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

## Second Progress Report for July 1972 to July 1973

Technical Report No. 79

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# ABSTRACT

*An investigation of recycling sewage effluent by irrigation under Hawaiian conditions is being conducted in pilot field studies near Mililani Town in central Oahu under the sponsorship of the Board of Water Supply and the Division of Sewers, City and County of Honolulu. The primary objective of the project is to determine the feasibility of waste water application to the soil and its probable effects on the quality of groundwater in terms of dissolved materials and viruses. Corollary objectives are to ascertain its effects on sugarcane yield and grasslands.*

*The studies began in September 1971 with the construction of a five-foot (1.52 m) deep hydraulic lysimeter in a grassed area on the grounds of the Mililani Sewage Treatment Plant. The upper surface of the lysimeter was at ground level. Soil within the lysimeter was repacked to the approximate original density. In an adjacent site, a number of two-foot square pans were placed at various depths down to five ft (1.52 m) in undisturbed soil adjacent to an access pit. The lysimeter and pan areas were sprinkler-irrigated with secondary sewage effluent from the Mililani Sewage Treatment Plant on a regular schedule. Five furrows of maturing sugarcane in the nearby Oahu Sugar Company (OSC) sugarcane Field No. 240 were also irrigated with the secondary effluent while the adjoining furrows continued to receive regular irrigation water. Numerous point water samplers were positioned in both furrows and ridges of the sugarcane field at depths to 33 in. (84 cm). Thirty test plots with uniform areas of approximately 0.1 acre (0.041 ha) each were established in a newly planted (February 1973) OSC sugarcane Field No. 246. The test plots were divided into three basic irrigation schemes of ten plots each--A, B, and C. Plots "A" will receive ditch water only for the nearly 24 month culture cycle; "B" plots are scheduled to receive secondary effluent for the first half of the growth cycle and ditch water thereafter; and "C" plots will receive effluent only for the full growth cycle. Fifty ceramic plant samplers were installed in representative "A", "B", and "C" plots at depths of 9 to 12 in. (23 to 30 cm) and 18 to 21 in. (46 to 53 cm). Two five-foot (1.52 m) deep field lysimeters were also installed in a furrow row adjacent to the test plot. The sugarcane growing on one lysimeter is irrigated with ditch water while the other receives secondary effluent. Sugarcane growth parameters are being monitored periodically throughout the culture cycle. The soil within the test sites of both the grass and sugarcane areas is of the Oxisol Lahaina series, the general soils type on which approximately 90 percent of Hawaii's irrigated sugarcane is grown.*

*Raw sewage, secondary effluent, and leachate from the soils were assayed for various physical, chemical, sanitary, and microbiological quality parameters. Analyses for pesticides and heavy metals were also performed occasionally. A virus laboratory, the first of its kind in Hawaii, was established at the University of Hawaii at the initiation of the project to serve the project and to assist in training the personnel of the Board of Water Supply. Consumptive use of water was determined by use of the hydraulic lysimeter.*

Operational analyses showed that the Mililani Sewage Treatment Plant, which employs the activated sludge process, is capable of removing a high percentage of the biodegradable substances and suspended solids as well as a surprisingly high percentage of nitrogen, a nutrient ordinary secondary treatment plants are not designed to remove. The sewage effluent was void of detectable mercury (less than 0.3 ppb) and the cadmium and lead were less than the Public Health Service drinking water standards. Pesticides were found to be less than 1 ppb. With the possible exception of the sodium percentage for very sensitve crops, the effluent appears to be of good quality for agricultural irrigation use.

The soil at Mililani appears 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 five-foot (1.52 m) deep lysimeter. Nitrogen, however, was not effectively removed until after five months of operation, whereas, the other constituents exhibited fairly rapid attenuation. There appeared to be evidence of a base exchange or similar phenomenon in the soil at least between sodium and calcium in the OSC Field No. 240. Similar results were also found for the leachate collected by the point samplers in the sugarcane fields. Virus cultures were obtained from the sewage effluent, however, only one positive virus culture has been identified from leachate passing through the five-foot (1.52 m) deep lysimeter.

The growth of sugarcane in the test plot of the OSC Field No. 240, which received quantities of secondary effluent applications that exceeded the water-short adjacent ditch irrigated sugarcane fields by a factor of three to four produced an estimated 40 percent more sugarcane growth. Laboratory analysis has indicated that the sugar purity of samples from secondary effluent irrigated sugarcane applied during the last half of the sugarcane culture cycle was approximately one percent less than sugarcane samples receiving only ditch water. Due to the relatively short period of time that chemical analyses have been conducted on leachate samples collected from various locations within the test plot of the OSC Field No. 246, no attempt will be made in this progress report to interpret the results.

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# INTRODUCTION

## Nature and Scope of Report

This is the second progress report for the project entitled, "Recycling of Water from Sewage by Irrigation: A Pilot Field Study on Oahu," and covers the period July 1972 to July 1973. The first progress report covered the time span from August 1971 to July 1972 (Lau et al. 1972). The project originated as the result of an act of the 1971 Hawaii State Legislature to supplement the Water Quality Program for Oahu of the City and County of Honolulu with a feasibility study by the Board of Water Supply of recycling sewage effluents. The project is funded by the Board of Water Supply and the City and County of Honolulu and conducted by the Water Resources Research Center of the University of Hawaii. The report is concerned with field and laboratory studies of infiltration rates, changes in water quality factors, and viral content in the percolating water when grassland and sugarcane fields are irrigated with sewage effluent. The history and background of the study and the progress of experimental work for the report period are summarized.

## Need for Study

Need for the study being reported is derived both from general national considerations and specific situations peculiar to Hawaii. At the national level, the concept that water resource conservation is necessary for public welfare is accepted widely and the belief that used water must soon be reclaimed in order to free unused water for ecological and other environmental objectives has become essentially a social and cultural ethic. Moreover, 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 such uses as irrigation of crops and grassland 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 percent of the drinking water is derived from surface sources. Thus, protection of the quality of groundwater is of primary importance to Hawaii, rather than of secondary importance, as has been the case until recently on the mainland. Second, the soils of Hawaii are strongly structured and highly pervious, even though their clay content is relatively high. However, the properties of Hawaiian soils differ from that of mainland soils of similar clay content so that is is impossible to apply criteria derived from research on such mainland soils to the design of land disposal systems in Hawaii. Third, the urban areas of Hawaii which are located along the coast, have been able to discharge sewage into the ocean. Thus, there was little pressure to invest heavily in sewage treatment during the long period when national concern was largely for surface water pollution control. Waste water discharges in coastal waters came under scrutiny only when national attention was directed to the oceans. As a result, reuse of water is an alternative yet to be considered in planning waste water treatment systems for Hawaii. Because most urban centers of Oahu are located on the coastal caprock of low permeability, they are not heavily concentrated on the infiltrative surfaces that overlie the state's groundwater supply; hence, there are no other convenient areas on which to discharge or apply reclaimed water if it is not to be directed into the ocean. Fourth and finally, trends and projections of the economic growth and of the water needs of Oahu indicate the necessity for augmentation of the water resources of the island in the foreseeable future. Reuse of water, desalination of ocean or brackish groundwater, and artificial rainmaking are the more common alternatives. At the present state of the art, reuse is the most feasible means from the standpoint of technology and economics.

From such considerations as the foregoing, it is clear that there is a need for study of the possibility of recycling water reclaimed from sewage on Oahu. Pollution travel parameters which cannot be imported from experience elsewhere needs to be assessed directly on 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 the Study

The general objectives of the study are implicit in the need for study. Specific objectives are 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 dissolved solids.
3. Evaluate the effects of various water quality parameters, as well as the effects of evapotranspiration, 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 the Study

The study initially was designed as a research project involving the application 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 seasonal 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, proceed to the application of primary effluent to the same culture types during the fourth year. Finally, during the fifth and sixth year, experiments would be conducted with tertiary effluent. The phases of the project using secondary effluent should be completed within three years. Since the initiation of the project, two highly pertinent articles of legislation have been signed into law (the Federal PL 92-500 and Hawaii's Department of Health *Public Health Regulations*, Chapter 38) which specify that sewage receive a minimum of secondary treatment before being used for irrigation.

Some limited irrigation with treated sewage effluents 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 is to determine whether the extension of local practice and the adoption of the minimum level of treatment (secondary) commonly accepted in the U.S. is compatible with the groundwater quality objectives of Hawaii.

Finally, irrigation, as a method of water conservation by tradeoff of reclaimed water for groundwater in Hawaii, depends upon whether the sugarcane industry will accept and utilize reclaimed water for irrigation. At the completion of the studies involving the application of secondary-treated sewage to grassland and sugarcane, a decision by all concerned groups will have to be made as to its probable future use in central Oahu and the feasibility of extending the study to cover tertiary effluent.

## Organization of the Study

The overall responsibility and direction of the project was delegated to L. Stephen Lau, Director, 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 engineers and agronomists from the Hawaii 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 University staff has been responsible for the following five major activity areas:

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| Paul C. Ekern | Soils and irrigation studies |
| Philip C.S. Loh | Virology studies |
| 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 |
| Hawaii Sugar Planters' Association | Field studies of sugarcane responses and irrigation application rates |
| Oahu Sugar Company, Ltc. | Sugarcane fields for experimental studies |

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

## BACKGROUND OF STUDY

### Reclamation versus Recycling

In designing an experimental program suited to the objectives of the Oahu study herein reported, it was important that the nature and results of some of the key research on water reclamation that have been accomplished and applied during the past 20 years in the U.S. be reviewed.

Because there was some careless use of terms in the early literature, there is a need to distinguish clearly the definition of reclamation, recycling, reuse, and groundwater recharge. As used here, reclamation refers to the processes by which enough components of waste water are removed to upgrade its quality to some useful or environmentally acceptable level. Recycling, reuse, and recharge refer to what is done with the reclaimed water after it comes from the processing plant. Thus, reclamation becomes the first step in a waste water recycling system but, in the context of this study, does not in itself constitute recycling.

Based on this definition, it can be said that the processes used for water reclamation on the mainland are applicable to Hawaiian conditions. What is not applicable as yet is how effluent from the reclamation systems may be utilized on the soil without danger to the groundwater quality. In other words, primary, secondary, or tertiary sewage effluents can be produced in Hawaii by today's technology, but mainland experience with land disposal of the effluents cannot be accepted as applicable to Hawaii without experimental verification.

### Studies of Pollution Travel

The travel of pollutants carried by percolating water which originate from surface spreading or direct injection of sewage effluents, septic tank percolation systems, and contamination of water by specific compounds have been studied extensively by the University of California, the U.S. Public Health Service, the California Institute of Technology, and researchers in the United States and other countries beginning about 1950. Sponsors of such studies have included such diverse agencies as the state of California, the Los Angeles County Sanitation Districts, the U.S. Public Health Service, the Federal Housing Administration, the Soap and Detergent Association, the Federal Water Pollution Control Administration (now a part of the Environmental Protection Agency), the Agricultural Research Service, and the Environmental Protection Agency. The most significant findings of such research and field experience prior to 1967 were summarized by McGauhey and Krone (1967), who emphasized the scientific and engineering parameters associated with effluent movement through the soil and the maintenance of infiltration rates. The findings indicate that the danger of bacterial pollution travel through the soil mantle of the earth is not a major limiting factor in land disposal of sewage effluents and that phosphates are absorbed in soil particles. However, nitrates and many other soluble chemicals travel with percolating water, and intermediate products of biodegradation of organic matter may, in some soils, escape below the biologically active soil mantle and produce tastes and odors. Generally, the two most difficult problems in recycling water reclaimed from sewage are those of maintaining the infiltrative capacity of the surface of a pervious soil and the buildup of solids or mineralization of groundwater. Parkhurst (1964) has shown, for example, that 300 mg/ℓ of dissolved solids added by the use of water in sewage is enough to limit the Colorado River water to a single cycle of reuse of 1000 mg/ℓ of total dissolved solids is accepted as the upper limit for drinking water and general agriculture.

Without going into the details of the many studies leading up to land disposal as a method of recycling water reclaimed from sewage, suffice it to say that there are some successful large installations of this type on the mainland U.S. The most important are those in the Los Angeles County Sanitation Districts which include the highly publicized (Parkhurst 1964; and McMichael and McKee 1965) Whittier Narrows Project and Project 52 in the adjacent Orange County, California (Envirogenics Co. 1972). A similarly large recharge project in Israel has been unable to solve the problem of nitrate buildup to unacceptable levels. Two additional projects which have received considerable attention utilize reclaimed water for a combination of recreation and grassland irrigation. These are the Santee Project (Merrell et al. 1967; and the San Diego County Department of Public Health 1965) near San Diego, California and the Indian Creek Reservoir of the South Tahoe Public Utility District Water Reclamation Plant (McGauhey, Porcella, and Dugan 1971; and Culp, Evans, and Wilson 1971).

There are at least 100 localities in California and dozens more throughout the Southwest (U.S.) in which water reclaimed from domestic sewage is being utilized for the irrigation of field crops, golf courses, and grasslands, or as industrial cooling water. Irrigation with waste water effluents of forested areas in Pennsylvania (Parizek et al. 1967) and of grassed basins in the Flushing Meadows Project in Arizona (Bouwer, Rice, and Escarcega 1972) have been studied on a prototype scale. These many instances demonstrate the recycling of water by irrigation is feasible, but only the major projects are equipped to measure the effects of recharge of waste water on groundwater quality. However, more attention to such effects can be expected in the future because environmental impact statements are required on many new projects.

Regional studies by the U.S. Corps of Engineers and numerous other engineering studies of water reclamation and land disposal of waste water have been conducted because of public interest and concern. In many current studies in California, the problem of meeting the dissolved solids restrictions imposed by state and federal authorities shows prospects of being insurmountable, short of partial desalination. Thus, the effects of waste water recycling on groundwater is being given close regulatory scrutiny.

In Hawaii, artificial recharge practices of groundwater have been limited to stream-water recharge through wells and shafts, storm drainage disposal through wells and pits, induced leakage from ditches and reservoirs, deliberate spreading of excessive irrigation water, incidental ditch and reservoir leakage, and cesspool seepage (Hargis and Peterson 1970). However, none of these practices has been planned to determine their probable effects on water quality.

Process studies in the laboratory have been made to determine the breakthrough of single polluting constituents (ABS, ammonia, and organic nitrogen, DDT, BOD, coliform bacteria, coliphage, and polio virus) in water percolating through Hawaiian soils and rocks (Young, Lau, and Burbank 1967; Ishizaki, Burbank, and Lau 1967; Tanimoto et al. 1968; and Hori et al. 1970).

In addition, the Water Resources Research Center of the University of Hawaii has had an ongoing field lysimeter research project in Kunia, Oahu, since 1967 in which studies have been made of evapotranspiration by sugarcane (Ekern 1970). As much as 400 lbs/acre (448 kg/day) of nitrate was removed by 15 to 30 in. (38 to 76 cm) of leachate from winter rains in 1969-70 and 1970-71. Leachate samples have contained initially as much as 200 mg/ℓ of nitrate, but samples obtained after the sugarcane had matured contained less than one mg/ℓ of nitrate.

The fate of nitrogen fertilizers in sugarcane agriculture has been extensively studied in lysimeters and experimental field plots by the HSPA Experimental Station (Ayres and Hagihara 1963; Sanford, Ayres, and Doi 1965; Takahashi 1964, 1967*a*, 1967*b*, 1968, 1969, and 1970). The only reported study regarding the response of plants to waste water irrigation was in a field study of the influence of mill water on the quality of sugarcane juice.

In addition, studies of the effects of return irrigation flow in Hawaii indicate a definite mineral (chloride, nitrate, sulfate, and silica) build-up at the top of the receiving basal groundwater and recycling of mineral constituents, resulting from percolation of sugarcane irrigation water (Mink 1962; Tenorio, Young, and Whitehead 1969; and Tenorio et al. 1970).

Sewage reclamation by sugarcane irrigation was evaluated by the Water Quality Program for Oahu (WQPO), Ciy and County of Honolulu, with special emphasis on waste disposal as an alternative method of disposal of sewage effluent for the central Oahu and Pearl Harbor regions (Department of Public Works 1971). This investigation led to the conclusion that knowledge is far from adequate for evaluating the effects of using sewage effluent for irrigation and for designing reclamation systems. The WQPO recommended further research in two general areas:

1. effects of irrigation with sewage effluent on groundwater quality, and
2. effects or irrigation with sewage effluent on sugarcane production.

## Studies of Viral Transmission

The American Water Works Association Committee on Viruses in Water (1969) summarized the status of the problem of viruses in water and the efficiency of water treatement processes in virus removal. The committee reported that disinfection would be effective with no more than a 1 mg/ℓ HOCl dosage with a 30-minute contact time if the turbidity could be kept to less than one Jackson candle unit.

Grigoryeva and co-workers (1968) isolated a wide variety of enteroviruses, pathogenic *E. coli*, and coliphage from the sewage, sludge, and irrigated soil of Kiev. Enteroviruses were found in 50.9 percent of sewage samples examined and three strains of enteroviruses were isolated from sludge. Significantly, virus survived in the sludge from 10 to 30 days.

Mats and Korsh (1967) reviewed the current literature, most of which were Russian, on the survival of certain viruses and bacteria in water, soil, and air. They concluded that the fairly prolonged survival of such organisms suggests a prolonged circulation in the external environment and may constitute an epidemiological danger to human populations.

Lothrop and Sproul (1969) studied inactivation of viruses in waste water by chlorination. Present chlorination practices were found inadequate to effect a high level of virus inactivation. Combined chlorine residuals of 28 mg/ℓ and 40 mg/ℓ after 30 minutes of contact time inactivated 99.99 percent of bacteriophate $T_2$ and poliovirus I, respectively, in settled waste water (primary waste treatment). Free chlorine residuals of 0.2 and 0.4 mg/ℓ with a 30-minute contact time completely inactivated both the poliovirus and phage in secondary effluent.

Limited studies of movement of viruses with percolating waste water effluent were reported in the reclamation study at Whittier Narrows (McMichael and McKee 1965). The normal density of enteric viruses in the raw waste water was described as low (less than 100 PFU/ℓ) except during summer and early fall. Samples taken after Sabin oral polio vaccine inoculations were administered to the contributing population resulted in about 250 PFU/ℓ of enteric viruses in the plant effluent but no measurable concentration in the leachate at the two-foot depth (0.6 m) in the spreading basin. A subsequent massive application of Sabin-III vaccine to the effluent prior to spreading over the test basin failed to produce measurable concentrations of enteric viruses in the leachate.

In the Santee reclamation project (Merrell et al. 1967; and San Diego County Department of Public Health 1965), viruses were identified in 100 percent of the samples collected from the San Diego and the Santee raw sewage primary treatment effluent and in 97 percent of the activated sludge effluent samples at Santee. All samples collected from the recreational lakes, after passage through sand and gravel, tested negative for virus. Activated sludge treatment followed by 30-day storage in a stabilization pond was termed relatively effective in removing poliovirus. Chlorination applied at a rate of 15 mg/ℓ with a 30-minute contact time was noted to be 100 percent effective against virus.

Tanimoto et al. (1968) and Hori et al. (1970) studied the possibility of percolation of viruses through Wahiawa and Lahaina soils in Hawaii. It was found that a depth of 2.5 in. (6 cm) was sufficient to retain bacteriophage $T_4$ at an applied concentration of $1.5 \times 10^6$ PFU/mℓ. However, tests with 6-in. (15 cm) soil columns showed a retention of only 99.3 percent of poliovirus Type II at a dosage of $1.5 \times 10^5$ PFU/mℓ. Removal was considered to be accomplished by an adsorption mechanism.

## Studies of Solute Movement through Hawaiian Soils

About 90 percent of the irrigated sugarcane in Hawaii is grown on Low Humic Latosols (Oxisol), such as Lahaina, Wahiawa, and Molokai, which are rich in iron oxide and dominantly kaolinitic, consisting of about 80 percent clay, and having a cation exchange capacity of 15 to 20 meq/g. The very stable aggregation of these soils imparts a high hydraulic conductivity under saturated condition, but a rapid reduction occurs under an unsaturated condition (Ahmed, Swindale, and El-Swaify 1969; Ekern 1967; and Sharma and Uehara 1968). Their structural units are extremely persistent even when leached with sodium solutions (El-Swaify 1970).

Water contained within the aggregates contributes little to water flow through the soil under saturated or low moisture tension ranges. Herbicide equilibrium with soils is also related to water in excess of intra-aggregate pore water (Green and Obien 1969). On the other hand, movement of herbicides and fertilizers through latosols has also been related to the mineralogic and physical makeup of the soil (Green and Young 1970; and Cagauan et al. 1968). Nitrate, chloride, bromine, and borate all move readily through the soil profile (Chao and Okazaki 1965; and Singh and Kanehiro 1969). Extensive use of nematocides in pineapple agriculture introduces both chloride and bromide which are subject to leaching and which alter the mobility of a number of other elements (Chao 1966; Smith 1963; and Hall 1970). In striking contrast to the ready leaching of other materials, latosols have a high phosphate-fixing power which minimizes the movement of phosphates (Fox, Plucknett, and Whitney 1968). The winter rainfall maximum ensures annual percolation and flushing of such soluble materials as chloride and nitrate from the soil, particularly in areas where the soil is kept moist during the summer by irrigation (Blummenstock and Price 1967; and Ekern 1970).

The need to explore the effects of recycling reclaimed water by irrigation clearly exists.

The Mililani Sewage Treatment Plant and adjacent areas, which are located at an elevation of about 400 ft (122 m) in central Oahu, were selected as the field investigation site because the predominant soil order in the proximity of the sewage treatment plant is Oxisol. Approximately 90 percent of the sugarcane under irrigation in Hawaii is grown on Oxisol (Fig. 1). The area receives a median annual rainfall (Taliaferro 1959, p. 44) of about 40 in. (102 cm), largely through northeast tradewind showers and occasional winter storms. Lahaina, a Low-Humic Latosol, which developed on a thick deposit of Koolau lava, is the prevalent Oxisol in the Mililani area.

Previous work by other investigators has shown that the soils are 80 percent clay, dominantly kaolinitic, with a cation exchange capacity of 15 to 20 meq/g. (See Table A-1, Appendix A for a complete description of the soil.) A chemical analysis at various depths of the soil is shown in Table A-2, Appendix A. The stable structure of the soils imparts a high infiltration rate as measured by double-ring infiltrometers of 1 to 4 in./hr (2.5 cm to 10 cm/hr) when the soil is loose and bulk densities of 1.3; the sustained infiltration rate is approximately 0.5 in./hr (1.3 cm/hr). These soils are readily compacted by conventional sugarcane and pineapple tillage operations to bulk densities of 1.3 and 1.4 which tend to reduce their infiltration capacity. Typical infiltration values and corresponding bulk densities for Low-Humic Latosols are tabulated in Table A-3, Appendix A.

Exploratory bore holes drilled prior to the construction of the sewage treatment plant at the site indicated no significant beds of local perched water in the upper 30 ft (9.1 m). In the summer of 1972, an intensive field study of Kipapa Gulch and tributary gullies in the vicinity of the sewage treatment plant was conducted by the Board of Water Supply in an effort to ascertain if the practice of turf irrigation by sewage effluent on the sewage treatment plant grounds could produce observable seepage. As in the presewage treatment construction study, no significant perching lava flows were observed nor could any seepage be attributable to sewage effluent irrigation, however, greener vegetation was noticeable below the sewage

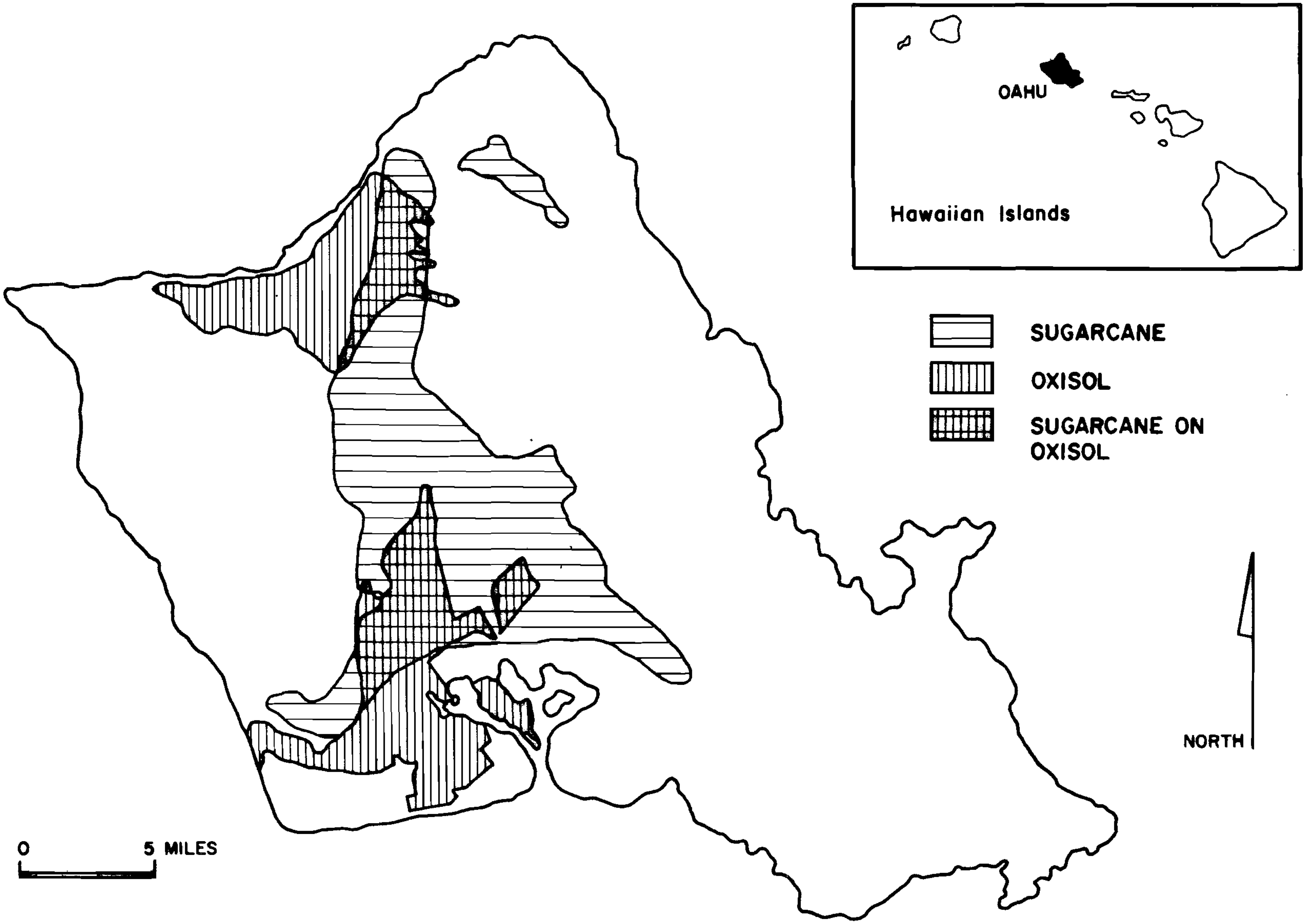


FIGURE 1. MAP OF OAHU SHOWING SUGARCANE, LAND USE, OXISOLS, AND PROJECT FIELD SITE.

treatment plant discharge point in Kipapa Gulch. Nevertheless, it should be emphasized that despite these observations, noticeable seepage is not likely to occur under the low application sprinkler rate and, consequently, the only positive conclusion reached was that there was no discernible seepage from the existing irrigation practices conducted at the sewage treatment plant.

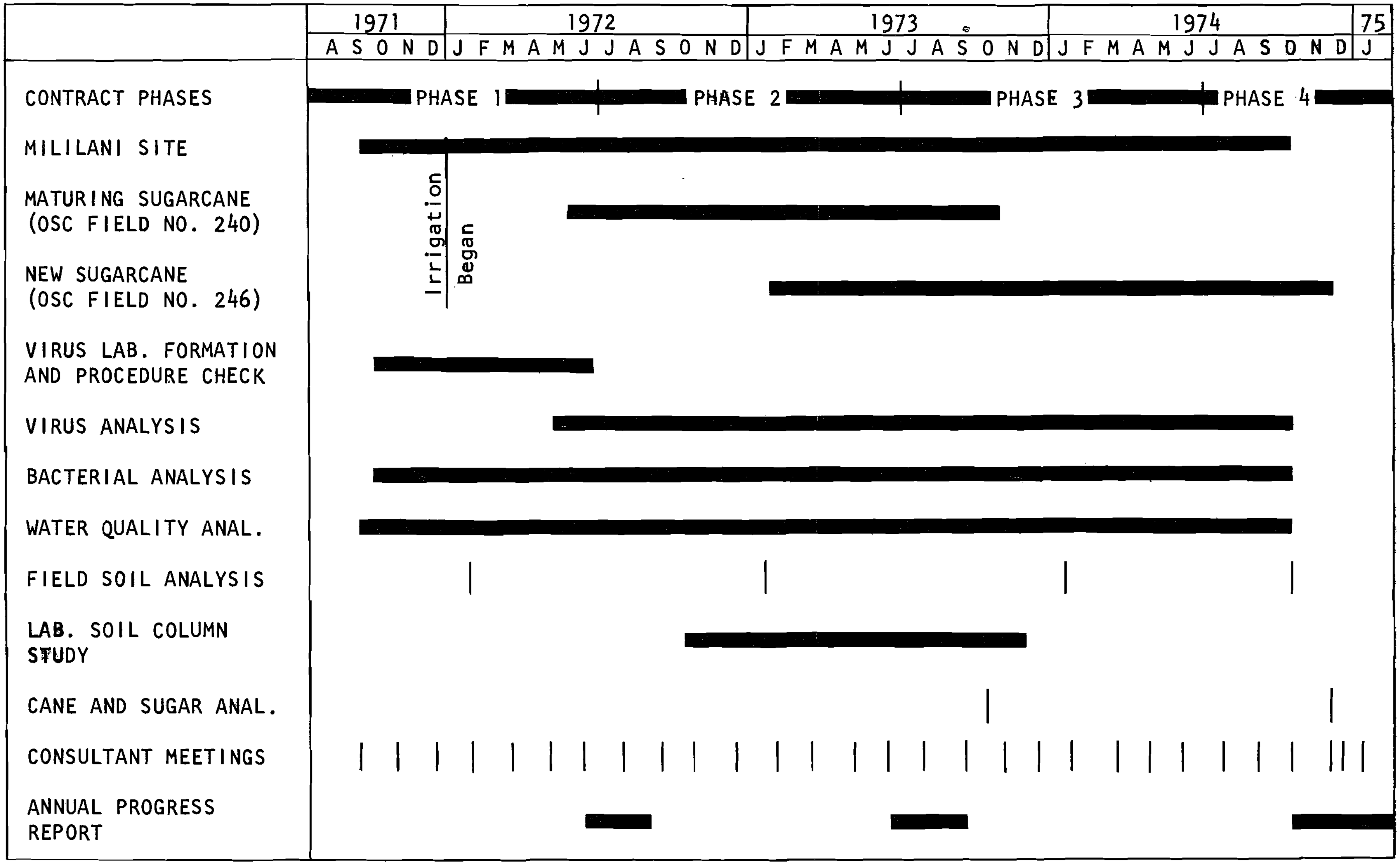
In operation since 1969, the Mililani sewage treatment plant utilizes the "Rapid Bloc" activated sludge process without prior primary treatment. However, construction of a primary clarifying unit should be complete and the unit in operation by fall 1973. According to analyses of influent raw sewage and chlorinated effluent conducted for one-and-one-half years, the commonly utilized parameters of $BOD_5$ and suspended solids show that the plant has had an efficiency of removal of over 90 percent, as shown in Table A-4, Appendix A. The remainder of the 12 acres (4.9 ha) of grounds not used in plant expansion are sodded with Bermuda grass and receive about 50,000 gal (189,250 $\ell$) daily of chlorinated secondary effluent as irrigation water in rotation with each receiving effluent for a period of approximately five hours a day, three times a week.

The sewage from the Mililani planned community development is largely domestic in origin and contains no known industrial discharges. The Board of Water Supply presently serves the Mililani area from two wells that provide water of very high quality. A recent analysis revealed that the total hardness was 45 mg/$\ell$, chloride 18 mg/$\ell$, and total nitrogen 0.7 mg/$\ell$.

The research plan consists of (1) the application of waste water, which has received different levels of treatment, to field soils and (2) the determination of short-term and seasonal changes in the resultant leachate. Secondary-treated effluent was studied first; tertiary-treated effluents may be studied in a subsequent phase. The applied effluent and leachate were monitored for chemical, physical, and microbiological quality changes.

The research results to date can best be described according to the previously mentioned three principal work areas: soils and irrigation, virology analysis, and water quality analysis. The timetable for the project is shown in Table 1. The initial phase of the work primarily involved the monitoring of the ongoing turf irrigation with secondary sewage effluent at the Mililani Sewage Treatment Plant site followed by effluent application

TABLE 1. WATER RECYCLING FROM SEWAGE: IRRIGATION WATER WORK PHASE SCHEDULE.



to a test plot in Oahu Sugar Company's (OSC) Field No. 240 located within two miles of the Mililani Sewage Treatment Plant. Secondary sewage effluent application to the OSC Field No. 246 for a full two-year growing season commenced in February 1973.

By the very nature of the project, the soil and irrigation work area comprise the major field work, except for sample collection for viral and water quality analyses. Water samples are collected after they pass through the soil column.

Double ring permeameters, installed at several sites located on the Mililani Sewage Treatment Plant grounds and within the Field No. 240 test site, have shown the infiltration rate at these sites to be much lower than the values reported in Appendix A, Table A-3. Excavation of the soil on the Mililani Sewage Treatment Plant grounds revealed a distinct tillage pan which demarked the surface root zone of the Bermuda sod as a dark colored, loose layer zone, 6 to 9 in. (15 to 23 cm). The tillage pan was widely distributed over the grounds, as evidenced by a penetrometer survey. An additional tillage zone was found at the 21- 23-in. (53 to 58 cm) depth, marked by another black soil band of 1- to 2-in. (2.5 to 5 cm) thickness which lies just above the undisturbed subsoil. Additional excavations and study of a bank exposed by the construction of a World War II airfield adjacent to the sewage treatment plant and adjoining sugarcane fields confirm the widespread distribution of the dense strata of subsoil beneath the ridge on which the sewage treatment plant is located. Studies are being planned to ascertain the reliable range and extent of these areas of low infiltration.

