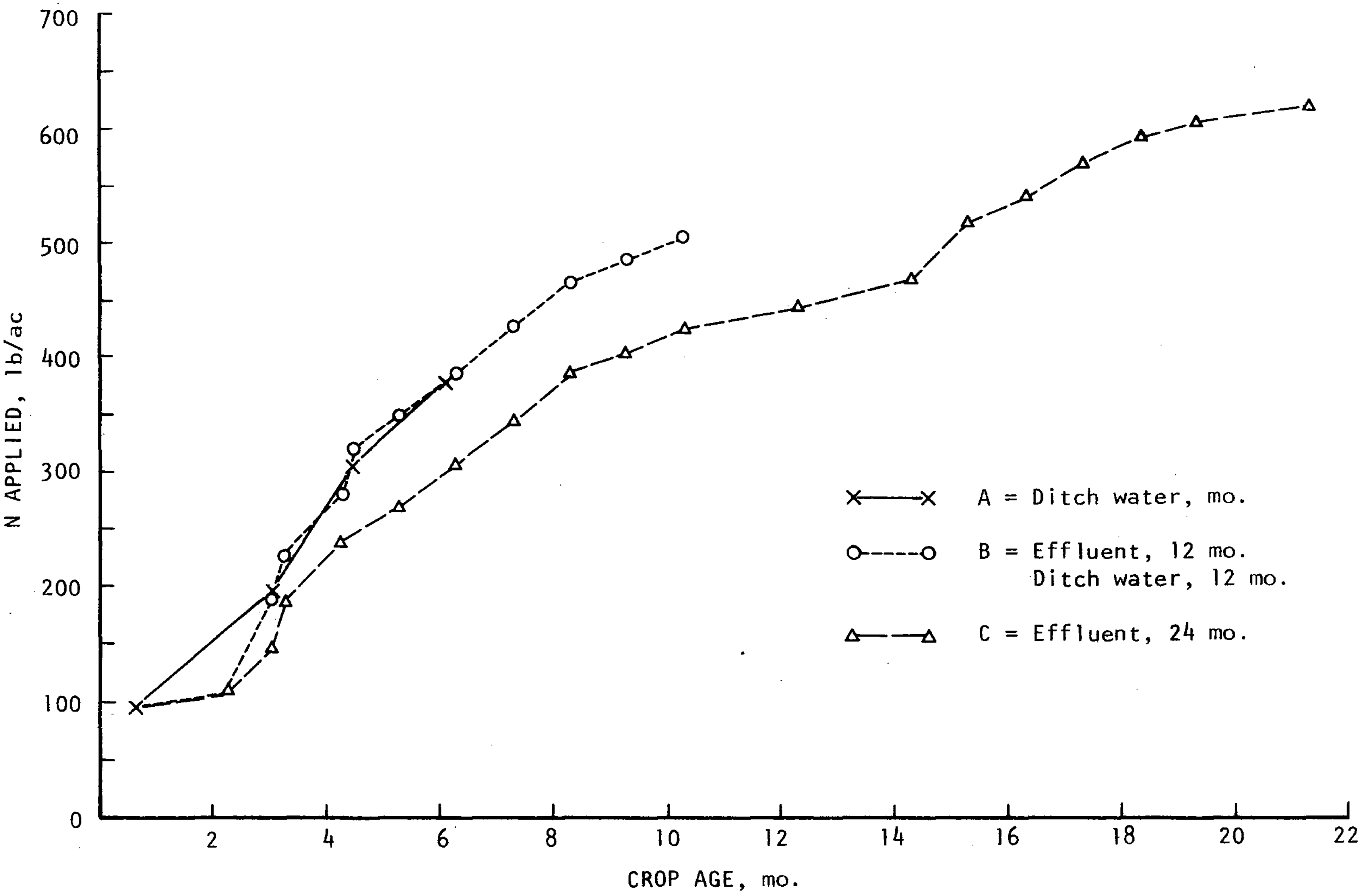

FIGURE D-1. AMOUNT AND TIMING OF N APPLICATION BY COMMERCIAL FERTILIZER AND/OR SEWAGE EFFLUENT FOR EACH TREATMENT IN OSC FIELD 246