A study site near the treatment headworks (Fig. 2) has been isolated for research use and a water meter, supplied by the Board of Water Supply, was added to the plant irrigation system to monitor the flow volume of secondary treated sewage to the study site. The 26 in. (117 cm) diameter hydraulic stainless steel lysimeter (Fig. 3), which was installed in a manhole-line pit was repacked to its 5-foot (1.5 m) depth with the same soil type, and to the approximate density, as the soil column which was removed and replaced. The lysimeter is supported by water-filled hydraulic tubes that are connected to a gage and recorder to provide a continuous record of the lysimeter's weight. A cross-section of the continuous recording lysimeter is illustrated in Figure 3. Leachate passing through the lysimeter soil is

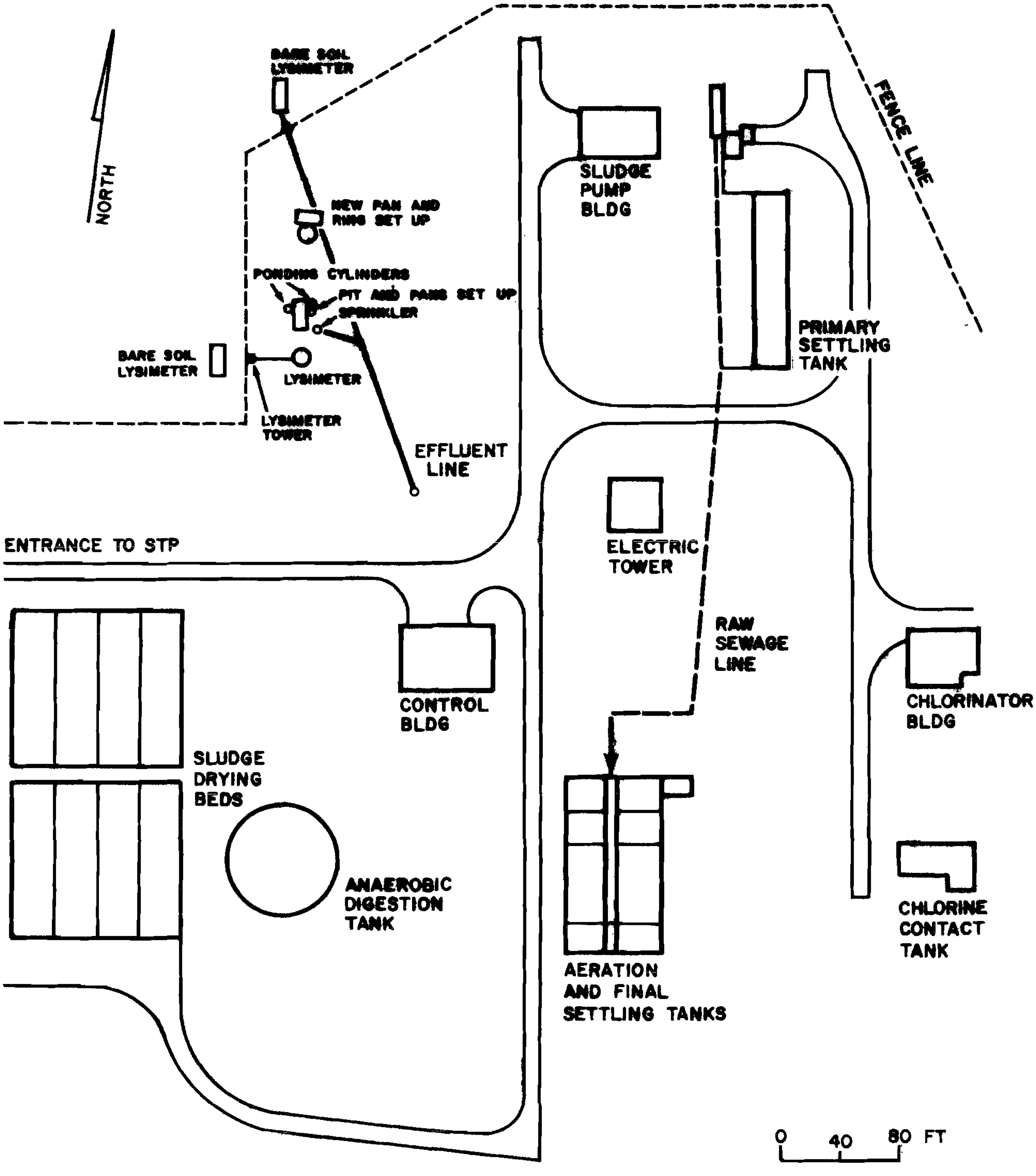


FIGURE 2. WATER RECYCLING OF SEWAGE BY IRRIGATION FIELD INSTALLATION: MILILANI STP.

pumped out on a regular basis for characterization.

A trench was cut adjacent to the lysimeter and two-foot square stainless steel pans were inserted at the 9-in. (23 cm), 2-ft (.61 m), 2.5-ft (.76 m), 3-ft (.91 m), 4-ft (1.22 m), and 5-ft (1.52 m) depths beneath intact subsoil to collect leachate.

Installation of the lysimeter and cutting of the trench was done with the assistance of Division of Sewers personnel and equipment.

## LABORATORY ANALYSES

The laboratory work carried on for the project can be classified into the following types of analyses: basic water quality parameters, pesticides, heavy metals, soils, and viruses. The basic water quality analyses included cations (calcium, magnesium, sodium, and potassium), anions (carbonate, bicarbonate, sulfate, chloride, and nitrate), pH, total dissolved solids, conductivity, suspended solids, biochemical oxygen demand, total organic carbon, total phosphorus, nitrogen series, silica dioxide, boron, grease, and fecal and total coliforms. The major laboratory work was divided among the following laboratories:

| | |
|---|---|
| Board of Water Supply laboratory | coliform |
| Pearl City Sewage Treatment Plant laboratory | total dissolved solids, suspended solids, total phosphorus, and chloride |
| Water Resources Research Center laboratory | remainder of the basic water quality parameters |
| Virus laboratory, University of Hawaii | viruses |
| Department of Agronomy and Soil laboratories | heavy metals and soils |
| Department of Agricultural Biochemistry laboratory | pesticides |

Pesticides, heavy metals, and soil analyses were performed on an infrequent basis. To date, pesticide and heavy metals have been restricted to 24-hour composite surveys of the raw sewage and unchlorinated and chlorinated effluent from the Mililani Sewage Treatment Plant. Soils were subjected to nonperiodic soil column characterization.

The virus laboratory was established at the initiation of the project. Considerable time and expense were spent in organizing the laboratory, the principal objectives of which are the detection, identification, and monitoring of human and animal pathogenic viruses in water supplies, waste water (both raw and treated), and in leachate which have passed through various depths of soil. The laboratory represents the first facility of its kind in Hawaii and includes such unique equipment as carbon dioxide incubators, sterilizing ovens, special glassware, biological media, and liquid nitrogen freezers for maintaining tissue cell line cultures.

The program for monitoring sewage effluents for virus detection is divided into three basic phases:

1. Recovery of small quantities of viruses from large volumes of water,
2. Growth of virus in appropriate indicator cell systems, and
3. Identification of isolated virus.

## Virus Recovery

Currently, a major challenge in the detection of viruses in waste waters is the development of a single standard technique for the efficient recovery and concentration of all kinds of pathogenic viruses from large volumes of waters. To date, no single method is available that is adequate for the recovery and concentration of all human enteric viruses. In general, as turbidity increases, the sensitivity of the test and the volume that can be assayed decreases. For the spectrum of waters and waste waters that are analyzed by the project, three separate assay techniques for the isolation of viruses are being utilized. These techniques are: the PE-60 method, the two-phase polymer method, and the cellulose nitrate membrane adsorption technique.

The PE-60 method of Wallis, Melnick, and Fields (1970), an insoluble cross-linked co-polymer of isobutylene maleic anhydride (Monsanto Co., St. Louis, Mo.), utilizes the charge characteristics of enteroviruses which makes them readily adsorbed by certain cationic polymers. Thus, under acidic conditions, viruses dispersed in large volumes of water readily adsorbs to PE-60 and can subsequently be eluted under alkaline conditions into smaller volumes of buffer. The eluted liquid is 1/500 to 1/1000th of the original volume, resulting in an effective concentration of the virus. The method is highly effective for the recovery of most human enteroviruses from large volumes of clean or lightly polluted waters, however, the efficiency and volume of liquid that this method can handle is proportional to the turbidity of the water. The method has been used on the project to assay up to 5 gal (19 ℓ) of chlorinated effluent and up to 20 gal (76 ℓ) of lysimeter leachate.

The two-phase polymer method as refined by Shuval (1969) relies on a liquid-liquid partitioning of two heavy polymers (dextran and polyethylene glycol). The lower dextran phase which makes up only 1/100th of the total volume, is the phase in which the virus, if found, is thereby concentrated. This method is least affected by turbidity, but is most severely limited in the samples volume it can handle (up to six liters - [1.6 gal]). Thus, it is well suited for raw sewage and unchlorinated effluent where the turbidity is generally high but where the concentration of virus is high enough that volumes of one gallon (3.8 ℓ) or less are sufficient.

The cellulose nitrate membrane absorption technique is limited to very clear water. This relatively simple method has proved quite efficient in easily handling clean water in volumes of 20 gal (76 ℓ) or more. In the present project, its use has been restricted to analyzing lysimeter leachate samples.

## Virus Growth in Indicator Cell Systems

The selection of a proper cell indicator system for the detection and isolation of animal viruses is extremely critical. Viruses, such as enteroviruses and adenoviruses, exhibit a high degree of specificity as to the cell species in which they can successfully infect and replicate. No single species of cells has yet been found that will support, with equal efficiency, the growth of all viruses. Thus, for the detection and isolation of viruses, the use of several cell lines are necessary. Primary rhesus monkey cells have the widest spectrum for growing the greatest variety of enteric viruses isolated, however, they are expensive and must be periodically purchased fresh from the mainland suppliers and stored in liquid nitrogen cell banks. Other cell systems used in the project include WI-38, a human embryonic lung diploid cell line, as well as continuous cell lines such as HeLa, HeP-2, LLC-MK, and CV-1 of human and monkey origins.

## Virus Identification

Virus identification and typing were done by established serological techniques, such as the neutralization test, which are based upon certain characteristics biological properties. However, since the number of human enteroviruses being monitored by this project is numerous, as shown in Table 2, this phase of the research has proven to be extremely time-consuming and expensive.

TABLE 2. AN ABBREVIATED OUTLINE OF VIRUSES MONITORED.

| VIRUSES MONITORED | | NO. OF SEROTYPES MONITORED |
|---|---|---|
| PICORNAVIRUS: | POLIOVIRUS | 3 |
| | COXSACKIEVIRUS A | 24 |
| | COXSACKIEVIRUS B | 6 |
| | ECHO | 30 |
| REOVIRUS: | REOVIRUSES | 3 |
| ADENOVIRUS: | ADENOVIRUSES | 32 |

NOTE: The viruses being monitored are found in contaminated waters and are those that primarily affect humans and do not include those affecting animals.

The Environmental Protection Agency's regional laboratory in Narragansett, Rhode Island has offered to provide assistance and advice for advice for virus related studies.

## Results and Discussion of Virus Studies

During the earlier phases of the project the majority of the assay procedures for virus isolation were qualitative in nature, that is, positive or negative in terms of the presence of viruses. Recently, however, quantitative assays have been performed on selected samples to determine their actual concentration of viruses. Also conducted have been the identification of virus isolates from selected samples collected at various phases of sewage treatment plant operation in order to determine if the sewage treatment plant process is selectively removing certain kinds of viruses. A summary of the results of these various analyses is shown in Table 3.

As expected, the highest incidence (100 percent) and concentration (27-170 PFU/$\ell$) of virus were found in the raw, untreated sewage. The incidence (69 percent) and concentration (7-69 PFU/$\ell$) of virus in the unchlorinated effluent remained significantly high indicating that the physical and biological processes of the treatment plant (settling, activated sludge) were not very effective in removing viruses. In contrast,

TABLE 3. SUMMARY OF VIRUS ISOLATION STUDIES UP TO 15 JUNE 1973.

| SAMPLES ANALYZED SOURCE | NO. | RANGE OF VOLUME ASSAYED ℓ | NO. AND PERCENT OF SAMPLES POSITIVE FOR VIRUS NO. | % | TYPES OF VIRUS IDENTIFIED FROM SELECTED SAMPLES | RANGE OF VIRUS CONC. PFU/ℓ |
|---|---|---|---|---|---|---|
| A. MILILANI SEWAGE TREATMENT PLANT | | | | | | |
| 1. RAW SEWAGE | 7 | 1.5 - 4 | 7 | 100 | COXSACKIE A-16,<br>POLIO | 27 - 170 |
| 2. UNCHLORINATED EFFLUENT | 13 | 2 - 9.5 | 9 | 69 | COXSACKIE B-5,<br>POLIO-3 | 7 - 69 |
| 3. CHLORINATED EFFLUENT | 36 | 5 - 20 | 19 | 50 | COXSACKIE B-5;<br>ECHO-7, 27, 1;<br>POLIO-3 | 2 - 4 |
| 4. LEACHATE FROM LYSIMETER | 27 | 4 - 76 | 1 | 3.7 | N.D.[a] | N.D.[a] |
| B. WAHIAWA SEWAGE TREATMENT PLANT | | | | | | |
| 1. RAW SEWAGE | 1 | 4 | 1 | 100 | ECHO-15 | N.D.[a] |
| 2. CHLORINATED EFFLUENT | 8 | 4 - 18 | 1 | 12.5 | POLIO-3 | N.D.[a] |

NOTE: liter x 0.264 = gallons.

[a] NONE DETECTED.

the incidence (50 percent) and concentration (2-4 PFU/ℓ) of virus in the chlorinated effluent was much lower indicating that chlorination was effective. However, infectious virus was still detectable in the final effluent. Furthermore, viruses were isolated from chlorinated effluent at residual chlorine readings of 0.5 to 1.9 mg/ℓ indicating that viruses were still viable at the range of chlorination normally found in the chlorination chamber.

Only one leachate sample, from a total of 27 tested, was positive for virus. Until the positive virus was isolated, the sample volume was originally 4 gal (15 ℓ), however, as a result of the one positive virus isolation, the sample size volume was increased to 20 gal (76 ℓ) in order to increase the chances of virus isolation. To date (15 June 1973), the 20-gal (76 ℓ) samples have all been negative. The most plausible explanation for the results is that the 5 ft (1.5 m) of soil at Mililani removes perhaps 99.99 percent of the virus applied to the top of the lysimeter. Thus, if under the usual conditions, chlorination reduces the virus concentration to about 3 PFU/ℓ and the lysimeter reduces that concentration another 99.99 percent, then the concentration of virus which can be expected in the leachate should be approximately 0.0003 PFU/ℓ. To isolate virus from this sample would require a concentration of at least 100 gal (379 ℓ) of leachate. So far assaying has been limited to a maximum of 20 gal (76 ℓ) of leachate as the percolation capacity of the present lysimeter is 10 gal/day (38 ℓ/day). Futhermore, it would be extremely difficult to handle 100 gal (379 ℓ) with the present available laboratory facilities.

The primary unresolved question is whether or not viruses can percolate throught 5 ft (1.5 m) of Mililani soil. It appears that the most feasible and fastest way to answer this question is to seed the water which is put on the lysimeter with a very high concentration of infectious virus labeled with radioactive $^{32}$P. Thus, leachate collected from the lysimeter could be analyzed for infectious virus and/or $^{32}$P radioactivity. This type of analysis should provide us with the answer as to what percentage of initial virus can percolate through 5 ft (1.5 m) of Mililani soil. If the virus reduction potential of the lysimeter is known and if the virus concentration of the water that is put on the lysimeter is known, some preknowledge should be gained as to the optium volume of leachate that must be assayed in order to obtain a positive virus identification. Marker viruses and/or labeled $^{32}P$ studies are presently being conducted, however, the results are too premature to be presented at this time.

The results as to the type of viruses being isolated show that the three major groups of human enteric-picorna viruses (Coxsackie, ECHO, and Polio) are being recovered from Mililani chlorinated effluent. The most predominant being Coxsackie B-5, ECHO-7, and Polio-3. Based on limited data, it does not appear that a specific kind or type of virus is being removed preferentially at a particular step in the treatment process. Although chlorination is effective in reducing the concentration of virus present, it must be stressed that the final chlorinated effluent still contains infectious human viruses.

A similar situation probably occurs at the Wahiawa Sewage Treatment Plant. Virus of human origin was readily isolated from a 1-gal (3.8 ℓ) sample of raw, untreated sewage obtained from the Wahiawa Sewage Treatment Plant. Samples of chlorinated effluent from this plant were difficult to process satisfactorily due to its characteristic high turbidity. However, virus was obtained from one of the eight chlorinated effluents assayed indicating that the finished effluent from the Wahiawa Sewage Treatment Plant also contains infectious virus of human origin.

## WATER QUALITY RESULTS

### Characteristics of Sewage Effluent and Raw Sewage

Due to their relationship to groundwater resources and irrigation, all liquid samples (raw sewage, secondary-treated effluent, and leachate) were analyzed for a wide range of parameters. The sampling frequency varied but generally did not exceed 10 to 14 days.

In general, raw sewage and secondary treated effluent exhibited reasonably uniform composition throughout the reported period of January 1972 through July 1973. The effluent quality was characteristic of that which had received secondary treatment. Uniform composition of the sewage and treated effluent is of considerable importance because it affords a greater opportunity for identifying the quality parameter changes in the leachate. Table 4 lists the range and median values of selected quality parameters for both raw sewage and secondary-treated effluent.

TABLE 4. MEDIAN, MINIMUM, AND MAXIMUM QUALITY PARAMETERS: MILILANI STP, JANUARY 1972 TO JULY 1973.

| CONSTITUENT | RAW SEWAGE[a] MEDIAN | RAW SEWAGE[a] MINIMUM | RAW SEWAGE[a] MAXIMUM | SECONDARY TREATED SEWAGE[b] MEDIAN | SECONDARY TREATED SEWAGE[b] MINIMUM | SECONDARY TREATED SEWAGE[b] MAXIMUM | CONSTITUENT REDUCTION |
|---|---|---|---|---|---|---|---|
| | | mg/ℓ | | | mg/ℓ | | % |
| TOTAL DISSOLVED SOLIDS | 502 | 318 | 620 | 342 | 262 | 415 | 32 |
| TOTAL HARDNESS | 60 | 48 | 144 | 58 | 24 | 115 | 3 |
| SUSPENDED SOLIDS | 210 | 130 | 312 | 17 | 4 | 134 | 92 |
| BIOCHEMICAL OXYGEN DEMAND | 208 | 170 | 310 | 17 | 6 | 148 | 92 |
| TOTAL ORGANIC CARBON | 90 | 55 | 127 | 24 | 5 | 62 | 73 |
| KJELDAHL NITROGEN | 38.6 | 19.0 | 57.8 | 13.9 | 3.2 | 26.0 | 64 |
| NITRITE & NITRATE NITROGEN | 0.1 | 0.0 | 1.3 | 0.5 | 0.1 | 5.4 | -400 |
| TOTAL NITROGEN | 38.7 | 19.1 | 58.5 | 14.6 | 5.0 | 26.0 | 62 |
| TOTAL PHOSPHORUS | 16.5 | 11.9 | 38.8 | 9.4 | 3.0 | 13.9 | 43 |
| CALCIUM | 16 | 9 | 38 | 10 | 5 | 30 | 38 |
| MAGNESIUM | 7 | 4 | 13 | 7 | 1 | 20 | 0 |
| SODIUM | 56 | 17 | 75 | 52 | 38 | 60 | 7 |
| POTASSIUM | 11.0 | 9.0 | 19.6 | 10.0 | 5.8 | 11.5 | 9 |
| CHLORIDE | 43 | 28 | 49 | 49 | 42 | 86 | -14 |
| SULFATE | 69 | 33 | 109 | 50 | 28 | 94 | 28 |
| SILICA DIOXIDE | 67 | 52 | 89 | 61 | 45 | 73 | 9 |
| BORON | 0.55 | 0.29 | 1.15 | 0.39 | 0.21 | 0.75 | 29 |
| GREASE | 43.7 | 22.9 | 67.0 | 8.7 | 3.6 | 54.4 | 80 |
| | | | | µmhos/cm | | | |
| ELECTRICAL CONDUCTIVITY | 520 | 440 | 670 | 400 | 315 | 540 | 23 |
| | | | | No./100 mℓ | | | |
| FECAL COLIFORM | -- | -- | -- | 2 | 0 | 37 | -- |
| TOTAL COLIFORM | -- | -- | -- | 4 | 0 | 160 | -- |

[a] Grab samples collected during the daylight hours at the Mililani STP raw sewage inlet.

[b] Grab samples collected during the daylight hours from either the discharge point of the STP, from the tank truck that transports secondary effluent to the Test Plot in OSC Field No. 240, or from the transmission pipeline that conveys effluent to the Test Plot in OSC Field No. 246.

From a purely agronomic standpoint, a water supply may be evaluated for its suitability for irrigation purpose only after the crop, the soil, the drainage condition, the irrigation practice, and the crop yield criteria are specified and only when the evaluation was conducted with locally developed criteria. In the case of the current project, such an evaluation is being made actually in the field for grassland and sugarcane. Taken separately, most quality parameters (Table 4) of the Mililani Sewage Treatment Plant effluent possess a level normally found acceptable for general agricultural use in the temperate zones of the United States. For example, the boron content in all effluent samples analyzed did not exceed 0.75 mg/ℓ and the median was 0.39 mg/ℓ. According to the United States Department of Agriculture, the median should satisfy even sensitive crops. Conductivity and total dissolved solids of the water, also used as common agricultural water quality criteria, had median values of 400 μmhos/cm and 342 mg/ℓ, respectively, which is below the minimum required for classifying irrigation water as "good."

The sodium content of the chlorinated effluent in comparison to the total major cations (Ca, Mg, Na, K) on an equivalence basis was 63 percent which may be considered slightly marginal, however, it is satisfied by another sodium criterion, the sodium absorption ratio (SAR). A high concentration of sodium in water, again by conventional mainland criteria, is considered undesirable because sodium reacts with soil to reduce permeability with an attendant displacement of calcium or other ions. However, the actual values of the cation constituents were all quite low.

A comparison between the quality of the influent raw sewage and the treated effluent is generally used as an indication of sewage treatment plant efficiency. The reduction of $BOD_5$ and suspended solids by 92 percent each is an indication of high efficiency. It should be noted also that the effluent is nearly free of both fecal and total coliforms.

Of particular note, in Table 4, in terms of irrigation water potential and sewage treatment plant efficiency, is the relatively high degree of total nitrogen removal (62 percent) in a secondary treatment plant where nitrogen removal is not among the primary objectives. The apparent high percentage of nitrogen removal at the Mililani STP is currently being studied in a Water Resources Research Center allotment project.

Composite samples of raw sewage and treatment effluent over periods ranging from 16 to 24 hours on four separate sampling dates extending from 22 to 23 October 1971 to 5 June 1973 have been analyzed for the standard water quality parameters. In addition, analyses were also conducted for selected pesticides and heavy metals content on the samples collected on 22 to 23 October 1971. The results (tabulated in Table A-5, Appendix A) show that the constituent concentrations of raw sewage entering the Mililani Sewage Treatment Plant, followed the profile of a typical domestic sewage. The data obtained from analyses of grab samples collected for a period of eighteen months (Table 4) corroborate these results. The $BOD_5$ and suspended solids reductions, with medians of 93.5 and 94 percent, respectively, for the four composite sampling dates, which for practical purposes are the same as the 92 percent reduction for both $BOD_5$ and suspended solids for the January 1972 to July 1973 period shown in Table 4, provide further evidence that the sewage treatment plant is operating at a high level of efficiency.

The pesticide (chlordane, dieldrin, DDT, DDD, and lindane) content of the composite samples from the October 1971 analyses was in the low parts per trillion (ng/ℓ) range. Although the levels of pentachlorophenol ranged from one to two orders of magnitude higher than for other pesticides in the effluent, the range was still less than one ppb (μg/ℓ). The concentration of these materials is about one order of magnitude higher than that previously reported for Oahu rain water and groundwaters (Bevenue 1972), but still well below levels of concern for potable water quality and other existing water quality standards.

Lead and cadmium in the composite samples were found in concentrations low enough to permit their acceptance for drinking water (U.S. Department of Health 1962) while mercury was less than the detectable limit of 0.003 ppm (mg/ℓ).

## Water Quality of the Leachate through the Hydraulic Lysimeter

The use of the lysimeter on the Mililani Sewage Treatment Plant grounds (Fig. 3) permitted an accurate determination of the gross hydraulic inputs (precipitation and secondary effluent application) and outputs (percolation and evapotranspiration) under field conditions. Inasmuch as the soil contained in the lysimeter was carefully repacked at about the same density as the soil material excavated to construct the lysimeter, it is considered

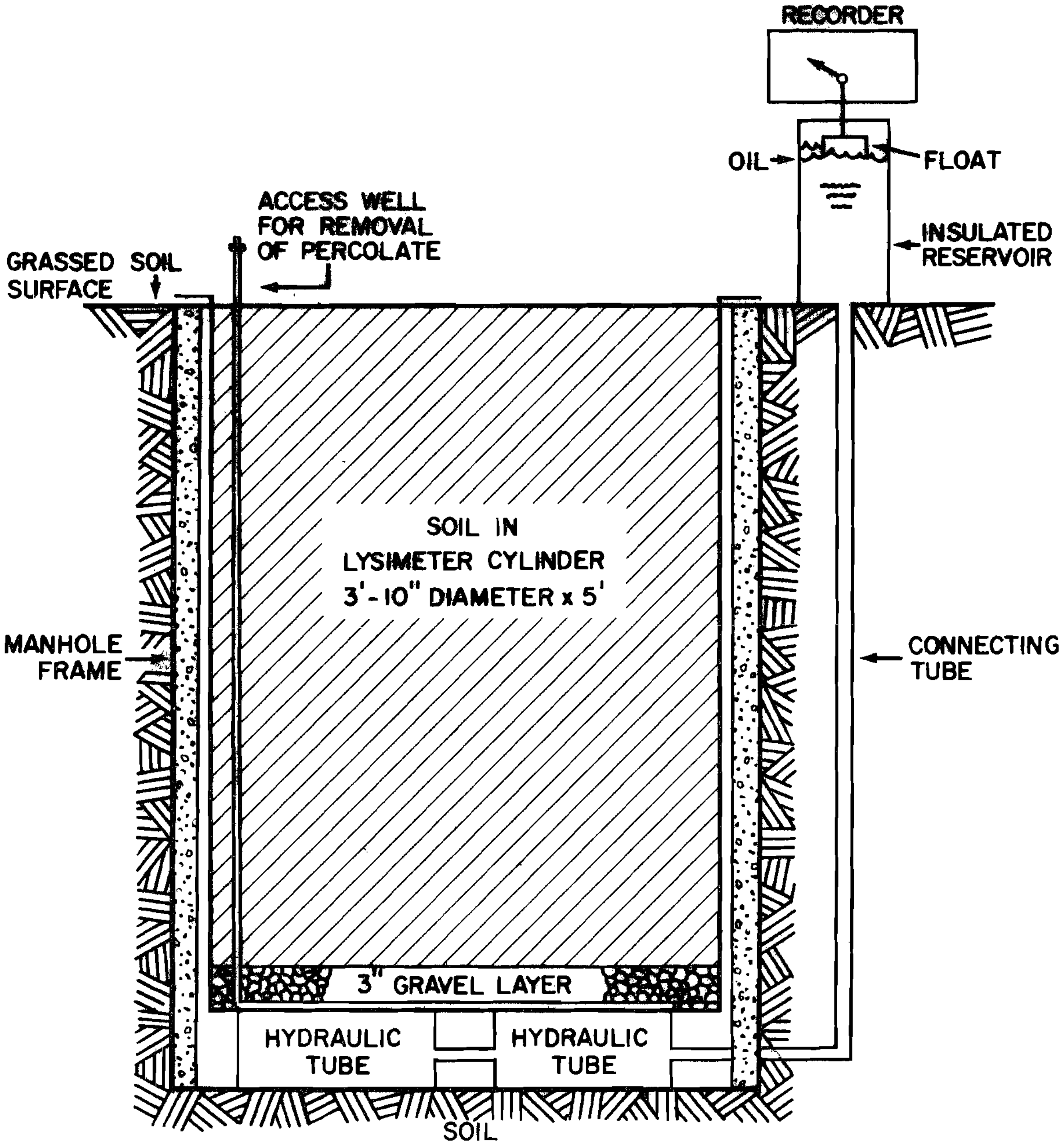


FIGURE 3. DIAGRAM OF THE FIVE-FOOT DEEP HYDRAULIC LYSIMETER.

to simulate closely *in situ* conditions.

The precipitation on the lysimeter was measured by a rain gage located adjacent to the Mililani Sewage Treatment Plant control building, approximately 250 ft (76 m) from the lysimeter. Precipitation from July 1972 to July 1973 amounted to 19.98 in. (50.7 cm), as tabulated in Table 5 and Table A-6, Appendix A, which is below the average annual precipitation of approximately 40 in. (102 cm), for this locality. The low quantity of precipitation is particularly noticeable in the first six months of 1973 when only 6.56 in. (16.7 cm) of precipitation was recorded.

The quantity of actual secondary effluent application to the lysimeter area would be difficult to ascertain with a fair degree of accuracy without resorting to a determination of the weight difference during the duration of effluent application. Even though the quantity of effluent pumped to the test area is metered, it is pumped to two sprinkler heads, one of which is located approximately 10 ft (3 cm) from the lysimeter. The quantity of effluent being applied is not necessarily distributed evenly between the two heads. In addition, there appears to be some variation in the spinkler pressure over the time of application as well as during changes in wind patterns. Efforts to establish the actual quantity applied to the lysimeter versus the gross metered effluent application of the two sprinkler heads have produced unsatisfactory results. The actual effluent quantities as determined by weight differences applied to the lysimeter for the July 1972 to July 1973 period, as shown in Table 5, amounts to approximately 141 in. (358 cm) or about seven times more than the measured precipitation during this same period. It must be stressed that the effluent application quantities presented in Table 5 should not be construed as necessarily representing optimum application conditions, but rather as reflecting the irrigation practices presently in effect at the Mililani Sewage Treatment Plant except at times when additional effluent was applied in order to obtain additional quantities of leachate for analysis. Also shown in Table 5 are values for the soil moisture tension.

In recharging the groundwater basin, the quantity of water percolating or leaching beyond the root zone is of prime importance. Under the conditions prevailing for the lysimeter, as can be observed in Table 5, approximately 45 percent of the liquid applied to the top of the repacked lysimeter (precipitation and secondary effluent) percolated the 5-foot (1.5 m) depth.

TABLE 5. FIVE-FOOT LYSIMETER WATER BALANCE.

| DATE | PRECIPITATION | APPLIED[a] IRRIG. WATER | EVAPOTRANS-PIRATION | | PERCO-LATE[b] | SOIL MOISTURE CONTENT DIFFERENTIAL | TENSION | PAN EVAPO-RATION[c] |
|---|---|---|---|---|---|---|---|---|
| | in. | in. | in. | in./day | in. | in. | centibar | in./day |
| 1972 | | | | | | | | |
| JULY | 0.84 | 7.50 | 6.85 | 0.221 | 3.89 | -2.40 | 16 | 0.257 |
| AUG. | 0.92 | 2.40 | 5.05 | 0.168 | 1.60 | -3.33 | 16 | 0.255 |
| SEPT. | 2.78 | 6.48 | 4.74 | 0.158 | 4.73 | -0.21 | 11 | 0.222 |
| OCT. | 3.27 | 15.51 | 3.94 | 0.127 | 12.21 | +2.63 | 6 | 0.206 |
| NOV. | 2.22 | 9.47 | 3.59 | 0.120 | 2.65 | +5.45 | 8 | 0.141 |
| DEC. | 3.39 | 9.46 | 4.83 | 0.156 | 7.74 | +0.28 | 14 | 0.142 |
| 1973 | | | | | | | | |
| JAN. | 0.93 | 15.82 | 6.51 | 0.210 | 4.55 | +5.69 | 5 | 0.185 |
| FEB. | 0.63 | 16.80 | 9.01 | 0.322 | 6.30 | +2.12 | -- | 0.215 |
| MAR. | 1.69 | 19.12 | 8.22 | 0.265 | 10.15 | +2.44 | 11 | 0.238 |
| APR. | 1.13 | 14.97 | 6.80 | 0.227 | 6.23 | +3.07 | 11 | 0.236 |
| MAY | 1.60 | 16.94 | 8.84 | 0.285 | 10.29 | -0.59 | 18 | 0.274 |
| JUNE | 0.58 | 6.62 | 6.85 | 0.228 | 2.86 | -2.51 | 19 | 0.259 |
| TOTAL | 19.98 | 141.09 | 75.23 | 0.207[d] | 73.20 | +12.64 | -- | 0.219 |

NOTE: in. x 2.54 = cm.

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

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

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

[d] Average.

On the other hand, pan lysimeters placed at various depths beneath the natural turf and located approximately 10 ft (3 m) from the five-foot (1.5 m) deep lysimeter as shown in Figure 2, collected only very small quantities of the applied liquid, thus indicating predominantly lateral, rather than vertical flow. At the present time, the areal extent of the soil and subsoil conditions that apparently restrict vertical water movement has not been determined. However, several prior hydrologic studies involving water balance for southern Oahu have determined that water recharge does occur in the Schofield Plateau region. Additional studies which are beyond the scope of this project may be required to ascertain the extent of area in which the high resistance to vertical flow prevails. The results of the pan lysimeter phase of the study will be discussed in a subsequent section.

The annual evapotranspiration rate from July 1972 through June 1973 of 0.206 in./day (0.523 cm/day) for the grass turf, as measured by weight difference of the five-foot deep lysimeter (Table 5) is 94 percent of the annual pan evaporation rate of 0.219 in./day (0.556 cm/day) measured in Oahu Sugar Company's Field No. 245, approximately two miles away.

The effective pore volume defined for use in this study is the volume of water that will drain freely from a saturated volume of soil under natural (gravitational) conditions. Soil tests indicate that the effective pore volume for the lysimeter is approximately 15 percent of the total volume. Expressed hydraulically, one pore volume is equal to about 9 in. (23 cm) of percolate in the lysimeter or approximately 57 gals (216 $\ell$). The 73.20 in. (186 cm) of percolate listed in Table 5 means that greater than eight pore volumes have passed through the lysimeter during the 12-month period from July 1972 through June 1973. As discussed in the first progress report, approximately four pore volumes passed through the lysimeter between its initial installation in January 1972 through June 1972, thus, a total of 12 pore volumes are calculated to have traversed up the lysimeter through June 1973.

It may generally be expected that after 12 pore volumes, the water quality of the percolate in the lysimeter would be approaching steady state conditions. However, when dealing with a soil system, the question of steady state is arbitrary inasmuch as in many cases it depends on the type and quantity of resident exchangeable material in both the soil system and liquid phase being applied to the soil column. Thus, under a given set of conditions, one exchangeable material in the soil column may be exhausted in a few days, whereas, another may have a reserve capacity to last 100 years or more. In addition to the pure physical and chemical reactions are the interacting biochemical reactions and combinations, thereof, in the soil column which are unfortunately only partly understood at the present time.

Therefore, it is not beyond reasonable expectation that the concentration of some parameters in the percolate may be less than the applied effluent, while others would be more, and still others may appear to be essentially unaffected by passage through the soil column. All three of these separate conditions were essentially borne out when a comparison was conducted between the concentration parameters of the applied secondary effluent, presented in Table A-4, Appendix A, and the hydraulic lysimeter, shown in Table A-7, Appendix A. For convenience, the number of samples, the median, minimum, and maximum concentrations, and the median constituent concentration change for various constituent parameters of the secondary effluent and percolate from the hydraulic lysimeter for the progress report period July 1972 through June 1973 are presented in Table 6.

As can be observed readily in Table 6, the constituents (total dissolved solids, electrical conductivity, chlorides, and sodium) resulted in relatively minor change as secondary effluent passed through the lysimeter. Chloride is classically considered a conservative substance, whereas, sodium and some of the other constituents comprising total dissolved solids as well as electrical conductivity which is a reflection of total dissolved solids, are particularly subject to base exchange within the soil complex under certain situations.

The column in Table 6 denoting percentage changes in the constituents passing through the lysimeter is essentially a "black box" approach when consideration is given to the previously discussed numerous complexities in the soil system. The percentage change reported to an accuracy of one decimal point is not intended to imply this high a degree of accuracy but only to indicate the situations when constituent removal approached one hundred percent.

The constituents shown in Table 6 that gained significantly in concentration (57.9 to 145.5 percent) were total hardness, calcium, magnesium,

TABLE 6. MEDIAN, MINIMUM, AND MAXIMUM QUALITY PARAMETERS: SECONDARY EFFLUENT - MILILANI STP AND PERCOLATE FROM HYDRAULIC LYSIMETER, JULY 1972 THROUGH JUNE 1973.

| CONSTITUENT | SECONDARY EFFLUENT[a] | | | | PERCOLATE FROM HYDRAULIC LYSIMETER[b] | | | | MEDIAN CONSTITUENT CONCENTRATION CHANGE THROUGH LYSIMETER % |
|---|---|---|---|---|---|---|---|---|---|
| | NO. OF SAMPLES | MEDIAN | MINIMUM | MAXIMUM | NO. OF SAMPLES | MEDIAN | MINIMUM | MAXIMUM | |
| TOTAL DISSOLVED SOLIDS | 19 | 336 | 262 | 413 | 9 | 330 | 226 | 720 | - 1.7 |
| TOTAL HARDNESS | 62 | 58 | 24 | 115 | 72 | 114 | 67 | 190 | +96.6 |
| SUSPENDED SOLIDS | 15 | 22 | 8 | 134 | 9 | 2 | < 1.0 | 19 | -90.9 |
| TOTAL ORGANIC CARBON | 39 | 25 | 8 | 34 | 29 | 1.5 | 1.0 | 4.0 | -94.0 |
| KJELDAHL NITROGEN | 62 | 16.1 | 3.6 | 26 | 63 | 0.01 | 0.0 | 0.9 | -99.9 |
| NITRITE & NITRATE NITROGEN | 61 | 0.4 | 0.1 | 3.5 | 73 | 0.01 | 0.0 | 1.63 | -97.5 |
| TOTAL NITROGEN | 60 | 16.3 | 5.0 | 26.0 | 61 | 0.02 | 0.0 | 1.63 | -99.9 |
| TOTAL PHOSPHORUS | 19 | 7.1 | 3.0 | 13.86 | 10 | 0.02 | 0.01 | 0.15 | -99.7 |
| CALCIUM | 57 | 11 | 5 | 30 | 73 | 27 | 19 | 44 | +145.5 |
| MAGNESIUM | 57 | 7 | 0 | 30 | 72 | 14 | 2 | 32 | +100.0 |
| SODIUM | 58 | 54 | 45 | 60 | 70 | 52 | 41 | 80 | - 3.7 |
| POTASSIUM | 58 | 9.9 | 7.5 | 11.5 | 70 | 1.3 | 0.5 | 2.6 | -86.9 |
| CHLORIDE | 58 | 49.5 | 44 | 99 | 63 | 52 | 40 | 89 | + 5.1 |
| SULFATE | 52 | 47.5 | 28 | 94 | 70 | 75 | 48 | 87 | +57.9 |
| SILICA DIOXIDE | 53 | 62 | 45 | 73 | 69 | 18 | 10 | 33 | -71.0 |
| ELECTRICAL CONDUCTIVITY (μmhos/cm) | 64 | 400 | 315 | 540 | 75 | 400 | 320 | 540 | 0.0 |

NOTE: Units in mg/ℓ, except where noted.

[a] Baseline values obtained from Tables A-4 and A-5, Appendix A.

[b] Baseline values obtained from Table A-9, Appendix A.

and sulfate. Total hardness is composed of the cations, calcium and magnesium. Thus, on an equivalence basis, with known concentrations of calcium and magnesium, the concentration of total hardness, usually expressed as $CaCO_3$ can be calculated or, conversely, if any two values are known, the third can be calculated. For this particular study, magnesium was determined by calculating the equivalence difference between total hardness and calcium. The soil at the Mililani Sewage Treatment Plant is rich in calcium as can be observed in Table A-2, Appendix A.

The high degree of sulfate leaching may be the result of possible resident quantities in the soil which may have occurred in the past when the land was in pineapple culture as ammonium sulfate is a common fertilizer for pineapple production.

Substantial losses (71.0 to 99.9 percent) were observed for suspended solids, total organic carbon, the entire nitrogen series, total phosphorus, potassium, and silica dioxide. These same constituents also showed significant losses during the first six months of operation as reported in the first progress report, except that total nitrogen did not begin to experience this significant loss until the fourth month of lysimeter operation.

With the exception of the nitrogen series, the substantial losses encountered for these constituents would generally be expected. In the nitrogen series, Kjeldahl nitrogen, which is composed of organic plus ammonia nitrogen, could be decreased significantly by sorption to the soil complex, taken up by macro- and microorganisms (including plants), volatilized to ammonia gas at higher pH values, or nitrified to nitrite, which in turn can be oxidized to nitrate. Nitrite and nitrate in nature and found essentially only in the soluble form except for saltpeter deposits. Although anion sorption can play a major part in the nitrate and sulfate balances in tropical soils, the relatively low content of amorphous material in the Lahaina Oxisol minimizes the importance of sorption in the nitrate balance. Oxidizable nitrogen forms can be utilized by soil microorganisms and plants or may denitrified to nitrogen gas under certain conditions.

As can be observed in Table 6, nearly all the applied nitrogen (99.9 percent) failed to traverse the five-foot (1.5 m) depth of soil in the lysimeter. In an attempt to quantify this apparent nitrogen deficiency, a nitrogen inventory of the known inputs and outputs of the lysimeter was conducted. The Bermuda grass covering the lysimeter was carefully cut by hand and collected for analytical determination of total nitrogen. The quantity of nitrogen output through the removal of grass clippings, shown in Table A-8, Appendix A, was determined by means of interpolation and extrapolation to be 26.52 g for the time period from January through June 1973. The estimated nitrogen in the 6.56 in. (16.7 cm) of precipitation during this time period at an assumed total nitrogen concentration content of 0.5 mg/ℓ would only amount to 0.09 g. The monthly quantity of irrigation application and collected percolate, as well as the average nitrogen concentration and the resulting monthly weight of nitrogen applied and collected in shown in Table 7.

As can be observed in Table 7, 39 percent of the applied nitrogen is not accounted for in the grass clippings and percolate in the nitrogen inventory for the period January through 13 July 1973. As discussed previously, a portion of the apparent nitrogen loss could be attributed to sorption or tie-up of organic and ammonia nitrogen in the root system. It is assumed at this time that the other portion of this loss can be ascribed to denitrification which is the reduction of nitrates to nitrites by bacteria and the freeing of nitrogen gas which is consequently lost to the atmosphere.

## Point Samplers Installed in the Five-foot Deep Lysimeter

In late March 1973, porous ceramic point samplers were installed at various depths in the five-foot (1.5 m) deep lysimeter in order to ascertain constituent changes with depth and for later use in virus recovery studies. The point samplers were positioned so as to collect percolate from the 0- to 9-in. (0-23 cm) depth, and at the 6-in. (15 cm), 15-in. (38 cm), 40-in. (102 cm), and the 46-in. (117 cm) depth as measured from the top surface of the lysimeter.

The chemical constituents surveyed at the various depths, ammonia nitrogen, nitrite, and nitrate nitrogen, sodium, potassium, and calcium, are tabulated in Tables A-9, A-10, A-11, A-12, and A-13, Appendix A, respectively. As can be noted from the individual constituent mean values for each depth, both ammonia-nitrogen and nitrite and nitrate nitrogen appear to decrease with depth at an inverse exponential rate; sodium apparently increased slightly from the surface to the 6-in. (15 cm) depth and then decreased fairly uniformly from a high of 63 mg/ℓ to 46 mg/ℓ and 44

TABLE 7. NITROGEN BALANCE IN FIVE-FOOT DEEP LYSIMETER

| 1973 | IRRIGATION | | | PERCOLATE | | |
|---|---|---|---|---|---|---|
| | liter | mg/ℓ N | g N | liter | mg/ℓ N | g N |
| JAN. | 400 | 16.5 | 6.60 | 124 | 0.02 | 0.002 |
| FEB. | 457 | 14.2 | 6.49 | 177 | 0.04 | 0.007 |
| MARCH | 520 | 17.5 | 9.10 | 276 | 0.02 | 0.006 |
| APRIL | 407 | 18.5 | 7.53 | 169 | 0.34 | 0.057 |
| MAY | 460 | 22.7 | 10.44 | 280 | 0.02 | 0.006 |
| JUNE | 180 | 20.1 | 3.62 | 78 | 0.012 | 0.001 |
| TOTAL | | | 43.78 | | | 0.079 |

NITROGEN INVENTORY FROM JANUARY THROUGH JUNE 1973

| | | | |
|---|---|---|---|
| Input: | Irrigation | 43.78 g | |
| | Precipitation | 0.09 g | |
| | Total Input | + 43.87 g | |
| Output: | Grass Clippings | 26.52 g | |
| | Percolate | 0.08 | |
| | Total Output | - 26.60 g | |
| Total Input - Total Output | | + 17.27 g | or 39% of Total Input |
| | Est. Tie-Up in Roots (Assumed 1/4 Clippings) | 6.63 | |
| | Unaccounted Loss | + 10.64 g | or 24% of Total Input |

mg/ℓ at the 46-in. (117 cm) and 60-in. (152 cm) depths, respectively; potassium remained at a low level range of 1.5 mg/ℓ to 0.22 mg/ℓ throughout the various depths, after being sharply decreased in the first few inches of soil from the nearly 10 mg/ℓ in the applied secondary effluent (Table 6); calcium increased rapidly from 12 mg/ℓ in the 6-in. (15 cm) depth to 47 mg/ℓ at the 46-in. (117 cm) depth, and then decreased sharply to 24 mg/ℓ at the final 60-in. (152 cm) depth.

A plausible explanation for the inverse results between sodium and calcium up to the 46-in. (117 cm) depth is base-exchange in the soil column, however, the sharp decrease from the 46-in. (117 cm) to the final 60-in. (152 cm) depth is not readily explainable with the present available data. Inasmuch as the five-foot lysimeter was repacked to the same density and with the same soil type per unit depth as the adjacent soil where it is located, it is possible that the concentration of calcium in the soil between the 46-in. (117 cm) and 60-in. (152 cm) depth is much lower than the overlying layers. In addition, it is possible that the base-exchange capacity replacing calcium was nearly exhausted after the 46-in. (117 cm) depth.

## Leachate Collected by Pan Lysimeter Underlying *in situ* Soil Conditions

Pan lysimeters, placed at various depths beneath *in situ* soil, is usually considered a practical method of obtaining actual data on leachate quality at any particular depth within the soil column. In the operation of the pan lysimeters in the soil profiles of a grassed area at the Mililani Sewage Treatment Plant site, considerable difficulty was experienced in collecting percolate samples because of the apparent soil resistance to vertical leachate flow. To attempt to compensate for this apparent lateral flow, a metal retainer ring 2 ft (0.61 m) in diameter and 1-ft (0.30 m) high was positioned in the soil with approximately 4 in. (10 cm) extending above the surface of the ground directly over the 2-ft (0.61 m) deep pan lysimeter. Thus, if water were placed in the ring, a 4-in. (10 cm) head resulted and horizontal flow was prevented for the first 8 in. (20 cm).

Through the use of the retaining ring to induce percolation when secondary effluent was placed inside the ring, a minimum amount of leachate was collected for laboratory analysis. In addition to the induced percolation and rainfall, the normal application of secondary effluent was continued. The chemical analysis of the leachate collected in the 2-ft (0.61 m) deep pan is tabulated in Table A-14, Appendix A.

When comparing the leachate quality of the pan lysimeters of Table A-14 with the leachate values from the five-foot (1.52) deep lysimeter, Table 6, and Table A-7, Appendix A, the most outstanding difference is the nitrogen concentration values. In the five-foot (1.52 m) deep lysimeter, the nitrogen values decreased after four months of operation to nearly nondetectable levels, whereas, no apparent nitrogen pattern resulted in the pan lysimeter after nearly seven months of operation with forced secondary effluent applications, although the last three nitrogen values in January 1973 did appear to be indicative of decreasing trend. However, the apparent decrease in nitrogen values that occurred in July 1972 increased in the following sequence of samples.

Other anomalies observed when comparing the five-foot (1.52 m) deep lysimeter and the pan lysimeter is the increase in the concentration of potassium in the pan lysimeter from 0.1 mg/ℓ in June 1972 to 6.0 mg/ℓ in January 1973, while the five-foot (1.52 m) deep lysimeter only varied from 0.5 mg/ℓ to 3.4 mg/ℓ over an eighteen month period as observed in the first progress report (Lau et al. 1972) and Table 6. Silica dioxide also appeared to be increasing during the seven months of pan lysimeter operation, however, it reached approximately the same concentration range as the five-foot (1.52 m) deep lysimeter. The median value for sulfate was 40 mg/ℓ in the pan lysimeter and 75 mg/ℓ in the five-foot (1.52 m) deep lysimeter. The operation of the two-foot (.61 m) deep pan lysimeter was terminated in January 1973.

In an attempt to compensate for the difficulty encountered in obtaining a sufficient quantity of percolate sample for laboratory analysis in the two-foot (.61 m) pan lysimeter using a 12-in. (30 cm) high retaining ring, another pan lysimeter installation consisting of three pans placed the 30-in. (76 cm) depth were installed in an adjacent location. The new lysimeter pans were positioned below a 48-in. (122 cm) diameter, 30-in. (76 cm) deep retaining ring submerged 18 in. (46 cm) into the soil.

The analyses of the chemical constituents collected from late August 1972, when the 30 in. (76 cm) deep pans were installed, until mid-February 1973 when their operation was discontinued are shown in Table A-15, Appendix A. The values of the chemical constituents, with minor exceptions, appeared to follow the same general pattern as experienced with the 2-foot (.61 m) pan lysimeters. Nitrogen did not appear to follow any particular pattern; calcium seemed to increase, then decrease. Potassium in contrast to the samples from the 2-foot (.61 m) lysimeter ranged very tightly from 0.6 mg/ℓ to 2.8 mg/ℓ; sulfate appeared to decrease during the final two months of operation.

At the present time the actual areal extent of the apparent resistance to vertical flow has not been fully determined.

## Test Plot in the OSC Sugarcane Field No. 240

Oahu Sugar Company's sugarcane Field No. 240, in which a test plot was located, was planted with sugarcane variety 50-7209 in September 1971. The test plot consists of five furrows, 70-ft (21.3 m) long, which receive secondary treated domestic sewage from the Mililani Sewage Treatment Plant. The sugarcane was approximately midway through its growth cycle when effluent applications began on 15 June 1972 and concluded on 8 June 1973. The field was scheduled for harvesting in August 1973. Percolation resulting from irrigation and rainfall was sampled by 29 porous ceramic points. The points were installed in each furrow at the 9-in. (23 cm) and 21-in. (53 cm) depths, just above and below the tillage pan and in the ridges at the 9-in. (23 cm), 21-in. (53 cm), and 33-in. (84 cm) depths, which corresponded to the approximate ponding depth of the irrigation water in the furrow just above the subsoil, and approximately one foot within the subsoil, respectively. Seven additional samplers were installed at depths ranging from 6 in. to 21 in. (15 cm to 53 cm) in adjacent furrows and ridges that receive irrigation ditch water. The ridges which support sugarcane growth are approximately 15 in. (38 cm) higher than the furrows. The sugarcane row spacing was approximately 5 ft (1.5 m). The point sampler depths, locations, and references are shown in Table A-16, Appendix A.

To obtain background leachate water quality data under normal irrigation practices, point samplers were initially installed approximately one-and-one-half months before treated sewage application began. Irrigation water which is obtained from Waiahole Ditch for the test plot area is of excellent quality. The chemical analysis of the Waiahole Ditch water is given in Table A-17, Appendix A.

The secondary treated sewage was transported the two-mile (3.218 km) distance from the Mililani Sewage Treatment Plant to the sugarcane test plot in 2200-gal (8327 ℓ) lots by a tank truck and discharged into an aluminum flume that conveys the effluent to the selected furrows. Two to three tank loads of secondary sewage were applied approximately once a week to the five furrows, an equivalent of approximately 4 in. to 6 in. (10 cm to 15 cm) of gross application. Each 2-in. (5 cm) application required about 15 minutes for discharge from the tank truck and an additional 30 minutes for complete infiltration into the upper reaches of the furrow. The adjacent normally-irrigated furrows received irrigation water at a rate of approximately 4 in. (10 cm) per three weeks or about one-fourth to one-third the application rate of the test plot. The monthly effluent applications to the test plot are shown in Table 8.

TABLE 8. EFFLUENT AND NITROGEN APPLICATION TO THE TEST PLOTS OF OSC SUGARCANE FIELD NO. 240.

| DATE | EFFLUENT APPLICATION | | |
|---|---|---|---|
| | HYDRAULIC in. | NITROGEN mg/ℓ | lbs/acre |
| (1972) | | | |
| JUNE | 12 | 13.3 | 36.2 |
| JULY | 12 | 14.3 | 39.0 |
| AUGUST | 20 | 9.7 | 44.0 |
| SEPTEMBER | 22 | 9.4 | 46.9 |
| OCTOBER | 22 | 11.5 | 54.4 |
| NOVEMBER | 16 | 13.3 | 48.3 |
| DECEMBER | 4 | 11.6 | 10.5 |
| (1973) | | | |
| JANUARY | 12 | 15.2 | 41.4 |
| FEBRUARY | 6 | 14.2 | 19.3 |
| MARCH | 6 | 17.5 | 23.8 |
| APRIL | 12 | 17.9 | 48.8 |
| MAY | 6 | 18.1 | 24.6 |
| JUNE | 6 | 18.3 | 24.9 |
| TOTAL | 156 | ---- | 462.1 |

NOTE: in. x 2.54 = cm; lb/acre x 1.121 = kg/ha.

Samples were collected from the point samplers during and one day after sewage application by subjecting the point samplers to a vacuum of approximately 25 in. (64 cm) of mercury, which generated a vacuum at the end of the lines of about 0.85 bar. The vacuum was applied at the beginning of the sewage application and was maintained for an hour after application was completed or for a total of 2 1/2 to 3 hours and also for a total of 2 hours on the day after sewage application. The leachate was removed from the point samplers by a hand pump.

## Leachate Collected by Point Samplers in the Test Plot Of the OSC Sugarcane Field No. 240

Ceramic point samplers were selected for this application because they are fairly easy devices to install and maintain for collecting leachate at relatively shallow depths and, hence, many such devices can be installed over a large area in a variety of arrangements and at various depths. The leachate collected by the 29 point samplers installed in the test plot were individually analyzed for nitrate and calcium and a few samples were also analyzed for pH, conductivity, total organic carbon, sodium, potassium, and silica dioxide as shown in Table A-17, Appendix A. Constituent concentrations for composite samples collected by the ceramic point samples in the furrows at the 9-in. (23 cm) and 21-in. (53 cm) levels, and in the ridges at the 21-in. (53 cm) and 31-in. (79 cm) levels, are shown in Table A-18, Appendix A. The quantity of leachate collected by individual point samplers is generally low and thereby limits the number and types of chemical analyses that may be performed.

The results from the individually collected point samples (Table A-18, Appendix A) and the composite of the samples at the various depths (Table A-19, Appendix A) permit an evaluation of quality data on individual sugarcane rows and/or at uniform depths for both the oxidized nitrogen ($NO_2$ and $NO_3$-N) and chloride concentrations. However, the larger quantities in the composite sample permit a wider range of constituent analyses and since there did not appear to be any particular pattern exhibited in the individual samples by row or position for equal depths in the furrows or ridges that are also not indicated in the composite samples, a discussion of the constituent results, for convenience, will be limited to the composite samples.

Chloride, which is considered to be one of the most conservative of the easily analyzed and abundant constituents, appeared to remain in approximately the same range as the secondary effluent (49 mg/ℓ, Table 6) from June 1972 through December 1973. The chloride concentration for the 27 December 1972 samples sharply increased to 100 mg/ℓ, 85 mg/ℓ, and 117 mg/ℓ for the 9-in. (23 cm) and 21-in. (53 cm) furrows, and the 33-in. (84 cm) ridge, respectively. There was an insufficient quantity of composite sample in this date to conduct analyses beyond the nitrogen series for the 21-in. (53 cm) ridge sample. The chloride concentration in the next series of samples (11 January 1973) decreased to the 58 mg/ℓ to 68 mg/ℓ range and from then on remained slightly higher than the point samples from applied secondary effluent. The reason for the sharp chloride concentration increase on the samples of 27 December 1972 is difficult to ascertain, however, as can be observed in Table 8, the test plot in the month of December received only 4 in. (10 cm) of applied secondary effluent, therefore, it may be postulated that this effect could have been at least produced partly by a lack of hydraulic flushing action.

The concentration of calcium as it passed through the soil column under field conditions increased similarly to the pattern occurring in the five-foot (1.5 m) deep lysimeter, except that the increase was from approximately 10 mg/ℓ (Table 4) in the applied secondary effluent to a median range of 70 to 80 mg/ℓ, which is a considerably higher increase than the 145 percent increase experienced with the percolate samples from the five-foot (1.5 m) deep lysimeter. The samples from the 33-in. (84 cm) ridge generally range from 10 to 20 mg/ℓ higher than the other composite samples. This particular site was the location of a World War II airstrip in which a considerable quantity of coral-bearing calcium was used for the runways. Thus, when the runway was plowed under for agricultural purposes, a large quantity of calcium was added to the soil.

Overall, the concentration of sodium from the composite point samplers was very similar to the applied secondary effluent (52 mg/ℓ, Table 4) except that the furrow samples appeared to have lower levels than the applied effluent for the first three months and then remained in the same general pattern as the applied effluent, whereas, the ridge samples were in a consistently lower range for the first seven months before converging. This is the same general condition that was observed in sodium concentration values for the five-foot (1.5 m) deep lysimeter.

As would be expected and as was observed in the five-foot (1.5 m) deep lysimeter, the total organic carbon concentration values from the point samplers decreased from a secondary effluent concentration values of 24 mg/ℓ to a median value of approximately 8 mg/ℓ in the leachate from the point samplers.

Electrical conductivity for both the point sampler leachate and the applied secondary effluent was approximately the same the first three months but after that initial period the point sampler leachate started to exceed the applied secondary effluent by 50 to 200 μmhos/cm. At least part of this may be the result of the high amount of calcium leaching or base exchange. Electrical conductivity remained virtually the same in the liquid passage through the five-foot (1.5 m) deep lysimeter.

The concentration of sulfate decreased from approximately 50 mg/ℓ in the applied secondary sewage to the 20 mg/ℓ range in the point sampler leachate. This is the opposite reaction of the condition that occurred in the five-foot (1.5 m) deep lysimeter where the concentration of sulfate increased by 58 percent (Table 6) in the liquid passage through the soil column, less effects from rainfall.

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. This is essentially the same reaction that occurred in the five-foot (1.5 m) deep lysimeter. Silica dioxide also exhibited the same general trend as potassium in both the point samplers and the five-foot (1.5 m) deep lysimeter. The concentration of silica dioxide in the point samples ranged from 10 mg/ℓ to 30 mg/ℓ with the 9-in. (23 cm) furrow samples being consistently higher than the 33-in. (84 cm) ridge samples. These values compare to a median of 61 mg/ℓ for the applied secondary effluent.

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 one of the most critical due to its effects on sugarcane growth and sugar yield; therefore, it was monitored closely in this phase of the study. As can be noted in Table A-19, Appendix A, the oxidizable forms of nitrogen ($NO_2$ and $NO_3$-N) were the overwhelming predominate form in the leachate in the point samplers, thus, it was the form that was chosen to be monitored in the analysis of the individual point samples (Table A-18, Appendix A) where a sufficient quantity of samples was critical. However, total nitrogen must be considered in the evaluation of the applied secondary effluent inasmuch as nitrogen in any form can readily change to its various forms under specific conditions. For example, the median value for nitrite and nitrate nitrogen was only 0.5 mg/ℓ, whereas, total nitrogen was 14.6 mg/ℓ, as shown in Table 4.

Under normal sugarcane fertilization practices, the total application of nitrogen for the two-year sugarcane crop is applied during approximately the first eight months of the growth cycle. In the OSC sugarcane Field No. 240 test plot, the sugarcane had already received its normal nitrogen application of 318 lbs/acre (357 kg/ha) before the application of secondary sewage effluent with a total nitrogen value that ranged from nearly 10 mg/ℓ to greater than 18 mg/ℓ was applied to an approximate hydraulic depth of 156 in. (396 cm) which amounts to an additional 462 lbs/acre (518 kg/ha), as shown in Table 8.

A plot of the apparent effect of applied secondary sewage application to the soil supporting sugarcane growth is presented in Figure 4. As can be noted readily, there is a fairly uniform nitrogen increase with time with no apparent trend throughout the point sampler locations, except that the values from the ridge-located samplers do not seem to have a continuing increasing trend as the furrow samplers for the January to March, 1973 period.

The effect of the increase in the nitrogen concentration of the soil water on sugarcane growth and sugar yield, if any, can only be fully evaluated when the sugarcane crop is harvested (scheduled for August 1973, but actually harvested in October 1973) and the test plots' sugarcane growth and sugar yield are compared to the rest of the field that received normal irrigation water and fertilization. Leaf punch tests conducted during the period when secondary effluent was substituted for irrigation water indicated there was a nitrogen buildup in the cane. An evaluation of the final results of the sugarcane growth and sugar yield in the test plot and adjacent field was somewhat difficult to ascertain fully inasmuch as the test area received three to four times the quantity of irrigation (secondary effluent) as did the rest of the water-short sugarcane fields. The extent

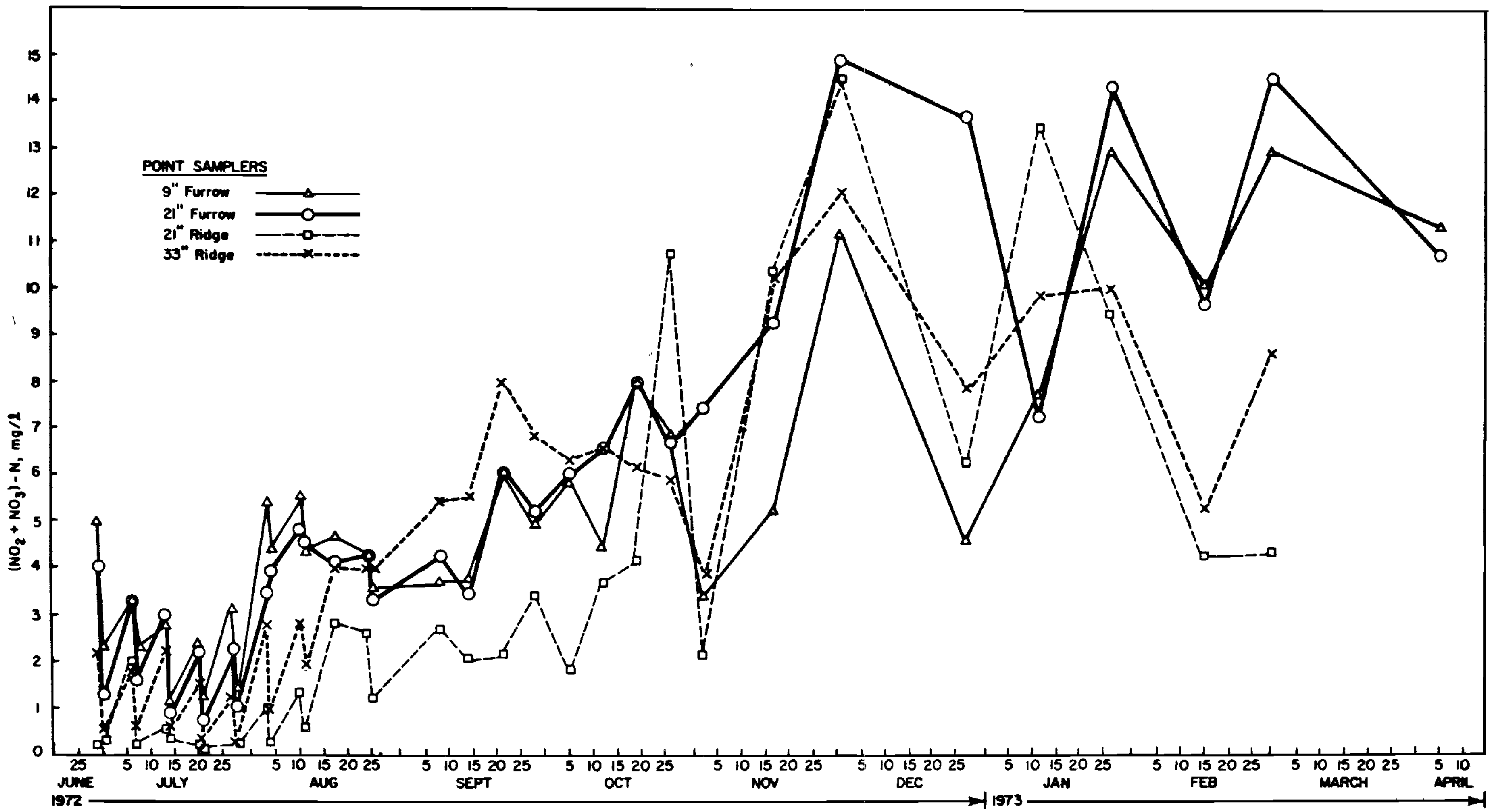


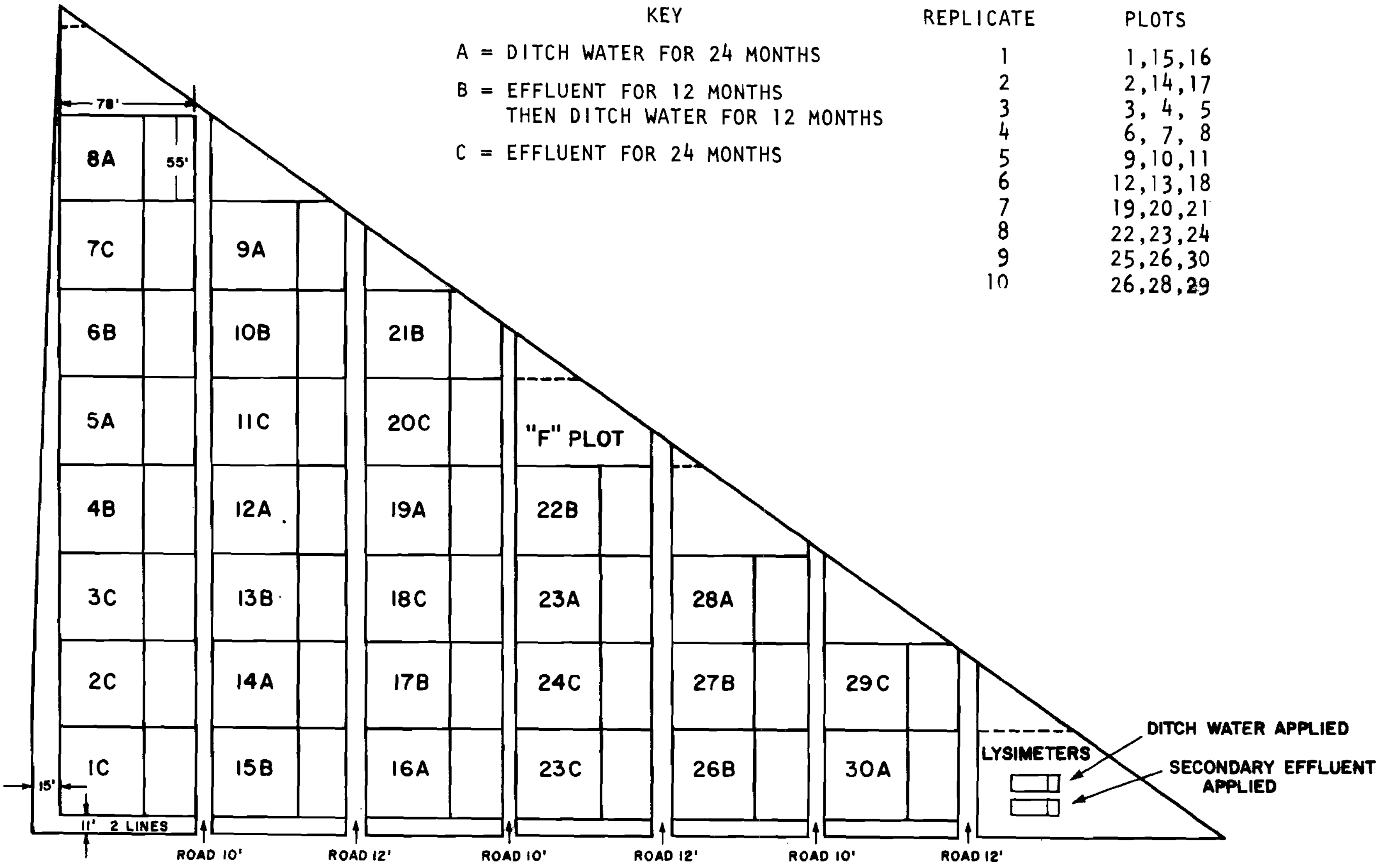
FIGURE 4. VARIATION IN NITRITE AND NITRATE NITROGEN CONCENTRATION OF LEACHATE COMPOSITED FROM POINT SAMPLERS LOCATED AT VARIOUS DEPTHS AND LOCATIONS IN THE TEST PLOT OF OSC SUGARCANE FIELD NO. 240.

of the water shortage was not anticipated at the initiation of the study and, therefore, no extra provisions were provided to import additional quantities of ditch water for at least a small portion of the adjacent field to bring it up to optimum irrigation water application rates. Probably, due primarily to irrigation liquid differences, the secondary effluent irrigated plots had an estimated growth that was nearly 40 percent greater than the water-short adjacent fields. In terms of laboratory determined sugarcane parameters when comparing secondary effluent irrigation to ditch water irrigation, the purity of the sugar averaged 74.25 and 75.20 percent, respectively, and the pol cane parameter was 10.70 and 9.75 percent, respectively.