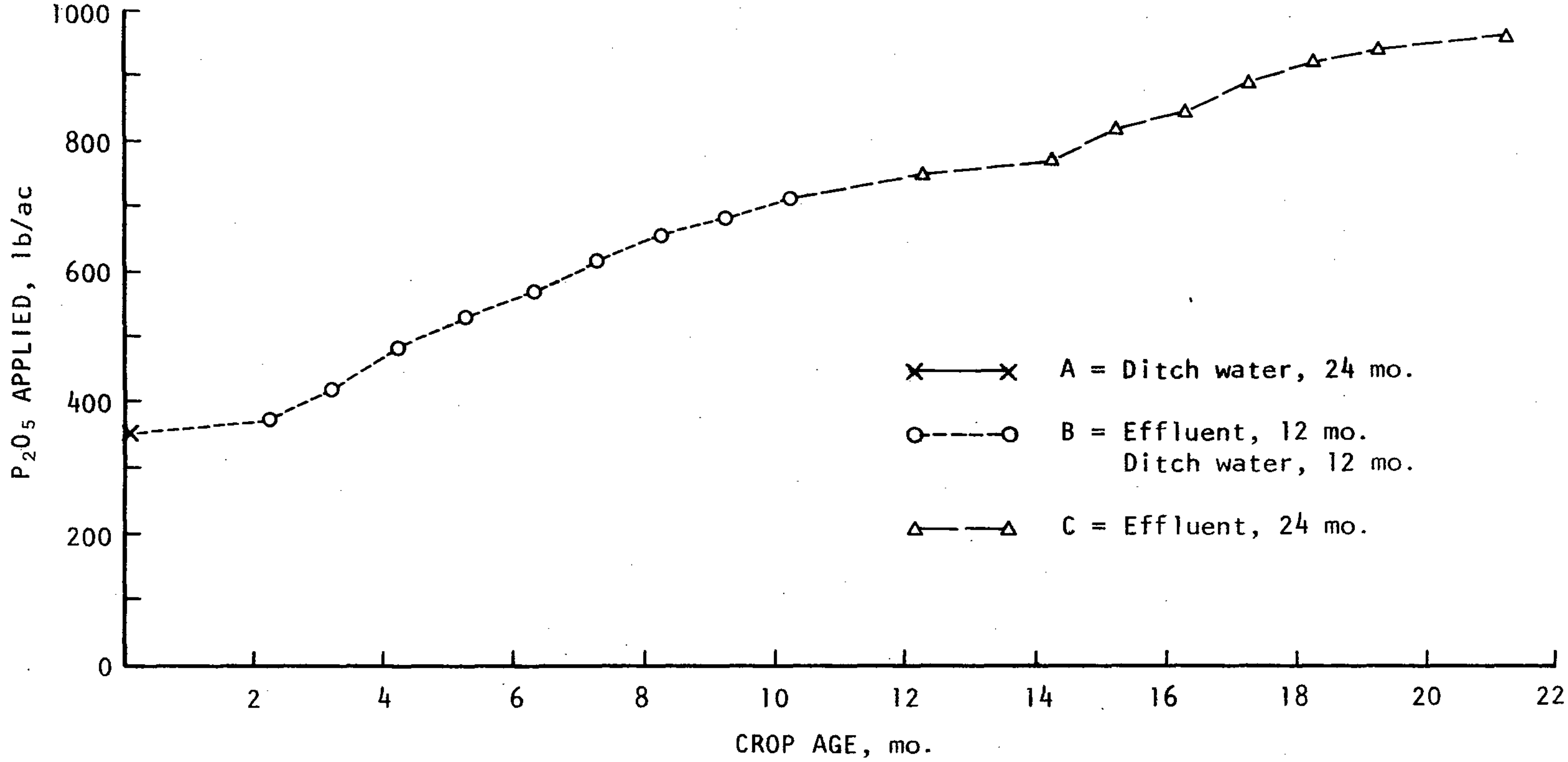

FIGURE D-2. AMOUNT AND TIMING OF $P_2O_5$ APPLICATION BY COMMERCIAL FERTILIZER AND/OR SEWAGE EFFLUENT FOR EACH TREATMENT IN OSC FIELD 246

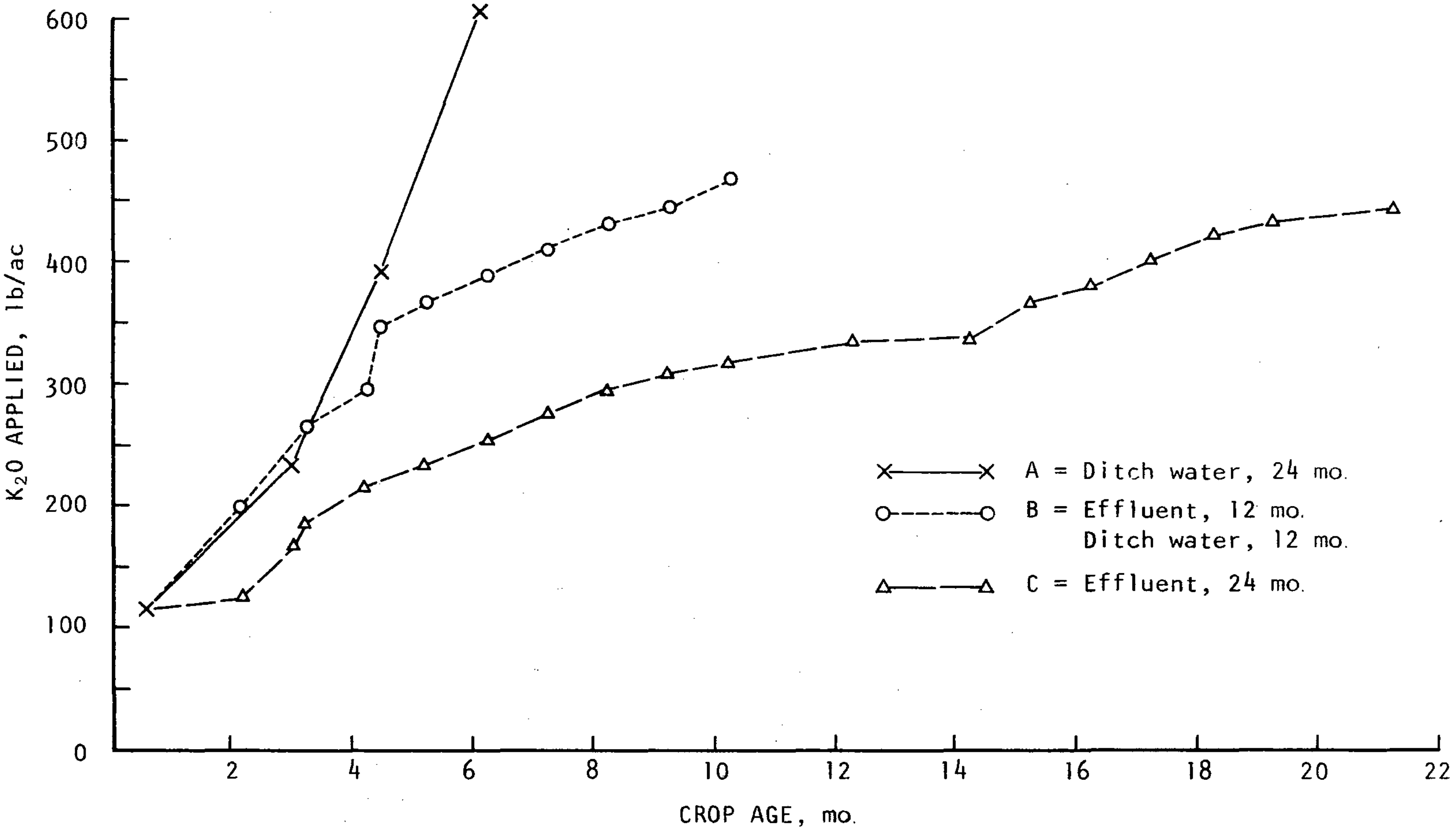

FIGURE D-3. AMOUNT AND TIMING OF $K_2O$ APPLICATION BY COMMERCIAL FERTILIZER AND/OR SEWAGE EFFLUENT FOR EACH TREATMENT IN OSC FIELD 246

# APPENDIX E. PUBLICATIONS AND PRESENTATIONS

## 1971

Water Resources Research Center. 1971. Wastewater reclamation project launched at Mililani. *Nuhou Kumu Wai* 1(3), Water Resources Research Center, University of Hawaii.

## 1972

KHET-Hawaii Public Television. 1972. "Water recycling from sewage by irrigation project." Production shown on Channel 11 (Educational TV), 9 April 1972, Honolulu, Hawaii.

Lau, L.S. 1972. Testimony (A summary status report for the Mililani waste water reclamation project) in *The technical session of the conference of pollution of the navigable waters of Pearl Harbor and its tributaries in the state of Hawaii, Proc. Environmental Protection Agency Conference*, pp. 151-65, 5-6 June 1972, Honolulu, Hawaii.

_____; Ekern, P.C.; Loh, P.C.S.; Young, R.H.F.; and Dugan, G.L. 1972. *Water recycling of sewage effluent by irrigation: A field study on Oahu.* Tech. Rep. No. 62, Water Resources Research Center, University of Hawaii.