## Test Plot Arrangement and Facilities in the OSC Sugarcane Field No. 246

The test plots in the Oahu Sugar Company's Field No. 246 afforded an opportunity, within the project's funding period, to conduct irrigation with sequential applications of both ditch water and secondary effluent to a newly planted sugarcane field within relatively close proximity (approximately one mile [1.609 km]) to the Mililani Sewage Treatment Plant, or about two miles (3.218 km) from the OSC Field No. 240. The soil of Field No. 246 is of the same general type as was described for Field No. 240. Soil analysis from five soil samples collected in the test plots are shown in Table A-20, Appendix A.

Thirty test plots were laid out in widths of ten sugarcane rows (55 ft or 16.8 m) each, with a length of 80 ft (24.4 m) or a total area of 4400 sq ft (408.8 sq m) per plot. The triangular arrangement of the test plots is shown in Figure 5. The letter designations A, B, and C after the numbers from 1 to 30 refer to the type of irrigation liquid and corresponding sequential application. Each of the letters apply to ten plots. The letter "A" refers to plots that will receive ditch water only for the sugarcane culture cycle of nearly two years; "B" refers to secondary effluent application during the first half of the culture cycle and ditch water during the last half; and "C" refers to plots that will receive secondary effluent only for the entire culture cycle. Also shown in Figure 5 is a listing of ten replicate "A," "B," and "C," plots. The replicate plots will receive approximately the same quantity of irrigation and are placed under dif-



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 5. TEST PLOT LAYOUT FOR VARIOUS IRRIGATION AND FERTILIZATION PRACTICES OSC SUGARCANE FIELD NO. 246.

fering orders of arrangements to try to compensate for any inherent irregularities in the soil and/or sugarcane culture management.

The initial planting of Field No. 246 occurred on 8-9 February 1973 and harvesting is scheduled for November 1974. At the time of planting, treble superphosphate was applied as $P_2O_5$ to all plots at an application rate of approximately 142 lbs/acre (392 kg/ha). This application and subsequent applications (up to 30 June 1974) of urea (N) and muriate of potash ($K_2O$) in various quantities to the different plots are shown in Table 9.

Ditch water application to all test plots was initiated on 15 February 1973, and was later repeated on 27 February, 2, 14 March and 4 April 1973. After the April 4th irrigation, only plots "A" received ditch water while "B" and "C" plots were irrigated with secondary sewage according to the testing schedule. The actual quantity of ditch water applied to the furrows, due to the method of application by the use of flumes, is difficult to determine to a high degree of accuracy, however, by rough measurements it is estimated to average, depending on rainfall, approximately 6 in. (15 cm) every two weeks. This quantity of application, which is considered in the optimum range for sugarcane growth in central Oahu, is nearly twice the irrigation water being applied to the water-short adjacent sugarcane fields.

Secondary effluent was pumped from the Mililani Sewage Treatment Plant to the test plots through 5000 ft (1524 m) of 3-in. (7.6 cm) PVC pipe at a rate of approximately 125 gpm (7.89 ℓ/sec). Nearly one-half of the total length of pipe is buried under a few inches of soil for protection against traffic and agricultural operations, especially the portions adjacent to pineapple fields. The secondary effluent, after being delivered to the test plot area, is distributed to the furrows of the test plots through 4-in. (10 cm) PVC pipes with 1-in. (2.5 cm) openings at each furrow. To facilitate the secondary effluent application, and to compensate for pipe head loss, a 200 gpm (12.6 ℓ/sec) booster pump together with three 1200-gal (4542 ℓ) interconnected secondary effluent storage tanks were installed adjacent to the test plot site.

Secondary effluent application to the "B" and "C" plots was initiated on 13 April 1973 and followed thereafter, as close as practical, a predetermined application pattern. Inasmuch as it requires several days to complete both the ditch water and secondary effluent irrigation to all test

TABLE 9. FERTILIZER APPLICATION ON THE INDIVIDUAL TEST PLOTS OF OSC SUGARCANE FIELD NO. 246.

| TEST PLOT | DATE | | | | | | | | | TOTAL FERTILIZER APPLICATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8-9 FEB. 1973 | 27 FEB. 1974 | | 9 MAY 1973 | | 20 JUNE 1973 | | 8 AUG. 1973 | | | | |
| SECTION | P* | N† | K‡ | N† | K‡ | N† | K‡ | N† | K‡ | P* | N† | K‡ |
| | lb/acre | lb/acre | | lb/acre | | lb/acre | | lb/acre | | lb/acre | | |
| A | 142 | 95 | 47 | 100 | 50 | 110 | 65 | 75 | 66 | 142 | 380 | 228 |
| B | 142 | 95 | 47 | 80 | 50 | 40 | 22 | | | 142 | 215 | 119 |
| C | 142 | 95 | 47 | 40 | 17 | | | | | 142 | 135 | 64 |

NOTE: lb/acre x 1.121 = kg/ha.

* As Treble Superphosphate: Applied mechanically with initial seeding.

† As Urea: Applied by hand.

‡ As Muriate of Potash: Applied by hand.

plots, it is generally not possible, with the available manpower and equipment, to irrigate the replicate plot series (as outlined on Fig. 5) on the same day, however, an attempt is made to balance the replicate series over a period of a week to a month. Not only the physical factors, but also the changing nitrogen concentration in the effluent interfere with both the hydraulic and nitrogen load in attempting to balance 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 test plots of Field No. 240) were installed in test plots 10, 11, 19, 20, 21, and plot "F" adjacent to plots 20 and 22, just outside the prescribed test plots (refer to Fig. 5). The point samplers in the "F" plots were installed for background purposes. The chemical analyses of the samples collected by the point samplers are tabulated in Table A-21, Appendix A. The point samplers are placed at one of two separate depths: the odd numbered point samplers, after the test plot designation (such as 20C-1), refer to point samplers set to sample at the 9- to 12-in. (23 to 30 cm) depth, or just above the tillage pan; and the even numbers (such as 20C-2) are set to collect samples at the 18- to 20-in. (46 to 51 cm) depth, or approximately 6 in. (15 cm) below the tillage pan. The initial sampling of the "F" plots commenced on 15 February 1973 and on 16 April 1973 for the point samplers within the test plots. Due to the relatively short period of sampling up to 30 June 1973 in comparison to the total projected investigation period for the test plots, in addition to interferences due particularly to initial installation and fertilization, no attempt will be made at this time to analyze the implications of the chemical results (Table A-21, Appendix A) from the collected point samples.

Two 5 ft x 9 ft (1.5 m x 2.7 m) metal field lysimeters 5-ft (1.5 m) deep, as shown in Figure 6, have been installed along furrow lines adjacent to the test plots in the OSC Field No. 246. A plan view and cross section of the two lysimeters are illustrated in Figure 6. The lysimeter designated "D" refers to ditch water application and "E" refers to secondary effluent application. Provision has been made to collect leachate samples from the bottom of each lysimeter. Both lysimeters are planted with a row of sugarcane along their lengths aligned with the field furrow. Also shown in Figure 6, for each lysimeter, are nine 36-in. (91 cm) long horizontally

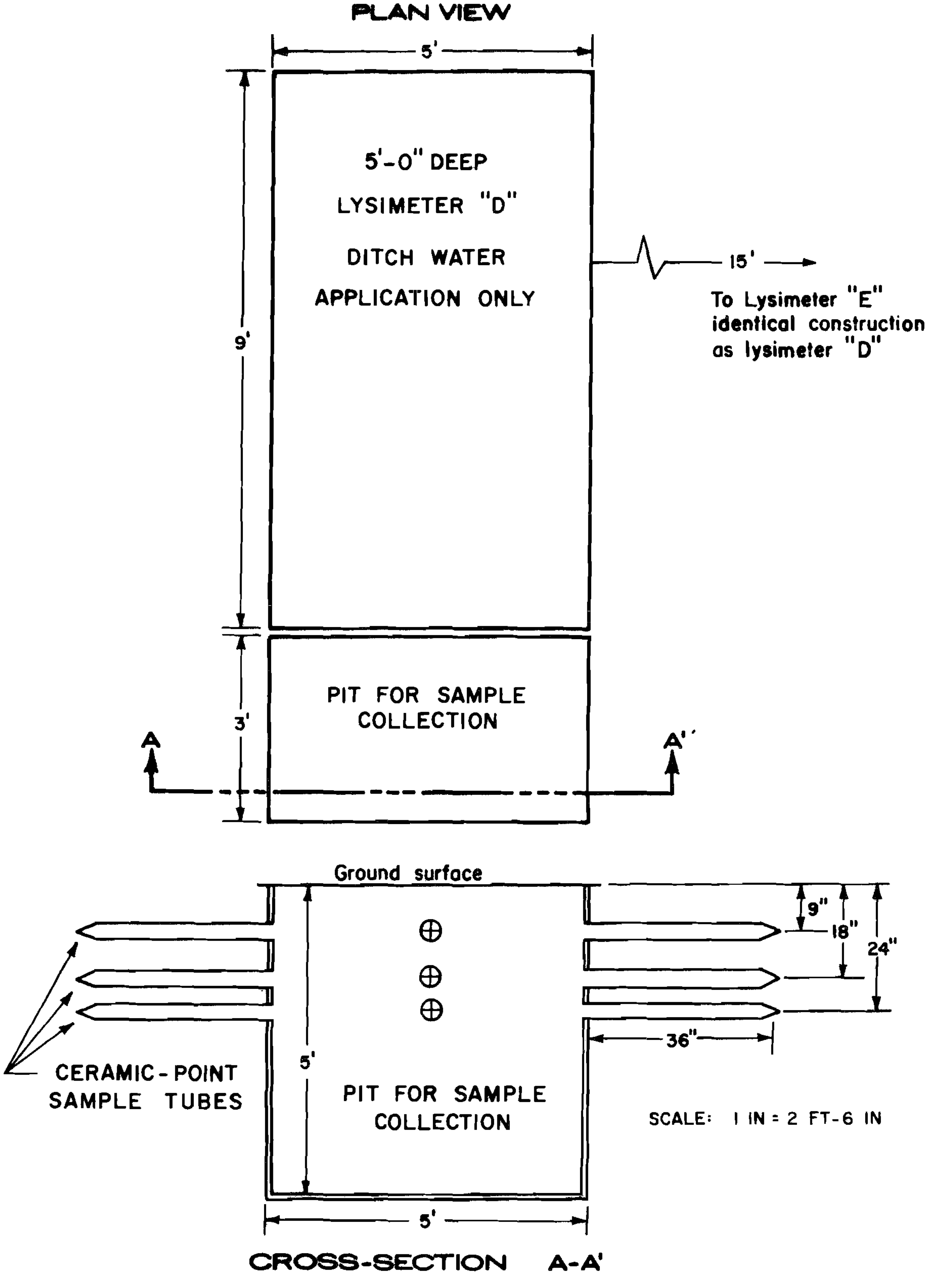


FIGURE 6. PLAN AND CROSS-SECTION VIEW OF 5-FT DEEP LYSIMETERS INSTALLED IN THE TEST PLOTS OF OSC SUGARCANE FIELD NO. 246.

positioned ceramic point lysimeters that are set at 9-in. (23 cm), 18-in. (46 cm), and 24-in. (61 cm) depths. Thus, leachated soil water samples can be collected from the 36-in. (91 cm) horizontal lysimeters from not only the intersected furrow, but also from the adjacent furrows on each side of the lysimeters. Leachate sample collection and analysis from the horizontal point samplers was just begun during the latter part of June 1973, and thus will not be presented in this progress report.

In an attempt to ascertain possible effects on sugarcane growth, sugar purity and production per unit area for each test plot, as a result of various irrigation and fertilization management practices as well as the irrigation water source, periodic sugarcane growth parameter analyses are scheduled to be conducted throughout the sugarcane culture cycle. Three such analyses were made by 30 June 1973. Sugarcane shoot counts were determined at time intervals of two and four months after planting. The results of the sugarcane shoot counts are presented in Table A-22, Appendix A. Results of chemical analysis of sheath and blade samples collected in the "A," "B," and "C," plots four months after sugarcane planting are shown in Table A-23, Appendix A. No readily apparent sugarcane growth parameter differences between plots "A," "B," and "C," could be detected.

Solar energy input, which is a critical factor in ascertaining sugarcane growth parameters, is measured by means of a project-installed solar energy recorder at the nearby (one-mile [1.609 km]) Mililani Sewage Treatment Plant. The results of the daily solar energy input for April, May, and June 1973 are shown in Table A-24, Appendix A.

## CONCLUSIONS

1. Mililani Sewage Treatment Plant raw sewage represents a very typical domestic sewage of fairly consistent quality.
2. The Mililani Sewage Treatment Plant efficiency of 92 percent, as measured by both suspended solids and BOD reduction, represents a well-operated secondary sewage treatment plant.
3. Total nitrogen removals at the Mililani Sewage Treatment Plant for an eighteen month period had a median value of 62 percent (from 38.7 mg/ℓ to 14.6 mg/ℓ). Such a high removal rate rivals many existing tertiary sewage treatment operations.

4. The quality of the effluent from the Mililani Sewage Treatment Plant appears to be excellent for agricultural purposes with the possible exception of the percentage of sodium (in comparison with the total amount of cations) which is slightly marginal for very sensitive crops (63 percent compared to <60 percent). However, when compared with the sodium adsorption ratio, it has the appearance of good quality irrigation water. According to a recently completed study (El-Swaify 1972) at the University of Hawaii, the standard irrigation water criterion which was developed for mainland conditions in the temperate zone may be unnecessarily conservative for subtropical conditions such as is found in Hawaii. Both the grassland and the sugarcane field test plots appear to be growing well.
5. Secondary effluent application to the grassed areas at the Mililani Sewage Treatment Plant did not represent necessarily optimum application conditions but, rather, only the irrigation practices presently in effect at the Mililani Sewage Treatment Plant.
6. The five-foot (1.5 m) deep hydraulically mounted lysimeter connected to a continuous recorder is an accurate method to determine both the water balance in a soil column and the actual daily rate of evapotranspiration.
7. Soil of the Lahaina series at Mililani appears to be very effective in removing $BOD_5$, total organic carbon, nitrogen, phosphorus, potassium, boron, coliforms, and viruses as evidenced by the leachate passing through the hydraulic lysimeter. Of these, nitrogen was not effectively removed until after about four months of operation, whereas the other constituents exhibited fairly rapid attenuation.
8. There appears to be some evidence of a base exchange or similar phenomenon in the soil complex for at least sodium and calcium in Oahu Sugar Company's Field No. 240.
9. Pan lysimeters placed at various depths in an *in situ* soil column at the Mililani Sewage Treatment Plant collected very limited amounts of leachate, which suggests that dense subsoil conditions exist. Tillage pans were also observed during excavation. There appears to be lateral soil water movement in this area. To facilitate the collection of sufficient quantities of leachate for chemical analysis, partially imbedded metal retaining rings as large as 48 in. (122 cm) in diameter and

30 in. (76 cm) high were employed.

10. The point sampler installed in the test area of Oahu Sugar Company Field No. 240, which receives secondary effluent applications at a rate that exceeds the irrigation practice used on adjacent fields by a factor of approximately three to four, have collected leachate from both furrow and ridge locations at various depths. The leachate exhibited many quality factors similar to that of the leachate from the hydraulic lysimeter except for nitrogen which appeared to continue to increase with time in the sugarcane field. Very little difference could be detected in the quality of the leachate from either the ridge or furrow sampling locations.
11. Sugarcane growth in the test plot, which received large quantities of secondary effluent, was estimated to be nearly 40 percent greater than the unanticipated (at the initiation of the study) water-short adjacent sugarcane furrows and fields. Chemical analysis of sugarcane samples collected from the test plot and adjacent sugarcane furrows indicated that the sugar purity difference was approximately one percent, with the ditch water irrigated furrows being the higher value.
12. Thirty test plots segregated into three separate irrigation management divisions, designated as "A," "B," and "C," were established in the OSC sugarcane Field No. 246 in February 1973. Each major irrigation management division consists of ten acres. Division "A" will receive only ditch water for the nearly two years of sugarcane growth cycle; "B" is schedule to receive secondary effluent for one-half the growth cycle and then ditch water the last-half; and "C" will receive only secondary effluent for the full growth cycle. The three divisions are further separated into ten replicate plots for similar irrigation liquid and fertilizer application. A total of 50 ceramic samplers have been installed in selected plots at depths of 9 to 12 in. (23 to 30 cm), just above the tillage pan, and at 18 to 21 in. (46 to 53 cm) approximately 6 in. (15 cm) below the tillage pan. Chemical analyses of the samples from the test plots commenced in April 1973. Two field lysimeters, one receiving ditch water and the other receiving secondary effluent, were installed parallel with two furrows. Nine horizontally positioned ceramic point samplers were installed in the lysimeter access pits of each lysimeter in order to sample leachate for both the in-line furrows

and the adjacent furrows. Chemical analysis of the lysimeter leachate commenced during June 1973. Due to the relatively short time that field and lysimeters point samplers have been installed, no evaluation of the results of the chemical analysis will be attempted.

13. Sugarcane growth in the test plots of OSC sugarcane Field No. 246 has progressed very well. No readily detectable differences were observed from sugarcane shoot counts at two and four month intervals (from time of planting), nor of chemical parameters of the stalk and leaf samples at the four month interval between the "A," "B," and "C" plots.

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## REFERENCES

Ahmed, S.; Swindale, L.D.; and El-Swaify, S.A. 1969. Effects of adsorbed cations on physical properties of trophical red earths and trophical black earths. *Jour. Soil Sci.* 20:255-68.

American Water Works Association. 1969. Viruses in water. AWWA Comm. on Viruses in Water, *J. Amer. Water Works Ass.* 61:491.

Ayres, A.S., and Hagihara, H.H. 1963. A lysimeter study of losses of nitrogen and potassium. *Hawaiian Planters' Record* 56(4):255-75.

Bevenue, A. 1972. Organochlorine pollutants of the marine environments in Hawaii. *Water Resources Seminar Series No. 2*, pp. 43-50, Water Resources Research Center, University of Hawaii.

Blummenstock, D.I., and Price, S. 1967. Climate of the states, Hawaii. *ESSA*, pp. 60-51.

Bouwer, H.; Rice, R.C.; and Escarcega, E.D. 1972. *Renovating secondary sewage by groundwater recharge with infiltration basins.* Water Poll. Contr. Res. Series 16060 DRV, Environmental Protection Agency, Washington, D.C.

Cagauan, B.G., Jr.; Lau, L.S.; Green, R.E.; and Uehara, G. 1968. Solute dispersion in two Hawaiian soils under saturated flow. 9th Int. Cong. *Soil Sci. Trans.* 1:185-94.

Chao, T.T. 1966. Effects of nitrogen forms on the adsorption of bromide by sorghum. *Agron. Jour.* 58:595-96.

———, and Okazaki, E. 1965. *The behavior of bromide ions in soil systems. I. The movement of bromide ions in soil columns.* PRI Res. Rep. 115.

Culp, R.L.; Evans, D.R.; and Wilson, J.C. 1971. *Advanced wastewater treatment as practiced at South Tahoe.* Water Poll. Contr. Res. Series 17010 ELQ, Water Quality Office, Environmental Protection Agency, Washington, D.C.

Department of Health, State of Hawaii. 1974. Chapter 37-A. Water Quality Standards. *Public Health Regulations.*

Department of Public Works, City and County of Honolulu. 1971. *Water quality program for Oahu with special emphasis on waste disposal: Final report work areas 8 and 9.* Prepared by Engineering-Science, Inc. and Sunn, Low, Tom & Hara, Inc.

Ekern, P.C. 1967. *Pilot evapotranspiration study: Lysimeter design.* Tech. Rep. No. 37, Water Resources Research Center, University of Hawaii.

———. 1970. *Consumptive use of water by sugarcane in Hawaii.* Tech. Rep.

No. 37, Water Resources Research Center, University of Hawaii.

El-Swaify, S.A. 1970. The stability of saturated soil aggregates in certain trophical soils as affected by solution composition. *Soil Sci.* 190:197-202.

———. 1972. Quality standard for irrigation water in the tropics. *Water Resources Seminar Series No. 1*, pp. 51-66, Water Resources Research Center, University of Hawaii.

Envirogenics Co. 1972. Water factory 21. A condensed report to Envirogenics Co., El Monte, California, *Water and Sewage Works* 119(4):80-81.

Fox, R.L.; Plucknett, D.L.; and Whitney, A.S. 1968. Phosphate requirements of Hawaiian Latosols and residual effects of fertilizer phosphorus. 9th Int. Cong. *Soil Sci. Trans.* 11:301-9.

Green, R.E., and Obien, S.R. 1969. Herbicide equilibrium in soils in relation to soil water content. *Weed Sci.*17:514-19.

———, and Young, R.H.F. 1970. Herbicide fertilizer movement in Hawaiian sugarcane soils in relation to subsurface water quality. *Hawaiian Sugarcane Technologist 1970 Reports.*

Grigoryeva, L.V.; Korchak, G.I.; and Bondarenko, V.I. 1968. Sanitary virologic and bacteriologic characteristics of sewage, water, and mud and soil in suburban zones of Kiev. *Gig. Sanit.* (USSR) 33a:44-48; translation in *Hyg. and Sanit.* 33(9):360-64, 1968.

Hall, D.H. 1970. "Use of agricultural chemicals and factors contributing to their transport to estuaries in Hawaii." Report to the Coastal Water Quality Project Planning Group of Sea Grant, University of Hawaii, Tech. Memo. Rep. No. 30, Water Resources Research Center, University of Hawaii.

Hargis, D.R., and Peterson, F.L. 1970. *Artificial recharge practices in Hawaii.* Tech. Rep. No. 43, Water Resources Research Center, University of Hawaii.

Hori, D.H.; Burbank, N.C., Jr.; Young, R.H.F.; Lau, L.S.; and Klemmer, H.W. 1970. *Migration of poliovirus type 2 in percolating water through selected Oahu soils.* Tech. Rep. No. 36, Water Resources Research Center, University of Hawaii.

Ishizaki, K.; Burbank, N.C., Jr.; and Lau, L.S. 1967. *Effects of soluble organics on flow through thin cracks of basaltic lava.* Tech. Rep. No. 16, Water Resources Research Center, University of Hawaii.

Lau, L.S.; 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.

Lothrop, T.L., Sproul, O.J. 1969. High level inactivation of viruses in wastewater by chlorination. *Journal WPCF* 41(4):567-75.

Mats, L.I., and Korsh, L.E. 1967. On the circulation of pathogenic microorganisms and viruses in the soils, water, and air. *Gig. Sanit.* (USSR) 32(9):84-87; translation in *Hyg. and Sanit.* 32(9):415-18, 1967.

Merrell, J.C., Jr.; Jopling, W.F.; Bott, R.F.; Katko, A.; and Pintler, H.E. 1967. *The Santee recreation project Santee, California: Final report.* Water Poll. Contr. Res. Series Pub. No. WP-20-7, Federal Water Poll. Contr. Adm., U.S. Dept. of the Interior.

McGauhey, P.H., and Krone, R.B. 1967. *Soil mantle as a wastewater treatment system.* SERL Rep. No. 67-11, Sanit. Engrg. Research Lab., University of California, Berkeley.

———; Porcella, D.B.; and Dugan, G.L. 1971. *Eutrophication of surface waters: Lake Tahoe Indian Creek Reservoir.* Water Poll. Contr. Res. Series 16010 DNY, Environmental Protection Agency, Washington, D.C.

McMichael, F.C., and McKee, J.E. 1965. *Final report of research on wastewater reclamation of Whittier Narrows.* Pub. No. 33, California State Water Quality Control Board.

Mink, J.F. 1962. Excessive irrigation and the soils and groundwater of Hawaii. *Science* 135:672-73.

Parizek, R.R.; Kardos, L.T.; Sopper, W.E.; Myers, E.A.; Davis, D.E.; Farrell, M.A.; and Nesbitt, J.B. 1967. *Wastewater renovation and conservation.* The Penn. State Univ. Studies No. 23, The Pennsylvania State University.

Parkhurst, J.D. 1964. Progress in wastewater re-use in Southern California. ASCE Environmental Engrg. Conf., Salt Lake City, Utah, May 11-15, 1964.

San Diego County Department of Public Health, State of California. 1965. *Virological study report for Santee water reclamation project: Covering the period of June 26, 1964 through June 30, 1965.*

Sanford, W.G.; Ayres, A.S.; and Doi, M. 1965. Mineralizable soil nitrogen in relation to fertility needs of sugarcane in Hawaii. *Soil Sci.* 99: 132-37.

Sharma, M.L, and Uehara, G. 1968. Influence of soil structure on water relations in Low-Humic Latosols: I. Water retention; II. Water movement. *Soil Sci. Soc. Amer. Proc.* 32:765-74.

Shuval, H.I.; Fattel, D.; Cymbalista, S.; and Goldblun, S. 1969. The phase-separation method for the concentration and detection of virus in water. *Water Research* 3:225-240.

Singh, B.R., and Kanehiro, Y. 1969. Adsorption of nitrate in amorphous and kaolinitic Hawaiian soils. *Soil Sci. Soc. Amer. Proc.* 33:681-83.

Smith, D.H. 1963. Effects of funigants on the soil and plant uptake of certain elements. *Soil Sci. Soc. Amer. Proc.* 27:358.

Takahashi, D.T. 1964. $N^{15}$ nitrogen field studies with sugarcane. *Hawaiian Planters' Record* 57:2.

———. 1967*a*. Effect of amount and timing on the fate of fertilizer nitrogen in lysimeter studies with $N^{15}$. *Hawaiian Planters' Record* 57:4.

———. 1967*b*. Fate of applied nitrogen as determined by the use of $N^{15}$. I. Summer and fall plant and ratoon crops on the Hamakua coast of Hawaii. *Hawaiian Planters' Record* 57:53.

———. 1968. Fate of ammonium and nitrate fertilizers in lysimeter studies with $N^{15}$. *Hawaiian Planters' Record* 58:1.

———. 1969. Fate of applied fertilizer nitrogen as determined by the use of $N^{15}$. III. Summer and winter plant and ratoon crops at Hilo, Hawaii. *Hawaiian Planters' Record* 58:2.

———. 1970. Fate of applied fertilizer nitrogen as determined by the use of $N^{15}$. III. Summer and winter plant and ratoon crops at two locations on Kauai. *Hawaiian Planters' Record* 58:4.

Taliaferro, W.J. 1959. *Rainfall of the Hawaiian Islands*. Hawaii Water Authority.

Tanimoto, R.M.; Burbank, N.C., Jr.; Young, R.H.F.; and Lau, L.S. 1968. *Migration of bacteriophage $T_4$ in percolating water through selected Oahu soils*. Tech. Rep. No. 20, Water Resources Research Center, University of Hawaii.

Tenorio, P.; Young, R.H.F.; and Whitehead, H.C. 1969. *Identification of return irrigation water in the subsurface: Water quality*. Tech. Rep. No. 33, Water Resources Research Center, University of Hawaii.

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

U.S. Department of Health, Education, and Welfare. 1962. *Public health drinking water standards*. Public Health Service, U.S. Dept. of HEW, Washington, D.C.

Wallis, C.; Melnick, J.L; and Fields, J.E. 1970. Detection of viruses in large volumes of natural waters by concentration of insoluble polyelectrolyte. *Water Research* 4:787-96.

Willocks, J.P.; Esaki, R.H.; Yukumoto, R.K.; and Lau, L.S. 1961. *A field investigation of infiltration for some soils on Oahu, Hawaii*. 1961 Student Chap. of ASCE, University of Hawaii and Dept. of Civil Engrg., University of Hawaii.

Yokoyama, J. 1956. *Soil-air-water relationships in Hawaiian soils*. M.S. Thesis No. 773, University of Hawaii.

Young, R.H.F.; Lau, L.S.; and Burbank, N.C., Jr.. 1967. *Travel of ABS and ammonia nitrogen with percolating water through saturated Oahu soils.* Tech. Rep. No. 1, Water Resources Research Center, University of Hawaii.

# APPENDICES

## Appendix Tables

## TABLE A-1. LAHAINA SOIL SERIES IN THE VICINITY OF THE MILILANI STP.

### LAHAINA SERIES - 2

*LAHAINA SILTY CLAY, 2 TO 6 PERCENT SLOPES.* THIS SOIL COMPRISES 3440 ACRES. IT OCCURS ON THE MEDIAL UPLANDS IN A NARROW BAND EXTENDING EASTWARD FROM PUU KUUA ABOVE WAIPAHU TO AIEA ON THE SOUTHERN PART OF THE ISLAND; ON THE NORTHERN PART OF THE ISLAND NEAR POAMOHO EXPERIMENTAL STATION EASTWARD TOWARD KAWAILOA.

REPRESENTATIVE PROFILE FOR:

0 TO 10 INCHES, DARK REDDISH-BROWN SILTY CLAY; WEAK GRANULAR STRUCTURE; FIRM WHEN MOIST; ABUNDANT ROOTS; STRONGLY ACID (pH 5.2)

10 TO 16 INCHES, DARK REDDISH-BROWN SILTY CLAY; WEAK SUBANGULAR BLOCKY STRUCTURE; FRIABLE WHEN MOIST; ABUNDANT ROOTS; COMPACTED BY TILLAGE; MEDIUM ACID (pH 6.0)

16 TO 23 INCHES, DARK REDDISH-BROWN SILTY CLAY; WEAK SUBANGULAR BLOCKY STRUCTURE; FRIABLE WHEN MOIST; PLENTIFUL ROOTS; NEUTRAL IN REACTION (pH 6.9)

23 TO 32 INCHES, DUSKY-RED SILTY CLAY; WEAK SUBANGULAR BLOCKY STRUCTURE; FRIABLE WHEN MOIST; NO ROOTS; COMPACT IN PLACE; SLIGHTLY ACID (pH 6.4)

32 TO 45 INCHES, DARK REDDISH-BROWN SILTY CLAY LOAM; MODERATE SUBANGULAR BLOCKY STRUCTURE; FRIABLE WHEN MOIST; NO ROOTS; FEW ROCK FRAGMENTS; NEUTRAL IN REACTION (pH 6.9)

45 TO 65 INCHES, DARK REDDISH-BROWN SILTY CLAY LOAM; WEAK SUBANGULAR BLOCKY STRUCTURE; VERY FRIABLE WHEN MOIST; NO ROOTS; MANY SOFT ROCK FRAGMENTS; NEUTRAL IN REACTION (pH 7.2)

### RANGE IN CHARACTERISTICS

THE STRUCTURE BELOW 23 INCHES RANGES FROM MODERATE TO STRONG. TEXTURE BELOW 32 INCHES RANGES FROM A SILTY CLAY LOAM TO A SILTY CLAY. DEPTH TO HIGHLY WEATHERED ROCK IS OVER 36 INCHES. MOST AREAS ARE ONLY SLIGHTLY ERODED OR UNERODED AND HAVE FEW OR NO STONES ON THE SURFACE. IN CULTIVATED AREAS, THE ORIGINAL SURFACE SOIL LAYER HAS BEEN MIXED WITH THIN LAYERS OF THE UNDERLYING SUBSOIL.

PERMEABILITY IS 0.63 TO 2.0 INCHES PER HOUR; INTERNAL DRAINAGE IS MEDIUM; RUNOFF IS SLOW AND EROSION HAZARD IS SLIGHT; AVAILABLE WATER HOLDING CAPACITY IS 1.3 INCHES PER FOOT IN THE SURFACE SOIL LAYER AND 1.5 INCHES PER FOOT IN THE SUBSOIL LAYER; WORKABILITY IS EASY; FERTILITY IS MEDIUM; THE SHRINK-SWELL POTENTIAL IS LOW.

THIS SOIL IS USED FOR IRRIGATED SUGARCANE, BOTH DRY AND OVERHEAD IRRIGATED PINEAPPLE, AND SMALL AREAS OF URBAN DEVELOPMENT. EXCESSIVE SOIL AND WATER LOSSES CAN BE REDUCED BY CROSS SLOPE CULTIVATION, CONTOUR IRRIGATION, DIVERSION TERRACES ON LONG SLOPES, AND A SURFACE MULCH. FERTILIZERS ARE NEEDED FOR FAVORABLE YIELDS. RATE AND KIND OF FERTILIZERS ARE BEST INDICATED BY SOIL TESTS, FIELD TRIALS, AND EXPERIMENTS.

IRON SULFATE WILL CORRECT IRON DEFICIENCIES IN PINEAPPLE. THIS SOIL IS SUITED TO PINEAPPLE, SUGARCANE, PASTURE, WILDLIFE, AND RECREATION. IT HAS NO LIMITATIONS FOR URBAN DEVELOPMENT.

SOURCE: U.S.D.A. SOIL CONSERVATION SERVICE. 1973. "Identification legend of the mapping unit: Oahu soil survey area."

NOTE: in. x 2.54 = cm.