Young, R.H.F.; Ekern, P.C.; and Lau, L.S. 1972. Wastewater reclamation by irrigation. *J. Water Poll. Control Fed.* 44(9):1808-14.

Water Resources Research Center. 1972. 1st results indicate nitrogen buildup. 1972. *Nuhou Kumu Wai* 2(4), Water Resources Research Center, University of Hawaii.

## 1973

Fujioka, R.S. 1973. "The virological characterization of Mililani Sewage." Seminar presentation, Water Resources Research Center Seminar Series, University of Hawaii.

## 1974

Dugan, G.L.; Young, R.H.F.; Lau, L.S.; Ekern, P.C.; Loh, P.C.S. 1974. "Land disposal of sewage in Hawaii--A reality?" Paper presented to the 47th Ann. Conf. of the Water Pollution Control Federation, 6-11 October 1974, Denver, Colorado.

Ekern, P.C. 1974. "Land disposal of sewage effluent: Mililani study." Seminar presentation, Water Resources Research Center Seminar Series, University of Hawaii.

_____. 1974. Land disposal of sewage effluent: Mililani study. In *Seventh Annual Hawaii Fertilizer Conference Proc.*, CES Misc. Pub. 116, Cooperative Extension Service, University of Hawaii, pp. 9-22.

_____. 1974. Land disposal of sewage effluent: Mililani study. In *Agronomy Abstracts, 1974 Annual Meeting*, Amer. Soc. Agronomy, Crop Sci. Soc.

of Amer., and Soil Sci. Soc. of Amer., 10-15 Nov. 1974, Chicago, Illinois, p. 27.

Fujioka, R.S., and Loh, P.C.S. 1974. Recycling of sewage for irrigation: A virological assessment. In *Abstract of the 1974 Annual Meeting, Amer. Soc. of Microbiology.*

Lau, L.S. 1974. Testimony presented to the Oahu Water Conference sponsored by the City and County, Board of Water Supply, 30 April 1974, Honolulu, Hawaii.

_____. 1974. "Sewage irrigation of sugarcane in Hawaii." Seminar presented to the Iowa State Water Resources Research Institute Technical Seminar, 9 December 1974.

_____; Ekern, P.C.; Loh, P.C.S; Young, R.H.F.; Burbank, N.C., Jr.; and Dugan, G.L. 1974. *Recycling of sewage effluent by irrigation: A field study on Oahu--Second Progress Report for July 1972 to July 1973.* Tech. Rep. No. 79, Water Resources Research Center, University of Hawaii.

_____. 1974. Water and nutrient recycling from sewage effluent by irrigation: A pilot field study on Oahu. In *Proc., Fertilizer I.N.P.U.T.S. Project,* East-West Center, University of Hawaii, pp. 165-68.

Water Resources Research Center. 1974. "Water recycling from sewage by irrigation: A field study on Oahu." 1975 Interim Prog. Rep., Water Resources Research Center, University of Hawaii.

Young, R.H.F.; Lau, L.S.; Dugan, G.L.; Ekern, P.C.; and Loh, P.C.S. 1974. "Waste water reclamation by irrigation in Hawaii." Presented to the Amer. Soc. Civil Engr. Water Resources Conf., Los Angeles, California, 21-25 January 1974, 28 p.

_____. 1974. What happens if water is recycled. *Proc.*, ECOPUSH Conf. on Water for Hawaii, University of Hawaii, pp. 31-34.

## 1975

Buren, L.L., and Ekern, P.C. 1975. Response of sugarcane irrigated with municipal sewage effluent. In *Agronomy Abstracts, 1975 Annual Meetings,* Amer. Soc. Agronomy, Crop Sci. Soc. Amer., and Soil Sci. Soc. Amer., 24-30 August 1975, University of Tennessee, Knoxville, Tenn., p. 79.

Dugan, G.L.; Young, R.H.F.; Lau, L.S.; Ekern, P.C.; and Loh, P.C.S. 1975. Land disposal of sewage in Hawaii--A reality? *J. Water Poll. Control Fed.* 47(8):2067-87.

Lau, L.S. 1975. "Mililani sewage effluent for sugarcane irrigation." Seminar presentation, Water Resources Research Center, University of Hawaii, 1 May 1975.

Seminar presentation, County of Maui Special Seminar, Wailuku, Maui, Hawaii, 14 May 1975.

Talk presented to the Hawaii Water Pollution Control Association, Quarterly Mtg., Honolulu, Hawaii, 17 June 1975.