TABLE A-2. SOIL CHEMICAL ANALYSIS AT MILILANI STP AND ADJACENT SUGARCANE TEST PLOTS.

| DATE | LOCATION | DEPTH in. | pH | $NO_3$* | P | K | Ca | Mg | CONDUCTIVITY µmhos/cm |
|---|---|---|---|---|---|---|---|---|---|
| | | | | lbs/acre | | | | | |
| 27 APRIL 1972 | MILILANI STP | 1-3 | 7.0 | <2 | 50 | 60 | 5000 | 325 | 0.42 |
| | | 9-12 | 7.3 | 2 | <25 | 40 | 2000 | <250 | |
| | | 1-3 | 6.7 | <2 | 25 | 40 | 3000 | 250 | |
| | | 9-12 | 7.1 | 2 | <25 | 40 | 2000 | 250 | |
| | | 1-3 | 7.5 | 8 | 200 | 160 | 6000 | 325 | 0.64 |
| | | 9-12 | 7.6 | 2 | <25 | 40 | 3000 | 250 | 0.40 |
| | | 3-6 | 7.6 | <2 | 50 | 240 | 6000 | 250 | 0.52 |
| 10 MAY 1972 | OSC SUGARCANE FIELD NO. 240 FURROW | 0-11 | 7.3 | 25 | <25 | <40 | 4000 | 250 | 0.40 |
| | | 11-17 | 6.9 | <2 | <25 | <40 | 4000 | 250 | 0.26 |
| | | 17-20 | 7.1 | <2 | <25 | <40 | 1000 | 250 | <0.10 |
| | | 20-26 | 7.1 | 2 | <25 | <40 | 1000 | 250 | 0.10 |
| | RIDGE | 0-6 | 7.2 | <2 | <25 | 240 | 5000 | 250 | 0.40 |
| | | 6-12 | 7.5 | 2 | <25 | 160 | 5000 | 250 | 0.34 |
| | | 12-18 | 7.5 | <2 | <25 | 60 | 5000 | 250 | 0.28 |
| | | 20-27 | 7.6 | <2 | <25 | 60 | 4000 | 250 | 0.32 |

FROM: SOIL TESTING SERVICE, COOPERATIVE EXTENSION SERVICE, UNIVERSITY OF HAWAII.

NOTE: in. x 2.54 = cm; lbs/acre x 1.121 = kg/ha.

* IN SOIL SOLUTION.

TABLE A-3. LOW-HUMIC LATOSOLS INFILTRATION RATES.

| SOIL TYPE | INFILTRATION INITIAL in./hr | INFILTRATION FINAL in./hr | BULK DENSITY |
|---|---|---|---|
| WAHIAWA (46) | 2.80 | 0.45 | |
| WAIMANALO (46) | 7.10 | 1.25 | |
| MANANA (46) | 10.70 | 2.10 | |
| WAHIAWA (47) (LOOSE) | | 3.90 | 1.00 |
| WAHIAWA (47) (COMPACT) | | 2.10 | 1.18 |
| MOLOKAI (47) (LOOSE) | | 1.50 | 1.16 |
| MOLOKAI (47) (COMPACT) | | 0.50 | 1.33 |

NOTE: VALUES OBTAINED BY THE USE OF DOUBLE RING INFILTROMETERS.

## TABLE A-4. MILILANI SEWAGE TREAMENT PLANT SEWAGE ANALYSES.

| DATE | WASTE WATER TYPE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARD-NESS | SS | BOD$_5$ | TOC | NITROGEN as N | | | TOTAL P mg/ℓ | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS | | Cl$_2$ mg/ℓ | ALK. as CaCO$_3$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | KJEL-DAHL | NO$_2$+NO$_3$ | TOTAL | | | | | | | | | | | FECAL lbs/100mℓ | TOTAL lbs/100mℓ | | |
| (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 | -- | -- | -- | -- | -- | -- |
| (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 | -- | — |

TABLE A-4. (CONTD.)

| DATE | WASTE WATER TYPE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N |  |  | TOTAL P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS |  | Cl$_2$ mg/ℓ | ALK. as CaCO$_3$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  | KJELDAHL | NO$_2$+ NO$_3$ | TOTAL | mg/ℓ |  |  |  |  |  |  |  |  |  | FECAL lbs/ 100mℓ | TOTAL lbs/ 100mℓ |  |  |
| MAR 23 | CHLORINATED SECONDARY EFFLUENT | -- | 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 | -- | -- | -- | -- |
| JUN 15 |  | 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[a] |  | -- | -- | 350 | -- | -- | -- | 17 | -- | 0.8 | -- | -- | -- | -- | 51 | 9.8 | 42 | 61 | 56 | 0.70 | 6.1 | -- | -- | -- | -- |
| JUN 22[a] |  | -- | -- | 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[a] |  | 6.6 | -- | 355 | -- | -- | -- | 47 | 11.6 | 1.5 | 13.1 | -- | -- | -- | 50 | 9.5 | 46 | 72 | 57 | 0.26 | 54.4 | -- | -- | -- | -- |
| JUL 6[a] |  | 7.0 | -- | 315 | 52 | -- | -- | 16 | 4.8 | 2.8 | 7.6 | -- | 5 | 9 | 54 | 8.8 | 50 | 50 | 57 | 0.35 | -- | -- | -- | -- | -- |
| JUL 13[a] |  | 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[a] |  | 7.1 | -- | 385 | 62 | -- | -- | 24 | 14.0 | 0.5 | 14.5 | -- | 18 | 4 | 55 | 10.0 | 50 | 50 | 60 | -- | -- | -- | -- | -- | -- |
| JUL 27[a] |  | 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[a] |  | 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[a] |  | 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[a] |  | 7.2 | -- | 350 | 54 | -- | -- | 17 | 3.6 | 1.4 | 5.0 | 7.10 | 9 | 8 | 53 | 9.0 | 52 | 54 | 61 | -- | -- | -- | -- | -- | -- |
| AUG 24[a] |  | 7.1 | -- | 425 | 57 | -- | -- | 20 | 12.1 | 3.5 | 15.6 | -- | 8 | 9 | 51 | 9.5 | 51 | 51 | 57 | -- | -- | -- | -- | -- | -- |
| AUG 31[a] |  | 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[a] |  | 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[a] |  | 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[a] |  | 7.0 | -- | 395 | 50 | -- | -- | 26 | 10.0 | 0.4 | 10.4 | -- | 6 | 9 | 54 | 7.5 | 49 | 55 | 59 | -- | -- | -- | -- | -- | -- |

TABLE A-4. (CONTD.)

| DATE | WASTE WATER TYPE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N | | | TOTAL P mg/ℓ | Ca | $Mg^{++}$ | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS | | Cl$_2$ mg/ℓ | ALK. as CaCO$_3$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | KJELDAHL | NO$_2$+NO$_3$ | TOTAL | | | | | | | | | | | FECAL lbs/100mℓ | TOTAL lbs/100mℓ | | |
| SEP 28[a] | CHLORINATED SECONDARY EFFLUENT | 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[a] | | -- | -- | 390 | 59 | -- | -- | 19 | 9.1 | 0.4 | 9.5 | -- | 12 | 7 | 53 | 7.9 | 50 | 60 | 61 | -- | -- | -- | -- | -- | -- |
| OCT 12[a] | | -- | 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[a] | | 7.0 | -- | 365 | 55 | -- | -- | 29 | 8.3 | 0.5 | 8.8 | -- | 11 | 7 | 53 | 9.3 | 48 | 48 | 59 | -- | -- | -- | -- | -- | -- |
| OCT 26[a] | | 7.3 | -- | 400 | 58 | -- | -- | 24 | 20.2 | 0.5 | 20.7 | -- | 13 | 6 | 55 | 9.4 | 48 | 47 | 58 | -- | -- | -- | -- | -- | -- |
| NOV 2[a] | | 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[a] | | 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[a] | | 7.4 | -- | 400 | 58 | -- | -- | 27 | 14.0 | 0.6 | 14.6 | -- | 13 | 6 | 54 | 8.4 | 49 | 39 | 59 | -- | -- | -- | -- | -- | -- |
| DEC 8[a] | | 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)<br>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[a] | | 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[a] | | 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[a] | | 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[a] | | 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[a] | | 7.1 | -- | 400 | 48 | -- | -- | 28 | 11.2 | 0.6 | 11.8 | -- | 8 | 6 | 60 | 10.0 | 51 | 40 | 65 | -- | -- | -- | -- | -- | -- |
| MAR 7[b] | | 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 | -- |

TABLE A-4. (CONTD.)

| DATE | WASTE WATER TYPE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARD-NESS | SS | $BOD_5$ | TOC | NITROGEN as N |  |  | TOTAL P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | COLIFORMS |  | $Cl_2$ mg/ℓ | ALK. as $CaCO_3$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | mg/ℓ |  |  |  | KJEL-DAHL | $NO_2+NO_3$ | TOTAL |  |  |  |  |  |  |  |  |  |  | FECAL lbs/100mℓ | TOTAL lbs/100mℓ |  |  |
| APR 5 | CHLORINATED SECONDARY EFFLUENT | 7.1 | — | 400 | 77 | — | — | 30 | 16.7 | 2.1 | 18.8 | — | 14 | 10 | 60 | 9.8 | — | 63 | 68 | — | — | — | — | — | — |
| APR 5[a] |  | 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 24 |  | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 4 | 0.4 | — |
| APR 26[a] |  | 7.2 | — | 400 | 60 | — | — | — | 18.0 | 0.1 | 18.1 | — | 13 | 7 | 54 | 10.6 | — | 41 | 64 | — | — | — | — | — | — |
| MAY 8 |  | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 110 | 490 | 0.8 | — |
| MAY 22 |  | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 4900 | >22,000 | 0 | — |
| JUN 5 |  | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1100 | 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 20 |  | 7.0 | — | 400 | — | — | — | — | — | — | — | 13.86 | — | — | — | — | 48 | — | — | — | — | — | — | — | — |

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

[a] EFFLUENT COLLECTED FROM TANK TRUCK DURING DISCHARGE TO THE EXPERIMENTAL SUGARCANE PLOT IN OSC SUGARCANE FIELD NO. 240.

[b] UNCHLORINATED EFFLUENT.

TABLE A-5. WEIGHTED COMPOSITE MILILANI STP ANALYSES.

| OCTOBER 22-23, 1971 | | | |
|---|---|---|---|
| CONSTITUENT[a] | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
| 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 | 27.7 | 9.5 | 66 |
| ORGANIC NITROGEN | | | |
| NITRITE NITROGEN | -- | -- | -- |
| NITRATE NITROGEN | 0.3 | 4.5 | -1400 |
| TOTAL NITROGEN | -- | -- | -- |
| TOTAL 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) | -- | -- | -- |
| CADMIUM | 0.004 | 0.005 | 25 |
| LEAD | 0.028 | 0.047 | -68 |
| MERCURY | ND[b] | ND | -- |
| α CHLORDANE | 0.000013 | 0.000006[c] | 54 |
| γ CHLORDANE | 0.000025 | 0.000004[c] | 84 |
| DIELDRIN | 0.000051 | 0.000017[c] | 67 |
| DDT | 0.000003 | 0.000002[c] | 33 |
| DDD | 0.000042 | 0.000008[c] | 81 |
| LINDANE | 0.000295 | 0.000032[c] | 89 |
| PENTACHLOROPHENOL | 0.003245 | 0.000730[c] | 78 |

NOTE: COMPOSITED FOR 24 HOURS.

[a] ALL UNITS IN mg/ℓ EXCEPT WHERE NOTED.

[b] MERCURY IS NOT DETECTABLE BELOW 0.003 mg/ℓ.

[c] ANALYSIS PERFORMED ON UNCHLORINATED EFFLUENT SAMPLES.

TABLE A-5. (CONTD.)

| AUGUST 9, 1972 | | | |
|---|---|---|---|
| CONSTITUENT[a] | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
| 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 |
| TOTAL PHOSPHORUS | 14.15 | 10.50 | 25 |
| 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 | -- |

NOTE : COMPOSITED FOR 16 HOURS.

[a] ALL UNITS IN mg/ℓ EXCEPT WHERE NOTED.

TABLE A-5. (CONTD.)

| FEBRUARY 13, 1973 | | | |
|---|---|---|---|
| CONSTITUENT[a] | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
| 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 |
| TOTAL 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 | -- |

NOTE: COMPOSITED FOR 16 HOURS.

[a] ALL UNITS IN mg/ℓ EXCEPT WHERE NOTED.

TABLE A-5. (CONTD.)

| JUNE 5, 1973 | | | |
|---|---|---|---|
| CONSTITUENT[a] | RAW SEWAGE | CHLORINATED EFFLUENT | CONSTITUENT REDUCTION (%) |
| pH RANGE | 6.9 - 7.8 | 6.8 - 7.2 | -- |
| CONDUCTIVITY RANGE (µmhos/cm) | 400 - 600 | 450 - 600 | -- |
| 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 |
| TOTAL 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) | $5.6 \times 10^5$- $19.9 \times 10^5$ | 2 - 1600 | -- |
| FECAL COLIFORM RANGE (/100 mℓ) | $0.5 \times 10^7$- $12.2 \times 10^7$ | 1 - 1505 | -- |
| FECAL STREPTOCOCCUS RANGE (/100 mℓ) | $5.9 \times 10^5$- $15.5 \times 10^5$ | 1 - 1350 | -- |

NOTE: COMPOSITED FOR 16 HOURS.

[a] ALL UNITS IN mg/ℓ EXCEPT WHERE NOTED.

## TABLE A-6. PRECIPITATION AT THE MILILANI STP.

| DAY | 1972 | | | | | | | | | | | | 1973 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEP. | OCT. | NOV. | DEC. | JAN. | FEB. | MAR. | APR. | MAY | JUNE |
| | in. | | | | | | | | | | | | in. | | | | | |
| 1 | 0.32 | -- | -- | -- | -- | -- | -- | -- | -- | 0.03 | -- | -- | 0.23 | 0.05 | -- | -- | 0.01 | -- |
| 2 | -- | -- | 0.02 | -- | -- | -- | -- | 0.42 | 2.42 | -- | -- | 0.05 | -- | 0.08 | 0.01 | -- | -- | 0.02 |
| 3 | -- | -- | 1.15 | 0.69 | -- | 0.02 | -- | 0.04 | 0.02 | -- | -- | 0.20 | -- | 0.08 | 0.09 | -- | 0.02 | -- |
| 4 | 0.01 | 0.07 | 0.22 | 0.01 | -- | 0.11 | -- | 0.01 | 0.20 | 0.83 | 0.04 | -- | -- | 0.14 | 0.07 | 0.01 | -- | -- |
| 5 | -- | 1.43 | 0.23 | 0.01 | -- | -- | -- | -- | -- | -- | 0.08 | -- | -- | -- | 0.11 | -- | -- | 0.04 |
| 6 | 0.01 | 0.12 | -- | 0.03 | -- | -- | -- | -- | 0.02 | -- | 0.35 | -- | -- | 0.01 | 0.08 | -- | 0.05 | -- |
| 7 | -- | -- | 0.14 | 0.17 | -- | -- | 0.01 | 0.01 | -- | -- | 0.80 | -- | 0.51 | 0.03 | 0.07 | -- | 0.07 | 0.06 |
| 8 | 0.02 | -- | 0.05 | 0.03 | -- | 0.01 | -- | -- | -- | 0.01 | -- | -- | -- | 0.04 | 0.02 | -- | 0.01 | 0.07 |
| 9 | -- | -- | -- | 0.02 | -- | -- | -- | -- | -- | -- | 0.23 | 0.03 | -- | 0.02 | -- | 0.04 | 0.02 | -- |
| 10 | -- | 0.01 | -- | 0.33 | -- | 0.27 | 0.07 | 0.10 | -- | 0.05 | 0.12 | -- | -- | 0.02 | -- | -- | -- | -- |
| 11 | -- | -- | -- | 0.01 | -- | 0.18 | -- | -- | -- | -- | -- | -- | -- | -- | 0.26 | 0.03 | 0.14 | 0.05 |
| 12 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- | -- | -- |
| 13 | -- | 0.02 | -- | 0.05 | 0.16 | -- | -- | -- | -- | -- | 0.02 | -- | -- | 0.03 | 0.01 | 0.05 | -- | 0.01 |
| 14 | -- | -- | -- | 0.04 | 0.04 | -- | 0.01 | -- | -- | -- | 0.02 | -- | -- | 0.01 | -- | -- | -- | 0.26 |
| 15 | 0.10 | -- | -- | 5.61 | -- | 0.07 | 0.15 | -- | 0.02 | -- | 0.02 | -- | -- | 0.01 | -- | -- | -- | 0.03 |
| 16 | 0.16 | -- | -- | 0.29 | -- | 0.02 | 0.06 | -- | -- | 0.27 | -- | 0.01 | -- | 0.04 | -- | 0.24 | -- | 0.01 |
| 17 | 0.72 | -- | -- | 0.05 | -- | 0.01 | 0.50 | -- | -- | -- | -- | 0.79 | -- | -- | 0.18 | 0.03 | 0.01 | 0.01 |
| 18 | -- | 0.16 | -- | 0.23 | -- | 0.16 | -- | 0.05 | -- | -- | -- | 0.74 | -- | -- | 0.14 | -- | 0.12 | -- |
| 19 | -- | 0.02 | -- | -- | -- | 0.03 | -- | -- | -- | -- | 0.01 | 1.54 | -- | -- | 0.11 | -- | 0.25 | -- |
| 20 | 0.02 | -- | -- | -- | 0.01 | -- | -- | 0.07 | 0.04 | -- | -- | -- | -- | 0.06 | -- | 0.33 | 0.17 | 0.01 |
| 21 | -- | -- | -- | -- | 0.01 | -- | -- | -- | 0.02 | -- | -- | -- | -- | -- | -- | -- | 0.40 | -- |
| 22 | 0.05 | 1.67 | -- | 0.11 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- | 0.13 | 0.09 | -- |
| 23 | 1.45 | 1.12 | 0.51 | -- | -- | -- | -- | -- | -- | -- | -- | 0.02 | -- | -- | 0.22 | -- | 0.01 | -- |
| 24 | 5.47 | 0.04 | 0.31 | -- | 0.01 | 0.03 | -- | 0.02 | -- | -- | 0.01 | -- | 0.02 | -- | -- | 0.01 | 0.11 | -- |
| 25 | -- | 0.49 | 0.01 | -- | -- | -- | -- | 0.13 | -- | -- | -- | -- | -- | -- | 0.02 | 0.01 | 0.04 | -- |
| 26 | -- | 0.01 | -- | 0.13 | -- | 0.04 | -- | -- | -- | 0.19 | 0.49 | -- | -- | -- | 0.02 | 0.03 | -- | -- |
| 27 | 0.05 | -- | 0.01 | 0.02 | -- | 0.07 | -- | -- | -- | 0.01 | -- | -- | 0.07 | -- | 0.06 | 0.20 | 0.04 | -- |
| 28 | -- | -- | -- | 0.03 | 0.04 | 0.01 | -- | 0.02 | 0.01 | 1.79 | -- | -- | -- | -- | 0.09 | 0.02 | 0.02 | -- |
| 29 | -- | -- | -- | 0.04 | -- | -- | 0.02 | -- | 0.02 | -- | -- | 0.01 | 0.06 | -- | 0.02 | -- | 0.02 | -- |
| 30 | -- | -- | 0.02 | -- | -- | -- | 0.02 | 0.02 | 0.01 | 0.01 | 0.03 | -- | 0.02 | -- | 0.03 | -- | -- | 0.01 |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.03 | -- | 0.08 | -- | -- | 0.02 | -- | 0.07 | -- | -- | -- |
| TOTAL | 8.38 | 5.17 | 2.67 | 7.90 | 0.27 | 1.03 | 0.84 | 0.92 | 2.78 | 3.27 | 2.22 | 3.39 | 0.93 | 0.63 | 1.69 | 1.13 | 1.60 | 0.58 |

NOTE: in. x 2.54 = cm.

TABLE A-7. PERCOLATE ANALYSES FROM THE FIVE-FOOT DEEP LYSIMETER WITH REPLACED SOIL--MILILANI STP.

| DATE | TDS mg/ℓ | 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 | TOTAL P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | COLIFORMS FECAL lbs/ 100mℓ | COLIFORMS TOTAL lbs/ 100mℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (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 A-7 (CONTD.)

| DATE | TDS mg/ℓ | 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 | TOTAL P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | COLIFORMS FECAL lbs/100mℓ | COLIFORMS TOTAL lbs/100mℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/ℓ | | | | | | | | | | | | | | | | | | |
| 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 A-7. (CONTD.)

| | | | | | | | | NITROGEN as N | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | KJELDAHL | NO$_2$+ NO$_3$ | TOTAL | TOTAL P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL COLIFORMS |
| | | | | | | | | | | | | mg/ℓ | | | | | | | | | |
| (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 | -- | -- | -- |
| 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 | -- | -- | -- | -- |
| 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 | -- | -- | -- |
| 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 | -- | -- | -- |
| 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 |
| NOV 20 | 7.4 | -- | 470 | 137 | -- | -- | -- | 0.00 | 0.01 | 0.01 | -- | 28 | 16 | 78 | 1.7 | 74 | 73 | 17 | -- | -- | -- |
| 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 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TABLE A-7. (CONTD.)

| | | | | | | | | NITROGEN as N | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | KJELDAHL | NO$_2$+NO$_3$ | TOTAL | TOTAL P | Ca | Mg | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL COLIFORMS |
| | | | | mg/ℓ | | | | | | | | | | | | | | | | | |
| 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 | -- | -- | -- |
| 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 |
| JAN 24 | 7.2 | -- | 320 | 86 | -- | -- | 1.0 | 0.06 | 0.01 | 0.07 | -- | 19 | 9 | 48 | 1.2 | 44 | 75 | 13 | -- | -- | 18 |
| 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 | -- | -- | -- |
| FEB 21 | 7.1 | -- | 380 | 98 | -- | -- | 2.0 | 0.01 | 0.01 | 0.02 | -- | 21 | 11 | 42 | 0.8 | 43 | 53 | 20 | -- | -- | 20 |
| 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 |
| MAR 29 | 6.9 | -- | 380 | 67 | -- | -- | -- | <0.01 | <0.01 | <0.02 | -- | 22 | 3 | 43 | 0.6 | -- | 72 | 10 | -- | -- | -- |
| APR 5 | 6.9 | -- | 380 | 67 | -- | -- | <1.0 | <0.01 | <0.01 | <0.02 | -- | 22 | 3 | 42 | 0.8 | -- | 70 | 12 | -- | -- | 20 |
| 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 | -- | -- | -- | -- | -- | -- |
| AUG 1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 66 | -- | -- | -- | -- | -- |

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

TABLE A-8. NITROGEN CONTENT OF GRASS CLIPPINGS HARVESTED FROM TURF COVERING FIVE-FOOT DEEP LYSIMETER.

| DATE | WET WT.<br>g | $H_2O$<br>% | N (DRY)<br>% | EQUIV. N<br>g |
|---|---|---|---|---|
| 3 JAN. | 1032 | 75.40 | 1.88 | 4.78 |
| 24 JAN. | 366 | 78.60 | 2.20 | 1.72 |
| 14 MARCH | 1105 | 72.35 | 2.10 | 6.50 |
| 27 APRIL | 1417 | 72.42 | 2.08 | 8.10 |
| 7 JUNE | 1419 | 73.22 | 2.06 | 7.80 |
| 13 JULY | 943 | 70.77 | 1.74 | 4.80 |

TABLE A-9. AMMONIUM NITROGEN VARIATION ALONG THE PROFILE OF THE FIVE-FOOT DEEP LYSIMETER.

| DATE | DEPTH FROM SOIL SURFACE, IN INCHES 0-9 | 6 | 15 | 40 | 46 | 60 |
|---|---|---|---|---|---|---|
| | mg/ℓ | | | | | |
| 3-29-73 | 1.00 | 1.10 | 0.30 | 0.25 | 0.10 | 0.01 |
| 4-03-73 | 0.75 | 0.88 | 0.80 | 0.35 | 0.10 | 0.01 |
| 4-11-73 | 0.80 | 0.80 | 0.91 | 0.20 | 0.05 | 0.01 |
| 4-12-73 | 0.75 | 0.54 | 0.82 | 0.21 | 0.05 | 0.01 |
| 5-01-73 | 1.10 | 1.50 | 0.40 | 0.10 | 0.05 | 0.00 |
| 5-03-73 | 1.15 | 1.00 | 0.41 | 0.09 | 0.01 | 0.00 |
| 5-08-73 | 1.75 | 1.25 | 0.85 | 0.41 | 0.09 | 0.01 |
| 5-16-73 | 1.25 | 2.05 | 0.65 | 0.06 | 0.05 | 0.00 |
| 5-22-73 | 2.10 | 0.80 | 0.60 | 0.05 | 0.05 | 0.00 |
| 5-23-73 | 1.50 | 1.25 | 0.80 | 0.21 | 0.00 | 0.00 |
| 5-30-73 | 1.60 | 1.50 | 0.21 | 0.01 | 0.01 | 0.00 |
| HIGH | 2.10 | 2.05 | 0.91 | 0.41 | 0.10 | 0.01 |
| LOW | 0.75 | 0.54 | 0.21 | 0.05 | 0.00 | 0.00 |
| MEAN | 1.25 | 1.15 | 0.55 | 0.17 | 0.03 | 0.00 |

NOTE: in. x 2.54 = cm.

TABLE A-10. NITRITE AND NITRATE NITROGEN VARIATION ALONG THE PROFILE OF THE FIVE-FOOT DEEP LYSIMETER.

| DATE | DEPTH FROM SOIL SURFACE, IN INCHES | | | | | |
|---|---|---|---|---|---|---|
| | 0-9 | 6 | 15 | 40 | 46 | 60 |
| | mg/ℓ | | | | | |
| 3-20-73 | 5.20 | 3.36 | 1.70 | -- | -- | -- |
| 3-21-73 | 6.50 | 0.91 | 0.36 | 0.52 | -- | -- |
| 3-22-73 | 6.50 | 1.04 | 1.82 | 0.51 | -- | 0.01 |
| 3-23-73 | 8.03 | 1.56 | 0.18 | 0.25 | -- | 0.01 |
| 3-27-73 | 8.60 | 3.53 | 0.21 | 0.18 | 0.26 | -- |
| 3-29-73 | 5.48 | 2.34 | 0.18 | 0.09 | 0.09 | 0.01 |
| 4-03-73 | 1.40 | 0.97 | 0.12 | 0.04 | 0.06 | 0.01 |
| 4-11-73 | 1.06 | 0.39 | 0.08 | 0.05 | 0.05 | 0.01 |
| 4-12-73 | 0.44 | 0.13 | 0.06 | 0.04 | 0.06 | 0.01 |
| 4-25-73 | 0.53 | 0.14 | 0.08 | 0.04 | 0.05 | 0.01 |
| 5-01-73 | 1.26 | 0.10 | 0.07 | 0.03 | 0.05 | 0.01 |
| 5-03-73 | 1.82 | 0.17 | 0.12 | 0.03 | 0.07 | 0.01 |
| 5-08-73 | 1.51 | 0.10 | 0.02 | 0.04 | 0.04 | 0.01 |
| 5-16-73 | 0.22 | 0.34 | 0.03 | 0.09 | 0.04 | 0.01 |
| 5-22-73 | 0.11 | 0.11 | 0.07 | 0.04 | 0.05 | 0.00 |
| 5-23-73 | 0.11 | 0.15 | 0.05 | 0.01 | 0.01 | 0.01 |
| HIGH | 8.60 | 3.53 | 1.82 | 0.51 | 0.26 | 0.01 |
| LOW | 0.11 | 0.10 | 0.02 | 0.01 | 0.01 | 0.01 |
| MEAN | 2.92 | 0.92 | 0.35 | 0.12 | 0.06 | 0.01 |

NOTE: in. x 2.54 = cm.

TABLE A-11. SODIUM VARIATION ALONG THE PROFILE OF THE FIVE-FOOT DEEP LYSIMETER.

| DATE | DEPTH FROM SOIL SURFACE, IN INCHES | | | | | |
|---|---|---|---|---|---|---|
| | 0-9 | 6 | 15 | 40 | 46 | 60 |
| | mg/ℓ | | | | | |
| 3-29-73 | 61 | 66 | 59 | 50 | -- | 41 |
| 4-03-73 | 60 | 66 | 58 | 48 | -- | 42 |
| 4-11-73 | 60 | 62 | 51 | 45 | -- | 42 |
| 4-12-73 | 57 | 60 | 51 | 45 | 44 | 42 |
| 4-25-73 | 63 | 57 | 57 | 49 | 45 | 45 |
| 5-03-73 | 60 | 57 | 53 | 49 | 46 | 46 |
| 5-16-73 | 67 | 59 | 53 | 48 | 46 | 41 |
| 5-22-73 | 58 | 70 | 54 | 48 | 47 | 45 |
| 5-23-73 | 58 | 70 | 54 | 48 | 47 | 45 |
| 5-30-73 | 62 | 70 | 60 | 52 | 49 | 45 |
| HIGH | 67 | 70 | 60 | 52 | 49 | 46 |
| LOW | 57 | 57 | 51 | 45 | 44 | 41 |
| MEAN | 60 | 63 | 55 | 48 | 46 | 44 |

NOTE: in. x 2.54 = cm.

TABLE A-12. POTASSIUM VARIATION ALONG THE PROFILE OF THE FIVE-FOOT DEEP LYSIMETER.

| DATE | DEPTH FROM SOIL SURFACE, IN INCHES | | | | | |
|---|---|---|---|---|---|---|
| | 0-9 | 6 | 15 | 40 | 46 | 60 |
| | mg/ℓ | | | | | |
| 3-29-73 | 4.8 | 3.6 | 1.2 | 0.2 | -- | 0.6 |
| 4-03-73 | 3.2 | 2.8 | 0.8 | 0.2 | -- | 0.6 |
| 4-11-73 | 2.2 | 1.0 | 0.6 | 0.2 | -- | 0.6 |
| 4-12-73 | 2.0 | 1.0 | 0.6 | 0.2 | 0.2 | 0.6 |
| 4-25-73 | 0.8 | 1.4 | 1.0 | 0.2 | 0.2 | 1.0 |
| 5-01-73 | 0.6 | 1.3 | 0.6 | 0.2 | 0.1 | 0.7 |
| 5-03-73 | 0.6 | 1.0 | 0.5 | 0.2 | 0.4 | 0.7 |
| 5-08-73 | 0.7 | 1.2 | 0.8 | 0.2 | 0.2 | 0.8 |
| 5-16-73 | 1.0 | 0.9 | 0.2 | 0.6 | 0.2 | 0.8 |
| 5-22-73 | 0.7 | 0.5 | 0.2 | 0.2 | 0.2 | 0.8 |
| 5-23-73 | 0.7 | 0.5 | 0.3 | 0.2 | 0.2 | 0.8 |
| 5-30-73 | 0.8 | 0.5 | 0.2 | 0.2 | 0.3 | 0.6 |
| HIGH | 4.8 | 3.6 | 1.2 | 0.2 | 0.4 | 1.0 |
| LOW | 0.6 | 0.5 | 0.2 | 0.2 | 0.1 | 0.6 |
| MEAN | 1.5 | 1.3 | 0.58 | 0.21 | 0.22 | 0.66 |

NOTE: in. x 2.54 = cm.

TABLE A-13. CALCIUM VARIATION ALONG THE PROFILE OF THE FIVE-FOOT DEEP LYSIMETER.

| DATE | DEPTH FROM SOIL SURFACE, IN INCHES | | | | | |
|---|---|---|---|---|---|---|
| | 0-9 | 6 | 15 | 40 | 46 | 60 |
| | mg/ℓ | | | | | |
| 3-29-73 | 10 | 16 | 16 | 44 | -- | 22 |
| 4-03-73 | 10 | 14 | 16 | 44 | -- | 22 |
| 4-11-73 | 10 | -- | 16 | 42 | -- | 24 |
| 5-03-73 | 10 | -- | 14 | 46 | -- | 24 |
| 5-08-73 | 18 | -- | 14 | 46 | 48 | 24 |
| 5-16-73 | 8 | 12 | 16 | 46 | 48 | 24 |
| 5-22-73 | 18 | 8 | 16 | 44 | 44 | 24 |
| 5-30-73 | 10 | 12 | 14 | 42 | 46 | 24 |
| HIGH | 18 | 16 | 16 | 46 | 48 | 24 |
| LOW | 8 | 8 | 14 | 42 | 44 | 22 |
| MEAN | 12 | 12 | 15 | 44 | 47 | 24 |

NOTE: in. x 2.54 = cm.

## TABLE A-14. *IN SITU* PAN LYSIMETER LOCATED AT 24-INCH (61 cm) DEPTH COLLECTING LEACHATE FROM UNDISTURBED SOIL, MILILANI STP.

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N | | | TOTAL P | Ca | Mg$^{**}$ | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | ALK. as CaCO$_3$ | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | KJELDAHL | NO$_2$+NO$_3$ | TOTAL | | | | | | | | | | | | |
| | | | | | | | | | | | | | mg/ℓ | | | | | | | | | |
| (1972) | | | | | | | | | | | | | | | | | | | | | | |
| JUN 16 | -- | -- | 240 | 93 | -- | -- | 8 | 0.1 | 6.2 | 7.3 | -- | 28 | 5 | 45 | 0.1 | 42 | 48 | 3 | 0.05 | 8.7 | -- | -- |
| JUN 20 | -- | -- | 280 | 96 | -- | -- | 6 | 0.0 | 7.4 | 7.4 | -- | 28 | 7 | 45 | 0.1 | 45 | 38 | 3 | 0.05 | 6.6 | -- | -- |
| JUN 22 | -- | -- | -- | 100 | -- | -- | 5 | 0.1 | 5.8 | 5.9 | -- | 26 | 9 | 46 | 0.1 | 47 | 56 | 4 | 0.05 | 7.9 | -- | -- |
| JUN 23 | -- | 274 | 300 | 108 | 0 | 1 | 5 | 0.1 | 5.8 | 5.9 | 0.03 | 26 | 10 | 45 | 0.1 | 47 | 36 | 5 | 0.10 | -- | -- | -- |
| JUN 28 | -- | -- | 330 | 73 | -- | -- | 7 | 0.2 | 7.3 | 7.5 | -- | 25 | 1 | 50 | 0.1 | 42 | 35 | 8 | 0.10 | 8.5 | -- | -- |
| JUN 29 | 6.3 | -- | 400 | 78 | -- | -- | 5 | 0.3 | 9.1 | 9.4 | -- | 25 | 1 | 50 | 0.9 | 47 | 35 | 10 | 0.05 | 8.0 | -- | -- |
| JUN 30 | 6.6 | -- | 360 | 76 | -- | -- | 4 | 1.5 | 7.1 | 8.6 | -- | 28 | 2 | 48 | 0.8 | 46 | 42 | 11 | 0.10 | 8.0 | -- | -- |
| JUL 3 | 6.5 | -- | 400 | 96 | -- | -- | 4 | 0.8 | 8.4 | 9.2 | -- | 26 | 8 | 50 | 1.2 | 49 | 34 | 12 | -- | 7.9 | -- | -- |
| JUL 5 | 6.4 | -- | 360 | 90 | -- | -- | 4 | 0.2 | 7.8 | 8.0 | -- | 25 | 7 | 49 | 0.8 | 49 | 41 | 12 | -- | 1.8 | -- | -- |
| JUL 6 | 7.4 | -- | 240 | 92 | -- | -- | 4 | 0.2 | 7.0 | 7.2 | -- | 27 | 6 | 45 | 0.9 | 48 | 43 | 10 | -- | 2.1 | -- | -- |
| JUL 7 | 7.5 | -- | 260 | 90 | -- | -- | 4 | 0.1 | 7.8 | 7.9 | -- | 25 | 6 | 51 | 0.8 | 50 | 45 | 10 | -- | 6.7 | -- | -- |
| JUL 10 | 6.8 | -- | 440 | 96 | -- | -- | 5 | 0.1 | 8.4 | 8.5 | -- | 26 | 8 | 48 | 0.8 | 49 | 39 | 8 | -- | -- | -- | -- |
| JUL 13 | 7.3 | 325 | 390 | 96 | 3 | 1 | 5 | 0.2 | 11.0 | 11.2 | 0.11 | 27 | 7 | 52 | 0.8 | 53 | 41 | 8 | -- | -- | -- | -- |
| JUL 14 | 7.1 | -- | 350 | 88 | -- | -- | -- | 0.2 | 2.4 | 2.6 | -- | 26 | 6 | 55 | 0.8 | 57 | 43 | 7 | -- | -- | -- | -- |
| JUL 17 | 7.3 | -- | 380 | 105 | -- | -- | 6 | 0.1 | 2.1 | 2.2 | -- | 30 | 7 | 54 | 0.8 | 50 | 43 | 9 | -- | -- | -- | -- |
| JUL 18 | 7.2 | -- | 290 | 98 | -- | -- | 4 | 0.1 | 9.2 | 9.3 | -- | 29 | 6 | 53 | 0.8 | 49 | 43 | 8 | -- | -- | -- | -- |
| JUL 19 | 7.1 | -- | 320 | -- | -- | -- | 4 | 0.2 | 9.2 | 9.4 | -- | -- | -- | 57 | 0.9 | 51 | 44 | 12 | -- | 5.2 | -- | -- |
| JUL 20 | 7.2 | -- | 340 | 100 | -- | -- | 5 | 0.1 | 7.9 | 8.0 | -- | 28 | 7 | 55 | 1.0 | 50 | 44 | 12 | -- | 5.3 | -- | -- |
| JUL 21 | 7.0 | -- | 300 | 92 | -- | -- | 4 | 0.1 | 11.3 | 11.4 | -- | 28 | 5 | 53 | 1.0 | 49 | 43 | 13 | -- | -- | -- | -- |
| JUL 24 | 6.9 | -- | 300 | 92 | -- | -- | -- | 0.2 | 8.2 | 8.4 | -- | 29 | 5 | 55 | 1.4 | 46 | 41 | 11 | -- | -- | -- | -- |
| JUL 26 | 7.4 | -- | 430 | 102 | -- | -- | -- | 0.2 | 11.9 | 12.1 | -- | 28 | 8 | 54 | 1.0 | 49 | 44 | 14 | -- | -- | -- | -- |
| JUL 27 | 7.4 | -- | 480 | 105 | -- | -- | 4 | 0.2 | 9.6 | 9.8 | -- | 30 | 7 | 55 | 1.0 | 48 | -- | 15 | 0.10 | -- | -- | -- |
| JUL 28 | 7.1 | -- | 430 | 100 | -- | -- | 5 | 0.1 | 9.7 | 9.8 | -- | 31 | 6 | 53 | 1.3 | 49 | 41 | 14 | -- | -- | -- | -- |
| JUL 31 | 7.1 | 270 | 300 | 96 | 4 | -- | -- | 0.1 | 10.2 | 10.3 | -- | 30 | 5 | 53 | 1.1 | 59 | 45 | 13 | -- | -- | -- | -- |
| AUG 2 | 7.1 | 272 | 400 | 92 | 4 | -- | -- | 0.2 | 10.7 | 10.9 | -- | 29 | 5 | 51 | 1.1 | 52 | 43 | 10 | -- | -- | 79 | -- |
| AUG 4 | 7.2 | 276 | 380 | 100 | 3 | -- | -- | 0.1 | 11.2 | 11.3 | -- | 29 | 7 | 55 | 1.0 | 58 | 40 | 13 | -- | -- | 74 | -- |
| AUG 7 | 7.4 | 271 | 380 | 88 | 3 | -- | 4 | 0.1 | 9.6 | 9.7 | -- | 28 | 4 | 54 | 1.0 | 55 | 42 | -- | -- | -- | 70 | -- |
| AUG 11 | 7.3 | 268 | 400 | 94 | 3 | -- | 4 | 0.2 | 10.1 | 10.3 | -- | 27 | 7 | 53 | 1.0 | 53 | 40 | 12 | -- | -- | 68 | -- |

TABLE A-14. (CONTD.)

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | $BOD_5$ | TOC | NITROGEN as N | | | TOTAL P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | ALK. as $CaCO_3$ | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | KJELDAHL | $NO_2$+ $NO_3$ | TOTAL | | | mg/ℓ | | | | | | | | | |
| AUG 14 | 7.5 | 280 | 370 | 100 | 5 | — | -- | 0.1 | 9.8 | 9.9 | — | 28 | 7 | 52 | 1.0 | 52 | 40 | 12 | -- | -- | 66 | -- |
| AUG 15 | 7.5 | 282 | 370 | 96 | 5 | -- | 4 | 0.2 | 10.2 | 10.4 | -- | 27 | 7 | 50 | 1.1 | 52 | 39 | -- | -- | -- | 66 | — |
| AUG 16 | 7.6 | 295 | 350 | 96 | 4 | — | 4 | 0.3 | 9.4 | 9.7 | — | 26 | 8 | 51 | 1.2 | 52 | 39 | 11 | -- | — | 65 | -- |
| AUG 17 | 7.4 | 278 | 330 | 90 | 5 | -- | 4 | 0.1 | 7.3 | 7.4 | -- | 22 | 8 | 55 | 1.4 | 50 | 40 | 17 | -- | -- | 66 | -- |
| AUG 21 | 7.3 | 271 | 380 | 90 | 3 | -- | 5 | 0.1 | 7.5 | 7.6 | -- | 26 | 6 | 53 | 1.4 | 54 | 40 | 17 | — | -- | 69 | — |
| AUG 22 | 7.3 | 283 | 380 | 91 | 4 | -- | 4 | 0.2 | 8.0 | 8.2 | -- | 27 | 6 | 53 | 1.5 | 51 | 39 | 19 | -- | -- | 74 | — |
| AIG 23 | 7.3 | 290 | 370 | 90 | 4 | — | 4 | 0.1 | 7.8 | 7.9 | -- | 27 | 5 | 53 | 1.6 | 51 | 37 | -- | — | — | 73 | — |
| AUG 24 | 7.4 | 277 | 350 | 89 | 3 | -- | 4 | 0.1 | 7.3 | 7.4 | -- | 27 | 5 | 54 | 1.8 | 51 | 38 | 21 | -- | -- | 76 | — |
| AUG 25 | 7.4 | 285 | 340 | 93 | 3 | -- | 4 | 0.1 | 7.0 | 7.1 | -- | 26 | 7 | 52 | 2.1 | 51 | 36 | 23 | -- | — | 79 | — |
| NOV 20 | 8.0 | — | 350 | 72 | -- | — | 29 | 0.21 | 4.67 | 4.9 | -- | 21 | 5 | 51 | 4.0 | 49 | 40 | 25 | -- | -- | -- | 2 |
| NOV 21 | 7.9 | -- | 400 | 74 | — | — | -- | 0.14 | 3.66 | 3.8 | — | 21 | 5 | 51 | 1.6 | 51 | 37 | 26 | -- | -- | -- | -- |
| NOV 24 | 7.9 | -- | 400 | 77 | -- | — | — | 0.05 | 10.01 | 10.2 | -- | 21 | 6 | 54 | 1.6 | 49 | 41 | 22 | -- | -- | -- | -- |
| NOV 29 | 7.9 | -- | 360 | -- | -- | — | -- | 0.17 | 11.20 | 11.4 | -- | -- | -- | 56 | 5.6 | -- | -- | -- | -- | -- | -- | — |
| NOV 29 | 7.9 | — | 280 | 82 | -- | — | -- | 0.04 | 9.85 | 9.9 | -- | 24 | 5 | 54 | 2.2 | 50 | 35 | 24 | -- | -- | -- | -- |
| NOV 30 | 7.4 | -- | 440 | 82 | — | — | 31 | 0.01 | 8.55 | 8.6 | -- | 23 | 6 | 56 | 2.2 | 50 | 33 | 26 | -- | -- | -- | 3 |
| DEC 4 | 7.8 | -- | 320 | 89 | — | — | -- | — | 9.25 | 9.3 | -- | 25 | 6 | 54 | 1.6 | 49 | 55 | 23 | -- | -- | -- | -- |
| DEC 5 | 7.6 | -- | 330 | 91 | -- | -- | -- | — | 6.90 | 6.9 | -- | 25 | 7 | 56 | 1.6 | 50 | 32 | 20 | — | — | -- | -- |
| DEC 6 | 7.6 | -- | 340 | 94 | — | -- | 32 | — | 7.40 | 7.4 | — | 27 | 6 | 54 | 2.0 | 50 | 37 | 22 | -- | -- | -- | 3 |
| DEC 11 | 7.5 | — | 360 | 94 | -- | -- | -- | 0.01 | 8.80 | 8.8 | — | 28 | 6 | 54 | 1.6 | 49 | 40 | 20 | -- | — | — | — |
| DEC 13 | 7.5 | -- | 420 | 100 | — | -- | -- | 0.02 | 6.50 | 6.5 | — | 30 | 6 | 54 | 2.6 | 49 | 35 | 20 | -- | -- | -- | -- |
| DEC 14 | 7.9 | -- | -- | -- | -- | — | — | 0.02 | 7.80 | 7.8 | — | -- | -- | 54 | 1.4 | 49 | 36 | 19 | -- | -- | -- | -- |
| DEC 18 | 7.5 | -- | 410 | 94 | -- | -- | 3 | 0.00 | 1.12 | 1.1 | -- | 27 | 6 | 51 | 2.2 | 59 | 37 | 19 | -- | -- | -- | 30 |
| DEC 19 | 7.5 | -- | 400 | 84 | — | -- | — | 0.00 | 5.49 | 5.5 | -- | 25 | 5 | 54 | 3.2 | 49 | 34 | 19 | -- | -- | -- | -- |
| (1973) | | | | | | | | | | | | | | | | | | | | | | |
| JAN 4 | 7.0 | — | 360 | 58 | -- | -- | -- | 0.12 | 3.74 | 3.8 | -- | 20 | 6 | 46 | 5.8 | 32 | 32 | 20 | — | -- | -- | — |
| JAN 5 | 7.1 | -- | 360 | 62 | -- | -- | -- | 0.01 | 2.60 | 2.6 | -- | 18 | 4 | 42 | 6.0 | 33 | 37 | 20 | -- | -- | -- | -- |
| JAN 11 | 7.0 | -- | 390 | 84 | — | -- | 4 | 0.01 | 1.48 | 1.5 | -- | 23 | 6 | 44 | 5.6 | 32 | 30 | 20 | -- | — | -- | 32 |

NOTE: UNDISTURBED SINCE THE INITIAL LANDSCAPING FOR THE CONSTRUCTION OF THE MILILANI SEWAGE TREATMENT PLANT. A 24-INCH BY 12-INCH (61 cm x 30 cm) HYDRAULIC RETAINING RING POSITIONED 8-INCH (200 cm) IN THE SOIL WAS USED TO INDUCE VERTICAL RATHER THAN HORIZONTAL PERCOLATION.

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

TABLE A-15. *IN SITU* PAN LYSIMETER LOCATED AT 30-INCH (76 cm) DEPTH COLLECTING LEACHATE FROM UNDISTURBED SOIL, MILILANI STP.

| | | | | | | | | NITROGEN as N | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | KJELDAHL | NO$_2$+ NO$_3$ | TOTAL | TOTAL P | Ca | Mg** | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | ALK. as CaCO$_3$ | TOTAL COLIFORMS |
| | | | | mg/ℓ | | | | | | | | | | | | | | | | | | |
| (1972) | | | | | | | | | | | | | | | | | | | | | | |
| AUG 28 | 7.5 | 266 | 360 | 50 | 1 | -- | 8 | 0.06 | 9.28 | 9.34 | -- | 10 | 6 | 52 | 2.7 | 51 | 57 | 24 | -- | -- | 57 | 27 |
| AUG 29 | 7.2 | 264 | 330 | 60 | 2 | <1 | 5 | 0.28 | 1.60 | 1.88 | 0.08 | 11 | 8 | 45 | 1.5 | 49 | 59 | 17 | -- | -- | 52 | 29 |
| AUG 31[a] | 7.0-7.5 | 273 | 340 | 66 | 2 | 3 | 7 | 1.46 | 0.54 | 2.00 | 0.30 | 11 | 9 | 43 | 1.8 | 51 | 55 | 18 | -- | -- | 64 | 38 |
| SEP 1[a] | 7.1-7.4 | 259 | 345 | 67 | 1 | -- | 8 | 0.77 | 0.53 | 1.30 | -- | 12 | 9 | 42 | 2.5 | 53 | 57 | 21 | -- | -- | 64 | 40 |
| SEP 3[a] | 7.2-7.3 | 227 | 355 | 70 | 1 | -- | -- | 0.10 | 0.80 | 0.90 | -- | 13 | 9 | 42 | 1.8 | 52 | 59 | 19 | -- | -- | 69 | -- |
| SEP 5 | 7.3 | 240 | 330 | 74 | 1 | -- | 4 | 0.03 | 0.58 | 0.61 | -- | 13 | 10 | 41 | 1.2 | 54 | 60 | 17 | -- | -- | 66 | 40 |
| SEP 8[a] | 7.4-7.6 | 269 | 360 | 89 | 1 | -- | 6 | 0.05 | 2.33 | 2.38 | -- | 14 | 13 | 46 | 2.0 | 52 | 65 | 23 | -- | -- | 72 | 35 |
| SEP 18[a] | 7.2-7.5 | 356 | 470 | 111 | 3 | -- | 5 | 0.02 | 2.31 | 2.33 | -- | 32 | 14 | 51 | 2.3 | 50 | 59 | 33 | -- | -- | 118 | 64 |
| SEP 20[a] | 7.4 | 287 | 390 | 105 | 1 | -- | 5 | 0.01 | 4.83 | 4.84 | -- | 17 | 15 | 48 | 1.8 | 53 | 71 | 26 | -- | -- | 80 | 46 |
| SEP* 21 | 7.8 | 320 | 420 | 120 | 2 | -- | -- | 0.02 | 9.25 | 9.27 | -- | 20 | 17 | 43 | 1.7 | 54 | 60 | 28 | -- | -- | 92 | -- |
| SEP 22 | 7.5 | 337 | 480 | 119 | 2 | -- | 10 | 0.02 | 6.90 | 6.92 | -- | 21 | 16 | 48 | 2.8 | 52 | 69 | 32 | -- | -- | 110 | 30 |
| SEP 25 | 7.4 | -- | 450 | 100 | -- | -- | 11 | 0.01 | 7.85 | 7.86 | -- | 18 | 13 | 44 | 2.5 | 56 | 65 | 9 | -- | -- | 98 | 35 |
| SEP 26 | 7.4 | -- | 480 | 98 | -- | -- | 12 | 0.01 | 7.90 | 7.91 | -- | 15 | 9 | 45 | 2.1 | 61 | 63 | 26 | -- | -- | 105 | 27 |
| OCT 3[a] | 7.6-7.8 | -- | 410 | 105 | -- | -- | 6 | 0.01 | 3.18 | 3.19 | -- | 24 | 11 | 49 | 1.3 | 51 | 55 | 26 | -- | -- | -- | -- |
| OCT 16 | 7.5-7.8 | -- | 440 | 137 | -- | -- | -- | 0.01 | 6.57 | 6.58 | -- | 40 | 11 | 54 | 1.7 | 51 | 53 | 26 | -- | -- | -- | -- |
| OCT 19 | 7.3 | -- | 530 | 184 | -- | -- | -- | 0.00 | 10.70 | 10.70 | -- | 52 | 13 | 72 | 1.7 | 50 | 44 | 26 | -- | -- | -- | -- |
| OCT 20[a] | 7.3-7.7 | -- | 470 | 154 | -- | -- | 6 | 0.00 | 8.77 | 8.77 | -- | 41 | 13 | 62 | 1.5 | 50 | 49 | 20 | -- | -- | -- | 21 |
| OCT 24[a] | 7.5-7.6 | -- | 430 | 158 | -- | -- | -- | 0.03 | 10.73 | 10.76 | -- | 45 | 11 | 52 | 1.5 | 50 | 40 | 21 | -- | -- | -- | -- |
| OCT 25[a] | 7.7-7.8 | -- | 400 | 127 | -- | -- | 3 | 0.00 | 10.50 | 10.50 | -- | 35 | 10 | 52 | 1.2 | 49 | 52 | 23 | -- | -- | -- | 27 |
| OCT 26[a] | 7.5-7.6 | 358 | 420 | 125 | -- | -- | 3 | 0.00 | 12.60 | 12.60 | -- | 36 | 8 | 52 | 0.9 | 50 | 58 | 25 | -- | -- | -- | -- |
| OCT 29[a] | 7.8-7.9 | -- | 405 | 132 | -- | -- | -- | 0.01 | 8.40 | 8.40 | -- | 40 | 8 | 52 | 1.2 | 49 | 46 | 22 | -- | -- | -- | -- |
| OCT 31[a] | 7.3-7.8 | -- | 420 | 117 | -- | -- | -- | 0.02 | 6.80 | 6.82 | -- | 36 | 7 | 50 | 0.6 | 49 | 55 | 20 | -- | -- | -- | -- |
| NOV 2[a] | 7.4-7.7 | -- | 435 | 113 | -- | -- | 2 | 0.03 | 11.75 | 11.78 | -- | 35 | 6 | 55 | 1.3 | 49 | 55 | 23 | -- | -- | -- | -- |
| NOV 6[a] | 7.6-7.7 | -- | 425 | 106 | -- | -- | -- | 0.02 | 4.05 | 4.07 | -- | 30 | 8 | 52 | 1.3 | 49 | 59 | 25 | -- | -- | -- | -- |
| NOV 13[a] | 7.5-7.9 | 295 | 415 | 104 | -- | -- | 2 | 0.00 | 3.01 | 3.01 | -- | 27 | 8 | 51 | 1.1 | 48 | 59 | 22 | -- | -- | -- | 19 |
| NOV 16[a] | 7.7-7.9 | -- | 435 | 108 | -- | -- | -- | 0.02 | 3.75 | 3.77 | -- | 29 | 8 | 49 | 1.0 | 50 | 45 | 21 | -- | -- | -- | -- |

TABLE A-15. (CONTD.)

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N | | | TOTAL P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | ALK. as CaCO$_3$ | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | KJELDAHL | NO$_2$+NO$_3$ | TOTAL | | | mg/ℓ | | | | | | | | | |
| NOV 20[a] | 7.8-7.9 | -- | 400 | 117 | -- | -- | 2 | 0.01 | 3.89 | 3.90 | -- | 29 | 11 | 51 | 1.3 | 51 | 67 | 30 | -- | -- | -- | 19 |
| NOV 21[a] | 7.5-7.6 | -- | 425 | -- | -- | -- | -- | 0.01 | 4.20 | 4.21 | -- | -- | -- | 52 | 1.2 | 50 | -- | 23 | -- | -- | -- | -- |
| NOV 22[a] | 7.2-7.5 | -- | 400 | 100 | -- | -- | -- | 0.05 | 4.23 | 4.28 | -- | 26 | 8 | 51 | 1.1 | 49 | 64 | 23 | -- | -- | -- | -- |
| NOV 28[a] | 7.6-7.7 | -- | 405 | -- | -- | -- | -- | 0.02 | 2.03 | 2.05 | -- | -- | -- | 50 | 1.0 | 50 | -- | 27 | -- | -- | -- | -- |
| NOV 29[a] | 7.7-8.0 | 277 | 405 | 105 | -- | -- | 2 | 0.01 | 3.68 | 3.69 | -- | 27 | 9 | 52 | 1.1 | 50 | 65 | 17 | -- | -- | -- | 25 |
| NOV 30[a] | 7.2-7.7 | -- | 360 | -- | -- | -- | -- | 0.00 | 2.94 | 2.94 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| DEC 4 | •8.3 | -- | 400 | 117 | -- | -- | -- | -- | 2.18 | -- | -- | 30 | 10 | 52 | 1.1 | 49 | 61 | 30 | -- | -- | -- | -- |
| DEC 5[a] | 7.9-8.1 | -- | 400 | 120 | -- | -- | -- | -- | 1.17 | -- | -- | 31 | 10 | 48 | 1.1 | -- | 55 | 22 | -- | -- | -- | -- |
| DEC 13[a] | 7.6-7.8 | -- | 390 | -- | -- | -- | 3 | 0.00 | 0.92 | 0.92 | -- | 29 | 10 | 49 | 0.8 | 50 | 52 | 17 | -- | -- | -- | 20 |
| DEC 19[a] | 7.7 | -- | -- | -- | -- | -- | -- | 0.00 | 1.08 | 1.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| DEC 20 | 7.8 | -- | -- | -- | -- | -- | 3 | 0.00 | 2.62 | 2.62 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| (1973) | | | | | | | | | | | | | | | | | | | | | | |
| JAN 4 | 7.5 | -- | 450 | 115 | -- | -- | -- | 0.00 | 11.30 | 11.30 | -- | 23 | 14 | 56 | 1.3 | 48 | 24 | 11 | -- | -- | -- | -- |
| JAN 5[a] | 7.5-7.6 | -- | 450 | 128 | -- | -- | 2 | 0.00 | 4.88 | 4.88 | -- | 23 | 17 | 48 | 1.3 | 47 | 23 | 16 | -- | -- | -- | -- |
| JAN 8 | 7.7 | -- | -- | 130 | -- | -- | -- | 0.00 | 16.30 | 16.30 | -- | -- | -- | 54 | 1.0 | 46 | 22 | 14 | -- | -- | -- | -- |
| JAN 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | 0.06 | 0.06 | -- | -- | -- | 20 | 0.3 | -- | -- | 15 | -- | -- | -- | -- |
| JAN 24 | 7.9 | -- | 380 | 122 | -- | -- | 2 | 0.00 | 5.71 | 5.71 | -- | 21 | 17 | 52 | 1.2 | 48 | 27 | 17 | -- | -- | -- | -- |
| JAN 25 | 7.8 | -- | -- | 120 | -- | -- | -- | N.D. | 27.70 | 27.70 | -- | 20 | 17 | 52 | 1.2 | 52 | 27 | 17 | -- | -- | -- | -- |
| JAN 26 | 7.8 | -- | -- | 115 | -- | -- | -- | N.D. | 10.30 | 10.30 | -- | 18 | 17 | 52 | 1.6 | 45 | 33 | 29 | -- | -- | -- | -- |
| FEB 5 | 7.6 | -- | -- | -- | -- | -- | -- | N.D. | 6.60 | 6.60 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FEB 8 | 7.6 | -- | -- | -- | -- | -- | -- | N.D. | 11.70 | 11.70 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FEB 9 | 7.6 | -- | -- | -- | -- | -- | -- | N.D. | 5.29 | 5.29 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FEB 12 | 7.7 | -- | -- | -- | -- | -- | -- | N.D. | 6.08 | 6.08 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

NOTE: UNDISTURBED SINCE THE INITIAL LANDSCAPING FOR THE CONSTRUCTION OF THE MILILANI SEWAGE TREATMENT PLANT. A 48-INCH (122 cm) DIAMETER, 30-INCH (76 cm) DEEP HYDRAULIC RETAINING RING POSITIONED 18 INCHES (46 cm) IN THE SOIL WAS USED TO INDUCE VERTICAL RATHER THAN HORIZONTAL PERCOLATION.

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

[a] MEAN OF SEPARATE ANALYSES FROM TWO TO THREE PANS POSITIONED AT 30-INCH (76 cm) DEPTH.

TABLE A-16. CERAMIC POINT SAMPLER DEPTHS IN A TEST PLOT OF OSC FIELD NO. 240.

| ROW POSITION NO. | CERAMIC POINT SAMPLER DEPTH | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IRRIGATION WITH SECONDARY TREATED SEWAGE | | | | | | | | IRRIGATION DITCH WATER | | | |
| | RI[a] | FI[b] | RII | F2 | RIII | F3 | RIV | F5 | RVI | F6 | RVII | F7 |
| | in. | | | | | | | | in. | | | |
| 1 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 12 | | 9 | 9 | 9 |
| 2 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 6 | 21 | | | 21 |
| 3 | 33 | | 33 | 21 | 33 | | 33 | | | | | |
| 4 | | | | 9 | | | | | | | | |
| 5 | | | | 9 | | | | | | | | |
| 6 | | | | 21 | | | | | | | | |

NOTE: in. x 2.54 = cm.

[a] RIDGE.

[b] FURROW.

## TABLE A-17. WAIAHOLE DITCH IRRIGATION WATER QUALITY.

| DATE | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | SS | BOD$_5$ | TOC | NITROGEN as N |  |  | TOTAL P | Ca | Mg* | Na | K | Cl | SO$_4$ | SiO$_2$ | B | GREASE | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  | KJELDAHL | NO$_2$+ NO$_3$ | TOTAL |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | 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 | -- | -- | -- |
| JUN 12 | 8.6 | -- | 96 | 34 | — | -- | 1.0 | -- | 0.05 | -- | — | 4 | 5.8 | 7.0 | 1.2 | 12 | -- | 27 | -- | -- | 10 |
| JUN 26 | 8.9 | 115 | 100 | 34 | -- | — | 1.0 | -- | 0.02 | -- | -- | 12 | -- | -- | -- | 22 | 8 | 26 | — | — | 8 |

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

## TABLE A-18. PERCOLATE FROM CERAMIC POINT SAMPLERS LOCATED IN A TEST PLOT OF OSC FIELD NO. 240.

| DATE | POINT SAMPLER LOCATION NO.[a] | POINT SAMPLER DEPTH in. | pH | $NO_3$ mg/ℓ | Cl mg/ℓ | COND. @ 25°C µmhos/cm |
|---|---|---|---|---|---|---|
| (1972) JUNE 7 | F1-1 | 9 | 7.3 | 4.3 | 50 | -- |
| | F1-2 | 21 | 7.4 | 0.3 | 29 | -- |
| | F2-1 | 9 | 7.1 | 3.0 | 31 | -- |
| | F2-2 | 21 | 7.1 | 12.9 | 48 | -- |
| | F2-3 | 21 | 7.2 | 4.5 | 37 | -- |
| | F2-4 | 9 | 7.4 | 5.3 | 27 | -- |
| | F2-5 | 9 | 7.1 | 13.1 | 54 | -- |
| | F2-6 | 21 | 7.0 | 9.9 | 40 | -- |
| | F3-1 | 9 | 7.2 | 12.2 | 30 | -- |
| | F3-2 | 21 | 7.4 | 11.4 | 28 | -- |
| | F5-1 | 12 | 7.4 | 3.3 | 25 | -- |
| | F5-2 | 6 | 7.3 | 7.1 | -- | -- |
| | RI-1 | 9 | 7.3 | 4.2 | 60 | -- |
| | RI-2 | 21 | 7.1 | 3.0 | 12 | -- |
| | RI-3 | 33 | 7.5 | 4.4 | 39 | -- |
| | RII-2 | 21 | 7.4 | 4.5 | 42 | -- |
| | RII-3 | 33 | 7.4 | 9.7 | 54 | -- |
| | RIII-2 | 21 | 7.4 | 0.5 | 51 | -- |
| | RIII-3 | 33 | 7.4 | 1.5 | 64 | -- |
| | RIV-2 | 21 | 7.2 | 6.3 | 98 | -- |
| | RIV-3 | 33 | 7.4 | 12.2 | 90 | -- |
| JUNE 8 | F1-1 | 9 | -- | 4.3 | 36 | -- |
| | F1-2 | 21 | -- | 0.9 | 12 | -- |
| | F2-1 | 9 | -- | 1.4 | 29 | -- |
| | F2-2 | 21 | -- | 14.0 | 29 | -- |
| | F2-3 | 21 | -- | 2.3 | 23 | -- |
| | F2-4 | 9 | -- | 3.7 | 19 | -- |
| | F2-5 | 9 | -- | 2.2 | 32 | -- |
| | F2-6 | 21 | -- | 8.4 | 29 | -- |
| | F3-1 | 9 | -- | 16.5 | 30 | -- |
| | F3-2 | 21 | -- | 7.4 | 16 | -- |
| | F5-1 | 12 | -- | 5.7 | 23 | -- |
| | F5-2 | 6 | -- | 3.3 | 25 | -- |
| | RI-1 | 9 | -- | 0.9 | -- | -- |
| | RI-2 | 21 | -- | 2.2 | 26 | -- |
| | RI-3 | 33 | -- | 0.9 | 38 | -- |
| | RII-1 | 9 | -- | 0.8 | -- | -- |
| | RII-2 | 21 | -- | 3.3 | 119 | -- |
| | RII-3 | 33 | -- | 6.5 | 47 | -- |
| | RIII-2 | 21 | -- | 0.7 | 60 | -- |
| | RIII-3 | 33 | -- | 26.0 | 50 | -- |
| | RIV-2 | 21 | -- | 2.8 | 84 | -- |
| | RIV-3 | 33 | -- | 11.6 | 91 | -- |
| JUNE 9 | F1-1 | 9 | -- | 3.2 | 30 | -- |
| | F1-2 | 21 | -- | 1.8 | 25 | -- |
| | F2-1 | 9 | -- | 0.4 | 30 | -- |
| | F2-2 | 21 | -- | 10.0 | 28 | -- |
| | F2-3 | 21 | -- | 4.4 | 30 | -- |
| | F2-4 | 9 | -- | 3.0 | 20 | -- |
| | F2-5 | 9 | -- | 21.0 | 33 | -- |
| | F2-6 | 21 | -- | 6.5 | 26 | -- |
| | F3-1 | 9 | -- | 9.7 | 35 | -- |
| | F3-2 | 21 | -- | 1.8 | 12 | -- |
| | F5-1 | 12 | -- | 5.2 | 20 | -- |
| | F5-2 | 6 | -- | 3.2 | 22 | -- |
| | RI-1 | 9 | -- | 5.5 | 40 | -- |
| | RI-2 | 21 | -- | -- | 15 | -- |
| JUNE 9 (contd.) | RI-3 | 33 | -- | 0.9 | -- | -- |
| | RII-2 | 21 | -- | 2.8 | 112 | -- |
| | RII-3 | 33 | -- | 5.7 | 60 | -- |
| | RIII-2 | 21 | -- | 0.8 | -- | -- |
| | RIII-3 | 33 | -- | 1.2 | -- | -- |
| | RIV-2 | 21 | -- | 21.6 | -- | -- |
| | RIV-3 | 33 | -- | 9.8 | 80 | -- |
| JUNE 15[b] (AM) | F1-1 | 9 | -- | 18.0 | 25 | -- |
| | F1-2 | 21 | -- | 0.8 | 28 | -- |
| | F2-1 | 9 | -- | 0.9 | 22 | -- |
| | F2-2 | 21 | -- | 6.0 | 27 | -- |
| | F2-3 | 21 | -- | 0.8 | 20 | -- |
| | F2-4 | 9 | -- | 0.9 | 23 | -- |
| | F2-5 | 9 | -- | 2.4 | 32 | -- |
| | F2-6 | 21 | -- | 8.8 | 31 | -- |
| | F3-1 | 9 | -- | 4.2 | 24 | -- |
| | F3-2 | 21 | -- | 4.1 | 30 | -- |
| | RII-1 | 9 | -- | 2.3 | -- | -- |
| | RII-2 | 21 | -- | 0.7 | 93 | -- |
| | RIII-1 | 9 | -- | 0.6 | -- | -- |
| | RIII-2 | 21 | -- | 0.9 | 68 | -- |
| | RIV-1 | 9 | -- | 5.4 | -- | -- |
| | RIV-2 | 21 | -- | 1.0 | -- | -- |
| | RIV-3 | 33 | -- | 0.9 | -- | -- |
| JUNE 15 (PM) | F1-1 | 9 | -- | 0.8 | 30 | -- |
| | F1-2 | 21 | -- | 1.0 | 30 | -- |
| | F2-1 | 9 | -- | 0.2 | 22 | -- |
| | F2-2 | 21 | -- | 5.3 | 23 | -- |
| | F2-3 | 21 | -- | 0.7 | 15 | — |
| | F2-4 | 9 | -- | 1.0 | 15 | -- |
| | F2-5 | 9 | -- | 5.7 | 22 | -- |
| | F2-6 | 21 | -- | 3.0 | 26 | -- |
| | F3-1 | 9 | -- | 2.8 | 21 | -- |
| | F3-2 | 21 | -- | 3.6 | 14 | -- |
| | RI-3 | 33 | -- | 0.5 | -- | -- |
| | RII-2 | 21 | -- | 0.0 | -- | -- |
| | RII-3 | 33 | -- | 1.0 | -- | -- |
| | RIII-2 | 21 | -- | 3.1 | -- | -- |
| JUNE 16 | F1-1 | 9 | -- | 0.6 | 34 | -- |
| | F1-2 | 21 | -- | 0.9 | 27 | -- |
| | F2-1 | 9 | -- | 0.1 | 17 | -- |
| | F2-2 | 21 | -- | 4.2 | 18 | -- |
| | F2-3 | 21 | -- | 0.1 | 18 | -- |
| | F2-4 | 9 | -- | 0.5 | 23 | -- |
| | F2-5 | 9 | -- | 4.0 | 32 | -- |
| | F2-6 | 21 | -- | 3.3 | 33 | -- |
| | F3-1 | 9 | -- | 1.4 | 26 | -- |
| | F3-2 | 21 | -- | 0.5 | 18 | -- |
| | RI-2 | 21 | -- | 0.3 | 24 | -- |
| | RI-3 | 33 | -- | 2.2 | 50 | -- |
| | RII-2 | 21 | -- | 0.3 | 74 | -- |
| | RII-3 | 33 | -- | 0.9 | 160 | -- |
| | RIII-2 | 21 | -- | 0.1 | -- | -- |
| | RIII-3 | 33 | -- | 16.3 | 70 | -- |
| | RIV-2 | 21 | -- | 1.0 | 70 | -- |
| | RIV-3 | 33 | -- | 3.3 | 17 | -- |

| DATE | POINT SAMPLER LOCATION NO.[a] | POINT SAMPLER DEPTH in. | pH | $NO_3$ mg/ℓ | Cl mg/ℓ | COND. @ 25°C µmhos/cm | TOC mg/ℓ | Na mg/ℓ | K mg/ℓ | $SiO_2$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 22 | F1-1 | 9 | -- | 0.7 | 36 | 500 | -- | 20 | 5.6 | -- |
| | F1-2 | 21 | -- | 5.5 | 39 | 470 | -- | 34 | 5.6 | -- |
| | F2-1 | 9 | -- | 2.0 | 30 | 480 | -- | 20 | 1.0 | -- |
| | F2-2 | 21 | -- | 1.9 | 24 | 460 | -- | 13 | 3.8 | -- |
| | F2-3 | 21 | -- | 0.6 | 19 | 460 | -- | 13 | 1.0 | -- |
| | F2-4 | 9 | -- | 1.7 | 27 | 450 | -- | 11 | 2.4 | -- |
| | F2-5 | 9 | -- | 2.5 | 31 | -- | -- | 13 | 9.5 | -- |
| | F2-6 | 21 | -- | 2.1 | 29 | 460 | -- | 12 | 9.5 | -- |
| | F3-1 | 9 | -- | 2.6 | 30 | 400 | -- | 13 | 3.0 | -- |
| | F3-2 | 21 | -- | 1.2 | 24 | 360 | -- | 13 | 2.0 | -- |
| | RI-2 | 21 | -- | 0.2 | 28 | 480 | -- | 14 | 7.7 | -- |
| | RI-3 | 33 | -- | 0.2 | 29 | 520 | -- | 15 | 2.5 | -- |

TABLE A-18. (CONTD.)

| DATE | POINT SAMPLER LOCATION NO.[a] | POINT SAMPLER DEPTH in. | pH | $NO_3$ mg/ℓ | Cl mg/ℓ | COND. @ 25°C μmhos/cm | TOC mg/ℓ | Na mg/ℓ | K mg/ℓ | $SiO_2$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 22 (contd.) | RII-2 | 21 | -- | 0.2 | 40 | -- | -- | 15 | 6.0 | -- |
| | RII-3 | 33 | -- | 0.8 | 39 | 540 | -- | 14 | 3.1 | -- |
| | RIII-2 | 21 | -- | 0.2 | -- | -- | -- | -- | -- | -- |
| | RIII-3 | 33 | -- | 0.9 | 37 | 560 | -- | 13 | 5.5 | -- |
| | RIV-2 | 21 | -- | -- | 57 | 520 | -- | 15 | 1.2 | -- |
| | RIV-3 | 33 | -- | 0.1 | 40 | 500 | -- | 14 | 2.5 | -- |
| JUNE 23 | F1-1 | 9 | -- | 3.4 | 28 | -- | -- | 13 | 5.0 | -- |
| | F1-2 | 21 | -- | 3.2 | 34 | 500 | -- | 26 | 4.7 | -- |
| | F2-1 | 9 | -- | 2.6 | 23 | 500 | -- | 17 | 1.0 | -- |
| | F2-2 | 21 | -- | 2.5 | 25 | 470 | -- | 14 | 3.5 | -- |
| | F2-3 | 21 | -- | 1.9 | 17 | 460 | -- | 15 | 1.3 | -- |
| | F2-4 | 9 | -- | 2.7 | 25 | 430 | -- | 12 | 3.1 | -- |
| | F2-5 | 9 | -- | 2.6 | 30 | 360 | -- | 13 | 9.6 | -- |
| | F2-6 | 21 | -- | 3.8 | 26 | 480 | -- | 11 | 11.0 | -- |
| | F3-1 | 9 | -- | 6.6 | 26 | 370 | -- | 13 | 4.0 | -- |
| | F3-2 | 21 | -- | 3.2 | 26 | 430 | -- | 13 | 1.6 | -- |
| | RI-2 | 21 | -- | 0.3 | 20 | 480 | -- | 13 | 7.2 | -- |
| | RI-3 | 33 | -- | 1.4 | 24 | -- | -- | 14 | 2.0 | -- |
| | RII-2 | 21 | -- | 0.3 | 42 | 520 | -- | 15 | 7.1 | -- |
| | RII-3 | 33 | -- | 2.5 | 39 | 440 | -- | 16 | 3.3 | -- |
| | RIII-2 | 21 | -- | 0.7 | -- | -- | -- | 15 | 8.1 | -- |
| | RIV-2 | 21 | -- | 0.4 | 37 | -- | -- | 14 | 0.7 | -- |
| | RIV-3 | 33 | -- | 0.9 | 30 | 480 | -- | 15 | 3.3 | -- |
| JUNE 27 | F1-1 | 9 | -- | 3.8 | 36 | -- | 7.0 | -- | -- | 22 |
| | F1-2 | 21 | -- | 1.7 | 36 | -- | 5.5 | -- | -- | 33 |
| | F2-1 | 9 | -- | 4.3 | 32 | -- | 6.0 | -- | -- | 21 |
| | F2-2 | 21 | -- | 2.8 | 24 | -- | 3.5 | -- | -- | 26 |
| | F2-3 | 21 | -- | 4.1 | 22 | -- | 5.0 | -- | -- | 22 |
| | F2-4 | 9 | -- | 5.3 | 30 | -- | 4.5 | -- | -- | 23 |
| | F2-5 | 9 | -- | 2.9 | 28 | -- | 4.5 | -- | -- | 39 |
| | F2-6 | 21 | -- | 5.1 | 34 | -- | 5.5 | -- | -- | 24 |
| | F3-1 | 9 | -- | 9.7 | 30 | -- | 7.0 | -- | -- | 25 |
| | F3-2 | 21 | -- | 6.4 | 27 | -- | 5.0 | -- | -- | 15 |
| | RI-2 | 21 | -- | 0.5 | 19 | -- | 5.0 | -- | -- | 24 |
| | RI-3 | 33 | -- | 2.1 | 29 | -- | 5.0 | -- | -- | 19 |
| | RII-2 | 21 | -- | 0.3 | 30 | -- | 6.5 | -- | -- | 37 |
| | RII-3 | 33 | -- | 2.5 | 38 | -- | 3.5 | -- | -- | 22 |
| | RIII-2 | 21 | -- | 0.3 | -- | -- | -- | -- | -- | -- |
| | RIII-3 | 33 | -- | 4.8 | 34 | -- | 3.5 | -- | -- | 19 |
| | RIV-2 | 21 | -- | 0.2 | 41 | -- | 6.0 | -- | -- | 22 |
| | RIV-3 | 33 | -- | 1.6 | 32 | -- | 2.5 | -- | -- | 17 |

| DATE | POINT SAMPLER LOCATION NO.[a] | POINT SAMPLER DEPTH in. | pH | $NO_3$ mg/ℓ | Cl mg/ℓ | COND. @ 25°C μmhos/cm |
|---|---|---|---|---|---|---|
| JUNE 30 | F1-1 | 9 | 7.1 | 1.0 | -- | -- |
| | F1-2 | 21 | 7.2 | 1.4 | 34 | -- |
| | F2-1 | 9 | 7.4 | 0.6 | 30 | -- |
| | F2-2 | 21 | 7.1 | 0.9 | 25 | -- |
| | F2-3 | 21 | 7.0 | 0.7 | 20 | -- |
| | F2-4 | 9 | 7.1 | 2.9 | 29 | -- |
| | F2-5 | 9 | 7.1 | 2.5 | -- | -- |
| | F2-6 | 21 | 6.8 | 4.1 | 34 | -- |
| | F3-1 | 9 | 7.1 | 3.1 | 26 | -- |
| | F3-2 | 21 | 6.9 | 1.6 | 29 | -- |
| | RI-2 | 21 | 7.4 | 0.2 | -- | -- |
| | RI-3 | 33 | 7.4 | 0.2 | -- | -- |
| | RII-2 | 21 | 7.2 | 0.2 | 27 | -- |
| | RII-3 | 33 | 7.2 | 0.3 | -- | -- |
| | RIII-2 | 21 | 7.1 | 1.9 | -- | -- |
| | RIII-3 | 33 | 7.2 | 0.2 | -- | -- |
| | RIV-2 | 21 | 7.0 | 0.2 | -- | -- |
| | RIV-3 | 33 | 7.1 | 0.2 | 20 | -- |
| JULY 6 | F1-1 | 9 | 7.7 | 2.9 | 45 | 390 |
| | F1-2 | 21 | 7.6 | 2.9 | 45 | 400 |
| | F2-1 | 9 | 7.9 | 2.5 | 45 | 410 |
| | F2-2 | 21 | 7.9 | 1.9 | 26 | 400 |
| | F2-3 | 21 | 7.6 | 2.8 | 36 | 480 |
| | F2-4 | 9 | 7.8 | 3.7 | 27 | 320 |
| | F2-5 | 9 | 8.3 | 2.9 | 39 | -- |
| | F2-6 | 21 | 7.7 | 5.1 | 34 | 480 |
| | F3-1 | 12 | 7.8 | 7.1 | 32 | 430 |
| | F3-2 | 6 | 7.7 | 5.1 | 16 | 430 |
| | F5-1 | 9 | 7.9 | 0.5 | 26 | 172 |
| | F5-2 | 9 | 7.7 | 4.5 | 24 | 320 |
| | F6-1 | 21 | 7.6 | 4.9 | 18 | 164 |
| | F7-1 | 21 | 7.8 | 1.4 | 24 | 230 |
| JULY 6 (contd.) | F7-2 | 33 | 7.6 | 1.2 | 18 | 184 |
| | RI-2 | 21 | 7.8 | 1.4 | 30 | 460 |
| | RI-3 | 33 | 7.8 | 2.8 | 34 | 520 |
| | RII-2 | 21 | 7.9 | 0.5 | 22 | -- |
| | RII-3 | 33 | 7.4 | 2.9 | 40 | 470 |
| | RIII-2 | 21 | 8.0 | 0.9 | 18 | -- |
| | RIII-3 | 33 | 7.8 | 3.2 | 34 | 480 |
| | RIV-2 | 21 | 7.7 | 2.6 | 56 | 320 |
| | RIV-3 | 33 | 7.6 | 2.6 | 14 | 480 |
| | RVI-2 | 21 | 7.9 | 1.4 | 48 | 420 |
| | RVII-1 | 9 | 7.7 | 5.6 | 42 | 400 |
| JULY 7 | F1-1 | 9 | 7.8 | 0.8 | 45 | -- |
| | F1-2 | 21 | 7.9 | 1.8 | 48 | -- |
| | F2-1 | 9 | 8.0 | 0.7 | 50 | -- |
| | F2-2 | 21 | 7.9 | 0.6 | 33 | -- |
| | F2-3 | 21 | 7.6 | 1.0 | 38 | -- |
| | F2-4 | 9 | 7.9 | 1.9 | 34 | -- |
| | F2-5 | 9 | 7.9 | 2.0 | 35 | -- |
| | F2-6 | 21 | 7.5 | 3.5 | 40 | -- |
| | F3-1 | 9 | 8.0 | 2.7 | 37 | -- |
| | F3-2 | 21 | 7.8 | 1.2 | 40 | -- |
| | F5-1 | 9 | 7.8 | 2.1 | 20 | -- |
| | F5-2 | 12 | 7.6 | 4.8 | 24 | -- |
| | F6-1 | 6 | 7.8 | 0.2 | 36 | -- |
| | F7-1 | 9 | 7.6 | 1.7 | 35 | -- |
| | F7-2 | 21 | 7.8 | 1.2 | 19 | -- |
| | RI-2 | 21 | 8.1 | 0.3 | 40 | -- |
| | RI-3 | 33 | 8.2 | 0.3 | 40 | -- |
| | RII-2 | 21 | 7.9 | 0.2 | 21 | -- |
| | RII-3 | 33 | 7.8 | 0.6 | 30 | -- |
| | RIII-2 | 21 | 7.9 | 0.5 | 27 | -- |
| | RIII-3 | 33 | 8.1 | 2.1 | 31 | -- |

TABLE A-18. (CONTD.)

| DATE | POINT SAMPLER LOCATION NO.[a] | POINT SAMPLER DEPTH in. | pH | $NO_3$ mg/ℓ | Cl mg/ℓ | COND. @ 25°C µmhos/cm |
|---|---|---|---|---|---|---|
| JULY 7 (contd.) | RIV-2 | 21 | 7.8 | 2.4 | 25 | -- |
| | RIV-3 | 33 | 7.7 | 0.2 | 29 | -- |
| | RVI-2 | 21 | 7.9 | 8.0 | 25 | -- |
| | RVII-1 | 9 | 7.9 | 6.2 | 34 | -- |
| JULY 13 | F1-1 | 9 | 7.9 | 2.3 | 44 | 480 |
| | F1-2 | 21 | 7.8 | 1.8 | 40 | 360 |
| | F2-1 | 9 | 8.0 | 1.7 | 50 | 300 |
| | -- | -- | -- | -- | -- | -- |
| | F2-2 | 21 | 8.1 | 9 | 22 | 240 |
| | F2-3 | 21 | 7.9 | 1.6 | 32 | 430 |
| | F2-4 | 9 | 7.9 | 2.4 | 36 | 450 |
| | F2-5 | 9 | 8.2 | 2.3 | 22 | -- |
| | F2-6 | 21 | 7.8 | 3.4 | 40 | 400 |
| | F3-1 | 9 | 8.0 | 5.6 | 34 | 380 |
| | F3-2 | 21 | 7.7 | 4.2 | 38 | 400 |
| | RI-2 | 21 | 8.2 | 0.3 | 30 | -- |
| | RI-3 | 33 | 8.0 | 1.1 | 32 | 450 |
| | RII-2 | 21 | 8.3 | 0.4 | 12 | 400 |
| | RII-3 | 33 | 7.8 | 1.7 | 36 | 500 |
| | RIII-2 | 21 | 7.9 | 0.5 | -- | -- |
| | RIII-3 | 33 | 7.9 | 3.6 | 34 | 440 |
| | RIV-2 | 21 | 7.9 | 8.0 | 38 | -- |
| | RIV-3 | 33 | 7.7 | 1.5 | 50 | 300 |
| JULY 14 | F1-1 | 9 | 8.4 | 1.2 | 47 | -- |
| | F1-2 | 21 | 7.9 | 1.2 | 47 | -- |
| | F2-1 | 9 | 8.4 | 0.4 | 50 | -- |
| | F2-2 | 21 | 8.0 | 0.2 | 29 | -- |
| | F2-3 | 21 | 7.9 | 0.6 | 35 | -- |
| | F2-4 | 9 | 8.2 | 1.3 | 40 | -- |
| | F2-5 | 9 | 8.1 | 0.9 | 29 | -- |
| | F2-6 | 21 | 7.9 | 1.9 | 45 | -- |
| | F3-1 | 9 | 8.2 | 1.7 | 41 | -- |
| | F3-2 | 21 | 7.9 | 0.7 | 40 | -- |
| | RI-2 | 21 | 8.2 | 0.2 | 35 | -- |
| | RI-3 | 33 | 8.2 | 0.2 | 30 | -- |
| | RII-2 | 21 | 8.0 | 0.1 | 21 | -- |
| | RII-3 | 33 | 8.0 | 0.2 | 40 | -- |
| | RIII-2 | 21 | 8.3 | 0.3 | -- | -- |
| | RIII-3 | 33 | -- | 1.7 | 40 | -- |
| | RIV-2 | 21 | 8.1 | 0.3 | 42 | -- |
| | RIV-3 | 33 | 7.7 | 0.2 | 52 | -- |
| JULY 20 | F1-1 | 9 | 8.0 | 2.3 | 36 | 400 |
| | F1-2 | 21 | 7.7 | 0.8 | 41 | 420 |
| | F2-1 | 9 | 7.9 | 1.4 | 31 | 430 |
| | F2-2 | 21 | 7.8 | 0.5 | 33 | 440 |
| | F2-3 | 21 | 7.7 | 1.8 | 31 | 440 |
| | F2-4 | 9 | 7.8 | 2.3 | 35 | 420 |
| | F2-5 | 9 | 8.2 | 3.2 | 24 | 400 |
| | F2-6 | 21 | 7.7 | 2.2 | 42 | 440 |
| | F3-1 | 9 | 8.0 | 7.0 | 37 | 390 |
| | F3-2 | 21 | 7.8 | 3.5 | 42 | 390 |
| | RI-2 | 21 | 8.0 | 0.5 | 35 | 310 |
| | RI-3 | 33 | 7.8 | 0.9 | 36 | 480 |
| | RII-2 | 21 | 8.0 | 0.3 | 15 | 420 |
| | RII-3 | 33 | 7.8 | 1.6 | 40 | 450 |
| | RIII-2 | 21 | 8.0 | 0.5 | 36 | 480 |
| | RIII-3 | 33 | 7.8 | 3.6 | 37 | 480 |
| | RIV-2 | 21 | 7.9 | 1.0 | 38 | 340 |
| | RIV-3 | 33 | 7.8 | 1.2 | 31 | 500 |
| JULY 21 | F1-1 | 9 | 7.7 | 1.0 | 35 | -- |
| | F1-2 | 21 | 7.6 | 1.2 | 40 | -- |
| | F2-1 | 9 | 8.1 | 0.6 | 55 | -- |
| | F2-2 | 21 | 8.1 | 0.1 | 32.5 | -- |
| | F2-3 | 21 | 7.4 | 0.7 | 30 | -- |
| | F2-4 | 9 | 7.8 | 1.6 | 35 | -- |
| | F2-5 | 9 | 8.0 | 0.9 | 25 | -- |
| | F2-5 | 21 | 7.7 | 1.3 | 45 | -- |
| | F3-1 | 9 | 8.1 | 2.5 | 35 | -- |
| | F3-2 | 21 | 7.7 | 0.8 | 47.5 | -- |
| | RI-2 | 21 | 7.9 | 0.2 | 35 | -- |
| | RI-3 | 33 | 7.9 | 0.2 | 35 | -- |
| | RII-2 | 21 | 7.8 | 0.2 | 17.5 | -- |
| | RII-3 | 33 | 8.2 | 0.2 | 40 | -- |
| | RIII-2 | 21 | 7.8 | 0.5 | 40 | -- |
| | RIII-3 | 33 | 7.9 | 1.9 | 40 | -- |
| | RIV-2 | 21 | 7.9 | 0.4 | 35 | -- |
| | RIV-3 | 33 | 7.7 | 0.3 | 42.5 | -- |
| JULY 27 | F1-1 | 9 | 7.4 | 3.7 | 32 | 420 |
| | F1-2 | 21 | 7.3 | 0.8 | 34 | 380 |
| | F2-1 | 9 | 7.8 | 2.3 | 32 | 460 |
| | F2-2 | 21 | 7.8 | 0.9 | 32 | 340 |
| | F2-3 | 21 | 7.6 | 2.6 | 36 | 420 |
| | F2-4 | 9 | 7.6 | 4.5 | 38 | 370 |
| | F2-5 | 9 | 7.8 | 2.8 | 24 | -- |
| | F2-6 | 21 | 7.6 | 2.3 | 39 | 420 |
| | F3-1 | 9 | 7.5 | 8.5 | 40 | 360 |
| | F3-2 | 21 | 7.6 | 5.0 | 42 | 400 |
| | RI-2 | 21 | 7.8 | 0.4 | -- | -- |
| | RI-3 | 33 | 7.7 | 0.8 | 36 | 380 |
| | RII-2 | 21 | 7.8 | 2.7 | -- | -- |
| | RII-3 | 33 | 7.8 | 1.2 | 36 | 420 |
| | RIII-2 | 21 | -- | 1.0 | -- | -- |
| | RIII-3 | 33 | 7.8 | 2.9 | 35 | 440 |
| | RIV-2 | 21 | 7.6 | 0.4 | 32 | -- |
| | RIV-3 | 33 | 7.5 | 0.8 | 28 | 400 |
| | F5-1 | 12 | 7.5 | 0.3 | 12 | 220 |
| | F5-2 | 6 | 7.4 | 0.4 | 14 | 240 |
| | F6-1 | 9 | 7.4 | 0.4 | 20 | 260 |
| | F7-1 | 9 | 7.4 | 0.8 | 24 | 240 |
| | F7-2 | 21 | 7.4 | 0.4 | 16 | 160 |
| | RVI-1 | 21 | 7.7 | 0.3 | 24 | 380 |
| | RVII-1 | 9 | 7.5 | 0.2 | 30 | 420 |
| JULY 28 | F1-1 | 9 | 7.4 | -- | -- | -- |
| | F1-2 | 21 | 7.6 | 0.9 | -- | -- |
| | F2-1 | 9 | 7.8 | 0.6 | -- | -- |
| | F2-2 | 21 | 7.7 | 0.2 | -- | -- |
| | F2-3 | 21 | 7.7 | 1.2 | -- | -- |
| | F2-4 | 9 | 7.7 | 3.1 | -- | -- |
| | F2-5 | 9 | 7.4 | 1.2 | -- | -- |
| | F2-6 | 21 | 7.6 | 1.4 | -- | -- |
| | F3-1 | 9 | 8.0 | 3.6 | -- | -- |
| | F3-2 | 21 | 7.4 | 1.5 | -- | -- |
| | RI-2 | 21 | 7.7 | 0.1 | -- | -- |
| | RI-3 | 33 | 7.8 | 0.2 | -- | -- |
| | RII-2 | 21 | 7.9 | 0.1 | -- | -- |
| | RII-3 | 33 | 7.8 | 0.2 | -- | -- |
| | RIII-2 | 21 | 7.6 | -- | -- | -- |
| | RIII-3 | 33 | 7.6 | 1.3 | -- | -- |
| | RIV-2 | 21 | 7.5 | 0.2 | -- | -- |
| | RIV-3 | 33 | 7.8 | 0.2 | -- | -- |
| | F5-1 | 12 | 7.8 | 0.3 | -- | -- |
| | F5-2 | 6 | 7.3 | 0.4 | -- | -- |
| | F6-1 | 9 | 7.5 | 0.2 | -- | -- |
| | F7-1 | 9 | 7.9 | 0.4 | -- | -- |
| | F7-2 | 21 | 7.4 | 0.5 | -- | -- |
| | RVI-1 | -- | 7.9 | 0.2 | -- | -- |
| | RVII-1 | 9 | 7.9 | 0.2 | -- | -- |
| AUG 3 | F1-1 | 9 | 7.7 | 3.1 | 48 | 280 |
| | F1-2 | 21 | 7.7 | 2.5 | 48 | 400 |
| | F2-1 | 9 | 7.9 | 3.5 | 62 | 460 |
| | F2-2 | 21 | 7.7 | 1.4 | 36 | 280 |
| | F2-3 | 21 | 7.6 | 5.2 | 42 | 300 |
| | F2-4 | 9 | 7.8 | 6.9 | 40 | 380 |
| | F2-5 | 9 | 8.1 | 4.1 | 26 | -- |
| | F2-6 | 21 | 7.6 | 4.1 | 50 | 300 |
| | F3-1 | 9 | 7.6 | 10.6 | 46 | 520 |
| | F3-2 | 21 | 7.5 | 4.1 | 48 | 410 |
| | RI-2 | 21 | 8.2 | 1.3 | 44 | 220 |
| | RI-3 | 33 | 7.6 | 0.7 | 46 | 380 |
| | RII-2 | 21 | 8.2 | 0.4 | 20 | -- |
| | RII-3 | 33 | 7.6 | 2.9 | 48 | 480 |
| | RIII-2 | 21 | -- | 0.7 | -- | -- |
| | RIII-3 | 33 | 7.7 | 18.4 | -- | 490 |
| | RIV-2 | 21 | 7.8 | 1.4 | 46 | 420 |
| | RIV-3 | 33 | 7.5 | 1.6 | 46 | 440 |
| AUG 4 | F1-1 | 9 | -- | -- | -- | -- |
| | F1-2 | 21 | 7.9 | 5.6 | -- | -- |
| | F2-1 | 9 | 8.2 | 1.3 | -- | -- |
| | F2-2 | 21 | 7.8 | 0.3 | -- | -- |
| | F2-3 | 21 | 7.7 | 3.3 | -- | -- |
| | F2-4 | 9 | 8.0 | 5.1 | -- | -- |
| | F2-5 | 9 | 7.8 | 1.6 | -- | -- |
| | F2-6 | 21 | 7.7 | 3.1 | -- | -- |
| | F3-1 | 9 | 7.9 | 5.6 | -- | -- |
| | F3-2 | 21 | 7.8 | 4.6 | -- | -- |

TABLE A-18. (CONTD.)

| DATE | POINT SAMPLER |  | pH | NO$_3$ | Cl | COND. @ 25°C |
|---|---|---|---|---|---|---|
|  | LOCATION NO.[a] | DEPTH in. |  | mg/ℓ |  | µmhos/cm |
| AUG 4 (contd.) | RI-2 | 21 | 7.9 | 0.2 | -- | -- |
|  | RI-3 | 33 | 8.0 | 0.4 | -- | -- |
|  | RII-2 | 21 | 8.0 | 0.3 | -- | -- |
|  | RII-3 | 33 | 7.8 | 0.7 | -- | -- |
|  | RIII-2 | 21 | -- | -- | -- | -- |
|  | RIII-3 | 33 | -- | -- | -- | -- |
|  | RIV-2 | 21 | 8.1 | 0.4 | -- | -- |
|  | RIV-3 | 33 | 7.6 | 1.2 | -- | -- |
| AUG 10 | F1-1 | 9 | 7.7 | 2.6 | -- | 300 |
|  | F1-2 | 21 | 7.7 | 4.3 | -- | 350 |
|  | F2-1 | 9 | 7.8 | 0.8 | -- | 380 |
|  | F2-2 | 21 | 7.6 | 0.5 | -- | -- |
|  | F2-3 | 21 | 7.7 | 4.8 | -- | 350 |
|  | F2-4 | 9 | 7.8 | 7.8 | -- | 400 |
|  | F2-5 | 9 | 7.9 | 2.6 | -- | -- |
|  | F2-6 | 21 | 7.6 | 3.0 | -- | -- |
|  | F3-1 | 9 | 7.6 | 6.6 | -- | 450 |
|  | F3-2 | 21 | 7.6 | 8.4 | -- | 420 |
|  | RI-2 | 21 | 7.9 | 0.1 | -- | -- |
|  | RI-3 | 33 | 7.7 | 1.1 | -- | -- |
|  | RII-2 | 21 | 8.0 | 0.4 | -- | -- |
|  | RII-3 | 33 | 7.7 | 3.4 | -- | 460 |
|  | RIII-2 | 21 | -- | -- | -- | -- |
|  | RIII-3 | 33 | -- | -- | -- | -- |
|  | RIV-2 | 21 | 7.9 | 1.0 | -- | -- |
|  | RIV-3 | 33 | 7.7 | 2.7 | -- | 450 |
| AUG 11 | F1-1 | 9 | -- | -- | -- | -- |
|  | F1-2 | 21 | 7.9 | -- | -- | -- |
|  | F2-1 | 9 | 7.8 | -- | -- | -- |
|  | F2-2 | 21 | 7.7 | -- | -- | -- |
|  | F2-3 | 21 | 7.7 | -- | -- | -- |
|  | F2-4 | 9 | 7.8 | -- | -- | -- |
|  | F2-5 | 9 | -- | -- | -- | -- |
|  | F2-6 | 21 | 7.9 | -- | -- | -- |
|  | F3-1 | 9 | 7.6 | -- | -- | -- |
|  | F3-2 | 21 | 7.6 | -- | -- | -- |
|  | RI-2 | 21 | 8.0 | -- | -- | -- |
|  | RI-3 | 33 | 7.9 | -- | -- | -- |
|  | RII-2 | 21 | 8.1 | -- | -- | -- |
|  | RII-3 | 33 | 7.6 | -- | -- | -- |
|  | RIII-2 | 21 | -- | -- | -- | -- |
|  | RIII-3 | 33 | -- | -- | -- | -- |
|  | RIV-2 | 21 | 8.1 | -- | -- | -- |
|  | RIV-3 | 33 | 7.8 | -- | -- | -- |
| AUG 17 | F1-1 | 9 | 7.7 | 4.2 | 48 | 340 |
|  | F1-2 | 21 | 7.6 | 3.5 | 39 | 400 |
|  | F2-1 | 9 | 7.8 | 1.3 | 52 | 380 |
|  | F2-2 | 21 | 7.7 | 0.9 | 40 | 370 |
|  | F2-3 | 21 | 7.8 | 4.1 | 46 | 400 |
|  | F2-4 | 9 | 7.9 | 7.0 | 44 | 380 |
|  | F2-5 | 9 | 7.8 | 2.5 | 32 | 400 |
|  | F2-6 | 21 | 7.7 | 2.8 | 52 | 370 |
|  | F3-1 | 9 | 7.9 | 6.7 | 50 | 420 |
|  | F3-2 | 21 | 7.7 | 7.8 | 50 | 400 |
|  | RI-2 | 21 | 8.1 | 1.3 | 54 | 440 |
|  | RI-3 | 33 | 7.9 | 1.6 | 50 | 420 |
|  | RII-2 | 21 | 8.1 | 1.2 | 39 | 440 |
|  | RII-3 | 33 | 7.9 | 3.7 | 50 | 480 |
|  | RIII-2 | 21 | -- | 7.8 | 55 | -- |
|  | RIII-3 | 33 | 8.1 | 6.3 | 49 | 460 |
|  | RIV-2 | 21 | 8.0 | 3.5 | 58 | 500 |
|  | RIV-3 | 33 | 7.8 | 4.0 | 52 | 450 |
|  | F5-1 | 12 | 8.1 | 0.2 | 10 | 220 |
|  | F5-2 | 6 | 8.1 | 0.3 | 13 | 230 |
|  | F6-1 | 9 | 7.9 | 0.4 | 19 | 190 |
|  | F7-1 | 9 | 8.1 | 0.4 | 16 | 180 |
|  | F7-2 | 21 | 7.9 | 0.2 | 16 | 150 |
|  | RVI-1 | -- | 8.1 | 0.0 | 14 | 360 |
|  | RVII-1 | 9 | 8.0 | 0.2 | 20 | 360 |
| AUG 24 | F1-1 | 9 | -- | -- | -- | -- |
|  | F1-2 | 21 | 8.0 | 2.2 | 48 | 320 |
|  | F2-1 | 9 | 8.1 | 0.6 | 56 | 320 |
|  | F2-2 | 21 | 7.9 | 0.5 | 40 | -- |
|  | F2-3 | 21 | 7.7 | 4.3 | 44 | 480 |
|  | F2-4 | 9 | 7.8 | 6.6 | 42 | 500 |
|  | F2-5 | 9 | 8.0 | 1.4 | 28 | -- |
|  | F2-6 | 21 | 7.8 | 2.4 | 50 | 520 |
| AUG 24 (contd.) | F3-1 | 9 | 7.8 | 7.1 | 50 | -- |
|  | F3-2 | 21 | 8.0 | 5.4 | 46 | 460 |
|  | RI-2 | 21 | 7.9 | 2.2 | 52 | 500 |
|  | RI-3 | 33 | 7.9 | 2.5 | 48 | 450 |
|  | RII-2 | 21 | 8.1 | 0.7 | 40 | -- |
|  | RII-3 | 33 | 7.8 | 4.6 | 50 | 500 |
|  | RIII-2 | 21 | 7.9 | 7.3 | 50 | -- |
|  | RIII-3 | 33 | 8.1 | 7.0 | 58 | 530 |
|  | RIV-2 | 21 | 8.1 | 3.3 | 50 | 530 |
|  | RIV-3 | 33 | 8.1 | 4.2 | 50 | 500 |
| AUG 25 | F1-1 | 9 | -- | -- | -- | -- |
|  | F1-2 | 21 | 8.0 | 6.5 | -- | -- |
|  | F2-1 | 9 | 7.8 | 0.2 | -- | -- |
|  | F2-2 | 21 | 7.9 | 0.3 | -- | -- |
|  | F2-3 | 21 | 7.9 | 4.9 | -- | -- |
|  | F2-4 | 9 | 7.9 | 5.0 | -- | -- |
|  | F2-5 | 9 | 7.9 | 0.7 | -- | -- |
|  | F2-6 | 21 | 7.9 | 2.0 | -- | -- |
|  | F3-1 | 9 | 8.0 | 5.2 | -- | -- |
|  | F3-2 | 21 | 8.0 | 6.0 | -- | -- |
|  | RI-2 | 21 | 7.9 | 3.6 | -- | -- |
|  | RI-3 | 33 | 8.1 | 3.0 | -- | -- |
|  | RII-2 | 21 | 8.1 | 0.6 | -- | -- |
|  | RII-3 | 33 | 7.8 | 3.1 | -- | -- |
|  | RIII-2 | 21 | -- | 10.2 | -- | -- |
|  | RIII-3 | 33 | -- | -- | -- | -- |
|  | RIV-2 | 21 | 8.0 | 2.4 | -- | -- |
|  | RIV-3 | 33 | 7.6 | 4.6 | -- | -- |
| SEPT 8 | F1-1 | 9 | 7.9 | 4.2 | 38 | 390 |
|  | F1-2 | 21 | 8.0 | 3.8 | 40 | 400 |
|  | F2-1 | 9 | 7.9 | 0.8 | 42 | -- |
|  | F2-2 | 21 | 7.8 | 0.8 | 36 | -- |
|  | F2-3 | 21 | 7.8 | 6.7 | 34 | 450 |
|  | F2-4 | 9 | 7.8 | 5.7 | 30 | 500 |
|  | F2-5 | 9 | -- | 1.8 | -- | -- |
|  | F2-6 | 21 | 7.8 | 2.7 | 34 | 500 |
|  | F3-1 | 9 | 7.7 | 8.5 | 28 | 480 |
|  | F3-2 | 21 | 7.8 | 6.8 | 40 | 500 |
|  | RI-2 | 21 | 7.9 | 3.0 | 44 | 550 |
|  | RI-3 | 33 | 7.9 | 3.3 | 44 | 500 |
|  | RII-2 | 21 | 8.0 | 0.9 | 40 | 520 |
|  | RII-3 | 33 | 7.7 | 5.5 | 52 | 530 |
|  | RIII-2 | 21 | -- | 8.8 | -- | 490 |
|  | RIII-3 | 33 | 8.0 | 8.4 | 50 | 490 |
|  | RIV-2 | 21 | 7.8 | 5.0 | 62 | 550 |
|  | RIV-3 | 33 | 7.6 | 5.9 | 50 | 550 |
| SEPT 14 | F1-1 | 9 | 7.5 | 4.1 | 52 | 350 |
|  | F1-2 | 21 | 7.4 | 4.0 | 46 | 400 |
|  | F2-1 | 9 | 7.7 | 0.7 | 50 | 350 |
|  | F2-2 | 21 | 7.8 | 0.8 | 44 | 450 |
|  | F2-3 | 21 | 7.8 | 7.2 | 36 | 480 |
|  | F2-4 | 9 | 7.7 | 6.9 | 39 | 500 |
|  | F2-5 | 9 | 8.1 | 2.0 | 29 | -- |
|  | F2-6 | 21 | 7.5 | 3.5 | 42 | 480 |
|  | F3-1 | 9 | 7.8 | 7.4 | 42 | 520 |
|  | F3-2 | 21 | 7.8 | 5.7 | 42 | 500 |
|  | RI-2 | 21 | 7.7 | 2.8 | 46 | 520 |
|  | RI-3 | 33 | 7.8 | 3.6 | 44 | -- |
|  | RII-2 | 21 | 7.7 | 0.9 | 40 | -- |
|  | RII-3 | 33 | -- | 6.2 | 50 | 550 |
|  | RIII-2 | 21 | -- | 8.0 | -- | -- |
|  | RIII-3 | 33 | 7.5 | 7.7 | 50 | -- |
|  | RIV-2 | 21 | 7.7 | 4.6 | 50 | 480 |
|  | RIV-3 | 33 | 7.7 | 5.4 | 51 | 550 |
| SEPT 21 | F1-1 | 9 | 7.7 | 4.3 | 50 | -- |
|  | F1-2 | 21 | 7.6 | 7.0 | 47 | -- |
|  | F2-1 | 9 | 7.9 | 2.8 | 48 | -- |
|  | F2-2 | 21 | 7.9 | 2.9 | 44 | -- |
|  | F2-3 | 21 | 7.7 | 9.9 | 40 | -- |
|  | F2-4 | 9 | 7.8 | 9.0 | 40 | -- |
|  | F2-5 | 9 | -- | 2.4 | 39 | -- |
|  | F2-6 | 21 | 7.7 | 2.7 | 44 | -- |
|  | F3-1 | 9 | 7.9 | 5.6 | 43 | -- |
|  | F3-2 | 21 | 7.8 | 6.2 | 43 | -- |
|  | RI-2 | 21 | 7.9 | 4.4 | 50 | -- |
|  | RI-3 | 33 | 7.9 | 4.5 | 46 | -- |
|  | RII-2 | 21 | 8.0 | 0.7 | 41 | -- |

TABLE A-18. (CONTD.)

| DATE | POINT SAMPLER | | pH | $NO_3$ | Cl | COND. @ 25°C |
|---|---|---|---|---|---|---|
| | LOCATION NO.[a] | DEPTH (in.) | | mg/ℓ | | μmhos/cm |
| SEPT 21 (contd.) | RII-3 | 33 | 7.7 | 7.9 | 50 | -- |
| | RIII-2 | 21 | -- | -- | -- | -- |
| | RIII-3 | 33 | 7.8 | 9.5 | 51 | -- |
| | RIV-2 | 21 | 7.9 | 0.7 | 50 | -- |
| | RIV-3 | 33 | 7.7 | 2.6 | 50 | -- |
| | F5-1 | 12 | 7.8 | 0.1 | 12 | -- |
| | F5-2 | 6 | 7.8 | 0.1 | 12 | -- |
| | F6-1 | 9 | 7.7 | 0.1 | 13 | -- |
| | F7-1 | 9 | 7.7 | 0.0 | 13 | -- |
| | F7-2 | 21 | 7.7 | 0.0 | 13 | -- |
| | RVI-1 | -- | 8.1 | 0.0 | 12 | -- |
| | RVII-2 | -- | 8.1 | 0.0 | 9 | -- |
| SEPT 28 | F1-1 | 9 | -- | 2.5 | 45 | -- |
| | F1-2 | 21 | -- | 6.6 | 45 | -- |
| | F2-1 | 9 | -- | 3.2 | 47 | -- |
| | F2-2 | 21 | -- | 2.7 | 41 | -- |
| | F2-3 | 21 | -- | 8.4 | 40 | -- |
| | F2-4 | 9 | -- | 7.4 | 40 | -- |
| | F2-5 | 9 | -- | 1.9 | 37 | -- |
| | F2-6 | 21 | -- | 1.7 | 49 | -- |
| | F3-1 | 9 | -- | 4.3 | 43 | -- |
| | F3-2 | 21 | -- | 3.7 | 45 | -- |
| | RI-2 | 21 | -- | 5.2 | 51 | -- |
| | RI-3 | 33 | -- | 4.4 | 47 | -- |
| | RII-2 | 21 | -- | 1.1 | 40 | -- |
| | RII-3 | 33 | -- | 4.9 | 52 | -- |
| | RIII-3 | 33 | -- | 4.6 | 48 | -- |
| | RIV-2 | 21 | -- | 0.7 | 59 | -- |
| | RIV-3 | 33 | -- | 2.2 | 59 | -- |
| OCT 5 | F1-1 | 9 | 7.7 | 4.1 | 46 | -- |
| | F1-2 | 21 | 7.7 | 9.8 | 46 | -- |
| | F2-1 | 9 | 7.8 | 3.6 | 48 | -- |
| | F2-2 | 21 | 7.9 | 3.0 | 42 | -- |
| | F2-3 | 21 | 7.9 | 10.0 | 42 | -- |
| | F2-4 | 9 | 7.8 | 8.9 | 40 | -- |
| | F2-5 | 9 | 7.9 | 2.1 | 34 | -- |
| | F2-6 | 21 | 7.7 | 1.7 | 46 | -- |
| | F3-1 | 9 | 7.8 | 3.6 | 44 | -- |
| | F3-2 | 21 | 7.7 | 5.0 | 46 | -- |
| | RI-2 | 21 | 8.1 | 4.7 | 56 | -- |
| | RI-3 | 33 | 8.1 | 5.9 | 48 | -- |
| | RII-2 | 21 | 8.2 | 0.6 | 42 | -- |
| | RII-3 | 33 | 7.8 | 5.2 | 52 | -- |
| | RIII-3 | 33 | 7.8 | 9.2 | 41 | -- |
| | RIV-2 | 21 | 8.1 | 0.5 | 60 | -- |
| | RIV-3 | 33 | 7.9 | 2.3 | 60 | -- |
| OCT 12 | F1-1 | 9 | 7.7 | 3.6 | 46 | -- |
| | F1-2 | 21 | 7.6 | 6.2 | 48 | -- |
| | F2-1 | 9 | 7.8 | 4.8 | 48 | -- |
| | F2-2 | 21 | 8.0 | 3.8 | 46 | -- |
| | F2-3 | 21 | 7.7 | 9.0 | 42 | -- |
| | F2-4 | 9 | 7.9 | 6.6 | 46 | -- |
| | F2-5 | 9 | 8.1 | 8.5 | -- | -- |
| | F2-6 | 21 | 7.7 | 8.6 | 44 | -- |
| | F3-1 | 9 | 7.9 | 4.0 | 44 | -- |
| | F3-2 | 21 | 7.8 | 6.0 | 44 | -- |
| | RI-2 | 21 | 8.0 | 3.0 | 54 | -- |
| | RI-3 | 33 | 8.0 | 2.9 | 52 | -- |
| | RII-2 | 21 | 8.1 | 1.0 | 46 | -- |
| | RII-3 | 33 | 7.7 | 11.0 | 54 | -- |
| | RIII-2 | 21 | -- | 1.5 | -- | -- |
| | RIII-3 | 33 | 7.9 | 9.7 | 52 | -- |
| | RIV-2 | 21 | 7.9 | 1.3 | 56 | -- |
| | RIV-3 | 33 | 7.7 | 1.1 | 60 | -- |
| | F5-1 | 12 | 7.9 | 0.05 | 10 | -- |
| | F5-2 | 6 | 7.7 | 0.2 | 14 | -- |
| | F6-1 | 9 | 7.8 | 0.05 | 14 | -- |
| | F7-1 | 9 | 7.6 | 0.02 | 14 | -- |
| | F7-2 | 21 | 7.6 | 0.03 | 14 | -- |
| | RVI-2 | 21 | 8.0 | 0.03 | 12 | -- |
| | RVII-2 | 9 | 8.1 | 0.04 | 8 | -- |
| OCT 19 | F1-1 | 9 | 7.4 | 3.0 | 50 | -- |
| | F1-2 | 21 | 7.3 | 8.0 | 50 | -- |
| | F2-1 | 9 | 7.5 | 8.5 | 51 | -- |
| | F2-2 | 21 | 7.6 | 6.3 | 49 | -- |
| | F2-3 | 21 | 7.6 | 6.5 | 46 | -- |
| | F2-4 | 9 | 7.6 | 10.2 | 47 | -- |
| OCT 19 (contd.) | F2-5 | 9 | 7.9 | 1.8 | 39 | -- |
| | F2-6 | 21 | 7.5 | 4.1 | 46 | -- |
| | F3-1 | 9 | -- | -- | -- | -- |
| | F3-2 | 21 | -- | -- | -- | -- |
| | RI-2 | 21 | 7.7 | 10.3 | 55 | -- |
| | RI-3 | 33 | 7.8 | 10.1 | 54 | -- |
| | RII-2 | 21 | 7.8 | 1.9 | 51 | -- |
| | RII-3 | 33 | 7.7 | 7.0 | 55 | -- |
| | RIII-2 | 21 | 7.7 | 5.4 | -- | -- |
| | RIII-3 | 33 | 7.7 | 10.2 | 54 | -- |
| | RIV-2 | 21 | 7.7 | 0.63 | 59 | -- |
| | RIV-3 | 33 | 7.7 | 1.60 | 60 | -- |
| OCT 26 | F1-1 | 9 | 7.5 | 3.0 | 48 | -- |
| | F1-2 | 21 | 7.4 | 6.6 | 52 | -- |
| | F2-1 | 9 | 7.6 | 6.6 | 54 | -- |
| | F2-2 | 21 | 7.8 | 4.2 | 51 | -- |
| | F2-3 | 21 | 7.6 | 9.8 | 49 | -- |
| | F2-4 | 9 | 7.7 | 12.4 | 49 | -- |
| | F2-5 | 9 | 8.0 | 1.5 | 40 | -- |
| | F2-6 | 21 | 7.7 | 2.7 | 48 | -- |
| | F3-1 | 9 | 7.8 | 4.0 | 51 | -- |
| | F3-2 | 21 | 7.6 | 6.1 | 50 | -- |
| | RI-2 | 21 | 7.8 | 11.9 | 58 | -- |
| | RI-3 | 33 | 8.0 | 10.0 | 52 | -- |
| | RII-2 | 21 | 8.0 | 2.8 | 54 | -- |
| | RII-3 | 33 | 7.6 | 8.0 | 55 | -- |
| | RIII-2 | 21 | 7.8 | 4.0 | -- | -- |
| | RIII-3 | 33 | 7.8 | 11.7 | 54 | -- |
| | RIV-2 | 21 | 7.8 | 0.8 | 68 | -- |
| | RIV-3 | 33 | 7.7 | 1.0 | 60 | -- |
| NOV 2 | F1-1 | 9 | 7.5 | 7.0 | 45 | -- |
| | F1-2 | 21 | 7.4 | 27.2 | 45 | -- |
| | F2-1 | 9 | 7.6 | 8.2 | 40 | -- |
| | F2-2 | 21 | -- | -- | -- | -- |
| | F2-3 | 21 | 7.6 | 16.4 | 50 | -- |
| | F2-4 | 9 | 7.6 | 10.9 | 48 | -- |
| | F2-5 | 9 | 7.9 | 5.7 | 42 | -- |
| | F2-6 | 21 | 7.4 | 3.1 | 36 | -- |
| | F3-1 | 9 | 7.6 | 4.6 | 40 | -- |
| | F3-2 | 21 | 7.5 | 12.4 | 45 | -- |
| | RI-2 | 21 | 7.9 | 16.2 | 44 | -- |
| | RI-3 | 33 | 7.9 | 16.3 | 52 | -- |
| | RII-2 | 21 | 8.0 | 6.0 | 52 | -- |
| | RII-3 | 33 | 7.7 | 10.6 | 56 | -- |
| | RIII-2 | 21 | -- | -- | -- | -- |
| | RIII-3 | 33 | 7.6 | 12.8 | 52 | -- |
| | RIV-2 | 21 | 7.6 | 0.8 | 49 | -- |
| | RIV-3 | 33 | 7.7 | 2.1 | 58 | -- |
| NOV 9 | F5-1 | 12 | -- | 0.05 | 12 | -- |
| | F5-2 | 6 | 7.1 | 0.5 | 17 | -- |
| | F6-1 | 9 | 7.4 | 0.03 | 18 | -- |
| | F7-1 | 9 | 7.7 | 0.05 | 16 | -- |
| | F7-2 | 21 | 7.9 | 0.1 | 13 | -- |
| | RVI-2 | 21 | 7.6 | 0.05 | 16 | -- |
| | RVII-1 | 9 | 7.7 | 0.05 | 31 | -- |
| NOV 16 | F1-1 | 9 | 7.7 | 3.9 | 44 | -- |
| | F1-2 | 21 | 7.7 | 10.9 | 46 | -- |
| | F2-1 | 9 | 8.0 | 4.7 | 42 | -- |
| | F2-2 | 21 | 8.0 | 9.6 | 44 | -- |
| | F2-3 | 21 | 7.8 | 13.1 | 46 | -- |
| | F2-4 | 9 | 7.9 | 6.0 | 48 | -- |
| | F2-5 | 9 | 8.0 | 1.6 | 29 | -- |
| | F2-6 | 21 | 7.9 | 1.6 | 30 | -- |
| | F3-1 | 9 | 7.9 | 4.9 | 44 | -- |
| | F3-2 | 21 | 8.0 | 6.4 | 44 | -- |
| | RI-2 | 21 | 8.0 | 17.1 | 48 | -- |
| | RI-3 | 33 | 8.1 | 12.9 | 46 | -- |
| | RII-2 | 21 | 8.2 | 8.2 | 46 | -- |
| | RII-3 | 33 | 8.0 | 8.3 | 54 | -- |
| | RIII-2 | 21 | 8.1 | 14.7 | -- | -- |
| | RIII-3 | 33 | 8.0 | 1.5 | 49 | -- |
| | RIV-2 | 21 | 8.0 | 5.7 | 56 | -- |
| | RIV-3 | 33 | 8.0 | 1.6 | 56 | -- |
| NOV 30 | F1-1 | 9 | -- | 8.0 | -- | -- |
| | F1-2 | 21 | -- | 16.6 | -- | -- |
| | F2-1 | 9 | -- | 14.7 | -- | -- |

TABLE A-18. (CONTD.)

| DATE | POINT SAMPLER LOCATION NO.[a] | POINT SAMPLER DEPTH in. | pH | $NO_3$ mg/ℓ | Cl mg/ℓ | COND. @ 25°C µmhos/cm |
|---|---|---|---|---|---|---|
| NOV 30 (contd.) | F2-2 | 21 | -- | 14.2 | -- | -- |
| | F2-3 | 21 | -- | 22.8 | -- | -- |
| | F2-4 | 9 | -- | 9.75 | -- | -- |
| | F2-5 | 9 | -- | 6.0 | -- | -- |
| | F2-6 | 21 | -- | 13.1 | -- | -- |
| | F3-1 | 9 | -- | 22.0 | -- | -- |
| | F3-2 | 21 | -- | 14.9 | -- | -- |
| | RI-2 | 21 | -- | 21.4 | -- | -- |
| | RI-3 | 33 | -- | 20.4 | -- | -- |
| | RII-2 | 21 | -- | 10.6 | -- | -- |
| | RII-3 | 33 | -- | 17.1 | -- | -- |
| | RIII-2 | 21 | -- | 14.6 | -- | -- |
| | RIII-3 | 33 | -- | 10.0 | -- | -- |
| | RIV-2 | 21 | -- | 0.37 | -- | -- |
| | RIV-3 | 33 | -- | 2.72 | -- | -- |
| DEC 7 | F5-1 | 12 | 8.1 | 0.02 | 13 | -- |
| | F5-2 | 6 | 7.9 | 0.03 | 16 | -- |
| | F7-1 | 9 | 8.0 | 0.07 | 17 | -- |
| | F7-2 | 21 | 7.8 | 0.02 | 14 | -- |
| | RVI-1 | 21 | 7.9 | 0.03 | 16 | -- |
| | RVII-1 | 9 | 7.9 | 0.04 | -- | -- |
| DEC 27 | F1-1 | 9 | -- | 4.2 | -- | -- |
| | F1-2 | 21 | -- | 21.0 | -- | -- |
| | F2-1 | 9 | 8.1 | 2.8 | -- | -- |
| | F2-2 | 21 | 8.1 | 17.5 | -- | -- |
| | F2-3 | 21 | 8.1 | 14.0 | -- | -- |
| | F2-4 | 9 | 8.2 | 7.2 | -- | -- |
| | F2-5 | 9 | 8.2 | 1.3 | -- | -- |
| | F2-6 | 21 | 8.1 | 3.3 | -- | -- |
| | F3-1 | 9 | 8.2 | 3.8 | -- | -- |
| | F3-2 | 21 | 8.2 | 8.7 | -- | -- |
| | RI-2 | 21 | 8.2 | 5.1 | -- | -- |
| | RI-3 | 33 | 8.2 | 16.8 | -- | -- |
| | RII-2 | 21 | -- | -- | -- | -- |
| | RII-3 | 33 | -- | 0.8 | -- | -- |
| | RIII-2 | 21 | -- | 21.0 | -- | -- |
| | RIII-3 | 33 | 8.2 | 12.7 | -- | -- |
| | RIV-2 | 21 | 8.2 | 0.8 | -- | -- |
| | RIV-3 | 33 | 8.2 | 6.0 | -- | -- |
| (1973) JAN 26 | F1-1 | 9 | 7.4 | 14.1 | -- | -- |
| | F1-2 | 21 | 7.6 | 16.1 | -- | -- |
| | F2-1 | 9 | 7.6 | 16.7 | -- | -- |
| | F2-2 | 21 | 7.9 | 18.6 | -- | -- |
| | F2-3 | 21 | 7.4 | 13.7 | -- | -- |
| | F2-4 | 9 | 7.7 | 13.9 | -- | -- |
| | F2-5 | 9 | 7.8 | 14.1 | -- | -- |
| | F2-6 | 21 | 7.5 | 12.4 | -- | -- |
| | F3-1 | 9 | 7.7 | 17.9 | -- | -- |
| | F3-2 | 21 | 7.7 | 19.4 | -- | -- |
| | RI-2 | 21 | 8.1 | 9.5 | -- | -- |
| | RI-3 | 33 | 8.2 | 20.1 | -- | -- |
| | RII-2 | 21 | 8.2 | 2.6 | -- | -- |
| | RII-3 | 33 | 8.2 | 7.8 | -- | -- |
| | RIII-2 | 21 | 7.5 | 42.5 | -- | -- |
| | RIII-3 | 33 | 7.9 | 11.2 | -- | -- |
| | RIV-2 | 21 | 7.7 | 8.9 | -- | -- |
| | RIV-3 | 33 | 8.1 | 2.8 | -- | -- |
| FEB 15 | F1-1 | 9 | 7.6 | 6.5 | -- | -- |
| | F1-2 | 21 | 7.5 | 6.5 | -- | -- |
| | F2-1 | 9 | 7.8 | 13.2 | -- | -- |
| | F2-2 | 21 | 8.1 | 9.4 | -- | -- |
| | F2-3 | 21 | 7.7 | 10.3 | -- | -- |
| | F2-4 | 9 | 7.7 | 9.3 | -- | -- |
| FEB 15 (contd.) | F2-5 | 9 | 7.9 | 12.4 | -- | -- |
| | F2-6 | 21 | 7.7 | 10.7 | -- | -- |
| | F3-1 | 9 | 7.8 | 11.3 | -- | -- |
| | F3-2 | 21 | 7.8 | 12.4 | -- | -- |
| | RI-2 | 21 | 8.1 | 9.2 | -- | -- |
| | RI-3 | 33 | 8.0 | 9.9 | -- | -- |
| | RII-2 | 21 | 7.9 | 24.8 | -- | -- |
| | RII-3 | 33 | 7.7 | -- | -- | -- |
| | RIII-2 | 21 | -- | 4.2 | -- | -- |
| | RIII-3 | 33 | 7.8 | 7.5 | -- | -- |
| | RIV-2 | 21 | 8.1 | 0.1 | -- | -- |
| | RIV-3 | 33 | 8.0 | 0.1 | -- | -- |
| MAR 1 | F1-1 | 9 | 7.4 | 8.1 | -- | -- |
| | F1-2 | 21 | 7.4 | 9.0 | -- | -- |
| | F2-1 | 9 | 7.5 | 15.6 | -- | -- |
| | F2-2 | 21 | 7.6 | 11.6 | -- | -- |
| | F2-3 | 21 | 7.4 | 14.6 | -- | -- |
| | F2-4 | 9 | 7.4 | 14.4 | -- | -- |
| | F2-5 | 9 | 7.6 | 14.9 | -- | -- |
| | F2-6 | 21 | 7.4 | 15.8 | -- | -- |
| | F3-1 | 9 | 7.5 | 17.0 | -- | -- |
| | F3-2 | 21 | 7.4 | 18.1 | -- | -- |
| | RI-2 | 21 | 7.8 | 9.9 | -- | -- |
| | RI-3 | 33 | 7.9 | 8.4 | -- | -- |
| | RII-2 | 21 | 7.9 | 2.2 | -- | -- |
| | RII-3 | 33 | 7.9 | 7.6 | -- | -- |
| | RIII-2 | 21 | -- | -- | -- | -- |
| | RIII-3 | 33 | 7.9 | 8.2 | -- | -- |
| | RIV-2 | 21 | 7.9 | 1.2 | -- | -- |
| | RIV-3 | 33 | 8.0 | 2.6 | -- | -- |
| APR 5 | F1-1 | 9 | 7.3 | 5.2 | 58 | -- |
| | F1-2 | 21 | 6.8 | 4.8 | 58 | -- |
| | F2-1 | 9 | 7.6 | 9.6 | 74 | -- |
| | F2-2 | 21 | 6.6 | 5.0 | 90 | -- |
| | F2-3 | 21 | 7.6 | 11.1 | 70 | -- |
| | F2-4 | 9 | 7.3 | 15.3 | 68 | -- |
| | F2-5 | 9 | 7.8 | 9.3 | 44 | -- |
| | F2-6 | 21 | 7.6 | 7.9 | 60 | -- |
| | F3-1 | 9 | 7.3 | 9.8 | 60 | -- |
| | F3-2 | 21 | 7.6 | 16.6 | 60 | -- |
| | RII-3 | 33 | 7.6 | 6.6 | -- | -- |
| | RIV-2 | 21 | 7.8 | 0.1 | -- | -- |
| APR 26 | F1-1 | 9 | 7.5 | 4.2 | -- | -- |
| | F1-2 | 21 | 7.6 | 3.4 | -- | -- |
| | F2-1 | 9 | 7.6 | 7.6 | -- | -- |
| | F2-2 | 21 | 8.0 | 2.7 | -- | -- |
| | F2-3 | 21 | 7.7 | 7.3 | -- | -- |
| | F2-4 | 9 | 7.6 | 6.3 | -- | -- |
| | F2-5 | 9 | 7.8 | 2.9 | -- | -- |
| | F2-6 | 21 | 7.9 | 6.2 | -- | -- |
| | F3-1 | 9 | 8.0 | 9.8 | -- | -- |
| | F3-2 | 21 | 7.9 | 14.3 | -- | -- |
| | RII-3 | 33 | 8.1 | 6.0 | -- | -- |
| | RIV-3 | 33 | 7.9 | 0.6 | -- | -- |
| MAY 10 | F1-1 | 9 | 6.8 | 4.1 | -- | -- |
| | F1-2 | 21 | 7.0 | 4.5 | -- | -- |
| | F2-1 | 9 | 7.3 | 10.4 | -- | -- |
| | F2-2 | 21 | 7.3 | 2.4 | -- | -- |
| | F2-3 | 21 | 7.2 | 10.0 | -- | -- |
| | F2-4 | 9 | 7.3 | 11.1 | -- | -- |
| | F2-5 | 9 | 7.3 | 4.1 | -- | -- |
| | F2-6 | 21 | 7.3 | 6.2 | -- | -- |
| | F3-1 | 9 | 7.2 | 8.9 | -- | -- |
| | F3-2 | 21 | 7.4 | 8.9 | -- | -- |

| DATE | POINT SAMPLER LOCATION NO.[a] | POINT SAMPLER DEPTH in. | pH | $NO_3$ as N[c] mg/ℓ | Cl mg/ℓ | COND. @ 25°C µmhos/cm | TOC mg/ℓ | Na mg/ℓ | K mg/ℓ | $SiO_2$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 8 | F1-1 | 9 | 6.9 | 4.7 | 48 | -- | -- | 53.5 | 5.6 | -- |
| | F1-2 | 21 | 7.1 | 6.3 | 48 | -- | -- | 64.5 | 1.1 | |
| | F2-1 | 9 | 7.4 | 2.8 | 70 | -- | -- | 60.0 | 0.66 | -- |
| | F2-2 | 21 | 7.3 | 2.2 | -- | -- | -- | 72.0 | 0.27 | -- |
| | F2-3 | 21 | 7.3 | 8.5 | 55.2 | -- | -- | 70.0 | 0.27 | -- |
| | F2-4 | 9 | 7.4 | 7.3 | 45.6 | -- | -- | 60.0 | 1.30 | -- |
| | F2-5 | 9 | 7.4 | 2.4 | 55.2 | -- | -- | 63.0 | 0.27 | -- |
| | F2-6 | 21 | 7.2 | 2.9 | 53.0 | -- | -- | 64.5 | 0.40 | -- |
| | F3-1 | 9 | 7.6 | 4.6 | 53.0 | -- | -- | 57.5 | -- | -- |
| | F3-2 | 21 | 7.5 | 5.8 | 55.2 | -- | -- | 64.0 | -- | -- |

NOTE: In. x 2.54 = cm.

[a] REFER TO TABLE A-16, APPENDIX A FOR POINT SAMPLER LOCATION.

[b] SECONDARY TREATED EFFLUENT REPLACED WAIAHOLE DITCH WATER AS THE IRRIGATION SOURCE FOR FURROWS 1, 2, AND 3.

[c] INCLUDES NITRITE CONCENTRATION VALUE.

## TABLE A-19. COMPOSITE LEACHATE FROM CERAMIC POINT SAMPLERS LOCATED IN THE TEST PLOT OF OSC FIELD NO. 240--IRRIGATED WITH SECONDARY SEWAGE EFFLUENT.

| DATE | POINT SAMPLER | | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | TOC | NITROGEN as N | | | TOTAL P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | ALK. as $CaCO_3$ | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEPTH in. | LOCATION | | | | | | KJELDAHL | $NO_2$+ $NO_3$ | TOTAL | | | | | | | | | | | | |
| | | | | | | | | | | | | | mg/ℓ | | | | | | | | | |
| (1972) | | | | | | | | | | | | | | | | | | | | | | |
| JUNE 29 | 9 | F[a] | 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[b] | 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 A-19. (CONTD.)

| DATE | POINT SAMPLER | | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | TOC | NITROGEN as N | | | TOTAL P | Ca | Mg* | Na | K | Cl | $SO_4$ | $SiO_2$ | B | GREASE | ALK. as $CaCO_3$ | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEPTH in. | LOCATION | | | | | | KJELDAHL | $NO_2$+ $NO_3$ | TOTAL | | | mg/ℓ | | | | | | | | | |
| 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 A-19. (CONTD.)

| DATE | POINT SAMPLER DEPTH in. | POINT SAMPLER LOCATION | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | 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 | ALK. as $CaCO_3$ | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | mg/ℓ | | | | | | | | | | | | | | | | |
| 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 A-19. (CONTD.)

| DATE | POINT SAMPLER DEPTH in. | POINT SAMPLER LOCATION | pH | TDS mg/ℓ | COND. @ 25°C µmhos/cm | TOTAL HARDNESS | 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 | ALK. as $CaCO_3$ | TOTAL COLIFORMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 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 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 59 | 2.2 | 70 | -- | -- | -- | -- | -- | -- |
| | 21 | F | 7.4 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 67 | 0.8 | 68 | -- | -- | -- | -- | -- | -- |

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.

[a] LOCATED IN THE FURROW OF THE SUGARCANE FIELD.

[b] LOCATED IN THE RIDGE OF THE SUGARCANE FIELD.

## TABLE A-20. SOIL ANALYSIS OF OSC SUGARCANE FIELD NO. 246 (SAMPLED JANUARY 26, 1973).

| TEST PLOT | LAB. NO. | FIELD NO. | SAMPLE NO. | DEPTH in. | DENSITY FACTOR | GSG | pH | P* | K | Ca | NITROGEN AVAIL. | NITROGEN MINER.[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | lbs/ac-ft | lbs/ac-ft | lbs/ac-ft | | |
| 9A | 122 | 246 | 1 | 0-12 | 2.9 | N | 5.9 | 135 | 290 | 4300 | 25 | 50 |
| 21B | 123 | " | 2 | 0-12 | 2.9 | N | 5.8 | 160 | 330 | 4250 | 25 | 60 |
| 29C | 124 | " | 3 | 0-12 | 2.9 | N | 6.9 | 175 | 205 | 6100 | 25 | 60 |
| 14A | 125 | " | 4 | 0-12 | 2.9 | N | 5.7 | 185 | 315 | 3950 | 20 | 55 |
| 25C | 126 | " | 5 | 0-12 | 2.9 | N | 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, EXCEPT FOR NITROGEN AND DENSITY FACTOR VALUES CONDUCTED BY THE AGRONOMY DEPARTMENT, UNIVERSITY OF HAWAII, HONOLULU.

* $NaHCO_3$-P.

[a] MINERALIZABLE.

## TABLE A-21. LEACHATE FROM CERAMIC POINT SAMPLERS LOCATED IN A TEST PLOT OF OSC SUGARCANE FIELD NO. 246.

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | Na | K | TOTAL HARDNESS ($CaCO_3$) | Ca | Mg | $SIO_2$ | ORTHO-P | TOTAL-P | TC | TOC | TDS | CON-DUC-TIVITY | $Cl_2$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | mg/ℓ | | | | | | | | |
| 02/15 | F45 | 7.8 | -- | 1.89 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 38 |
| " | F46 | 7.9 | -- | 2.83 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 40 |
| " | F47 | 7.7 | -- | 4.62 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 40 |
| " | F48 | 8.0 | -- | 3.78 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| " | F49 | 2.9 | -- | 3.63 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 40 |
| " | F50 | 2.5 | -- | 2.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 30 |
| " | F51 | 2.3 | -- | 1.77 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 20 |
| " | F52 | 6.9 | -- | 4.46 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 40 |
| " | F53 | 3.5 | -- | 3.75 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 35 |
| " | F54 | 4.3 | -- | 3.45 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 45 |
| 02/27 & 02/28 | F45 | 7.2 | -- | 20.80 | -- | -- | -- | -- | -- | -- | 0.080 | -- | -- | -- | -- | -- | -- |
| " | F46 | 7.2 | -- | 2.91 | -- | -- | -- | -- | -- | -- | 0.080 | -- | -- | -- | -- | -- | -- |
| " | F47 | 6.7 | -- | 16.20 | -- | -- | -- | -- | -- | -- | 5.240 | -- | -- | -- | -- | -- | -- |
| " | F48 | 6.8 | -- | 22.00 | -- | -- | -- | -- | -- | -- | 0.210 | -- | -- | -- | -- | -- | -- |
| " | F49 | 4.5 | -- | 1.47 | -- | -- | -- | -- | -- | -- | 0.050 | -- | -- | -- | -- | -- | -- |
| " | F50 | 4.0 | -- | 4.07 | -- | -- | -- | -- | -- | -- | 0.050 | -- | -- | -- | -- | -- | -- |
| " | F51 | 3.9 | -- | 3.10 | -- | -- | -- | -- | -- | -- | 0.060 | -- | -- | -- | -- | -- | -- |
| " | F52 | 6.8 | -- | 16.80 | -- | -- | -- | -- | -- | -- | 0.160 | -- | -- | -- | -- | -- | -- |
| " | F53 | 4.3 | -- | 6.12 | -- | -- | -- | -- | -- | -- | 0.110 | -- | -- | -- | -- | -- | -- |
| " | F54 | 6.2 | -- | 23.60 | -- | -- | -- | -- | -- | -- | 0.100 | -- | -- | -- | -- | -- | -- |
| 03/14 | F45 | 6.7 | 0.25 | 10.60 | -- | -- | -- | -- | -- | 21 | 0.049 | 0.179 | -- | -- | -- | -- | -- |
| " | F46 | 6.8 | 0.65 | 7.68 | -- | -- | 385 | 128 | 15.9 | 18 | 0.154 | 0.270 | -- | -- | -- | -- | -- |
| " | F47 | 3.8 | 0.75 | 9.80 | -- | -- | 337 | 96 | 23.7 | 80 | 0.122 | 0.244 | -- | -- | -- | -- | -- |
| " | F48 | 6.5 | 0.01 | 19.90 | -- | -- | 216 | 70 | 10.0 | 4 | 0.068 | 0.228 | -- | -- | -- | -- | -- |
| " | F49 | 3.6 | 1.50 | 20.60 | -- | -- | 192 | 56 | 12.7 | 45 | 0.059 | 0.195 | -- | -- | -- | -- | -- |
| " | F50 | 4.2 | 1.61 | 13.05 | -- | -- | 110 | 38 | 3.7 | 21 | 0.041 | 0.162 | -- | -- | -- | -- | -- |
| " | F51 | 4.0 | 1.46 | 3.56 | -- | -- | 164 | 64 | 1.0 | 3 | 13.400 | 13.900 | -- | -- | -- | -- | -- |
| " | F52 | 4.1 | 1.61 | 31.20 | -- | -- | 253 | 95 | 3.9 | 25 | 0.070 | 0.244 | -- | -- | -- | -- | -- |
| " | F53 | 4.8 | 1.30 | 11.00 | -- | -- | 173 | 64 | 3.2 | 25 | 0.032 | 0.162 | -- | -- | -- | -- | -- |
| " | F54 | 2.4 | 0.76 | 20.60 | -- | -- | -- | -- | -- | 23 | 0.390 | 0.550 | -- | -- | -- | -- | -- |

TABLE A-21. (CONTD.)

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | Na | K | TOTAL HARDNESS $CaCO_3$ | Ca | Mg | $SiO_2$ | ORTHO-P | TOTAL-P | TC | TOC | TDS | CON-DUC-TIVITY | $Cl_2$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | mg/ℓ | | | | | | | | |
| 04/04 | F45 | 6.4 | 0.12 | 30.05 | 30 | 2.6 | 398 | 128 | 19.0 | 14 | 0.050 | 0.090 | 7 | 1 | -- | 600 | -- |
| " | F46 | 6.6 | 0.18 | 47.59 | 26 | 2.0 | 398 | 130 | 17.8 | 14 | 10.010 | 10.010 | 8 | 1 | -- | 580 | -- |
| " | F47 | 6.5 | 0.72 | 27.50 | 26 | 1.6 | 288 | 86 | 17.7 | 31 | 0.530 | 0.780 | 8 | 1 | -- | 500 | -- |
| " | F48 | 6.7 | 0.05 | 32.60 | 23 | 1.6 | 201 | 66 | 8.8 | -- | 0.060 | 0.070 | 7 | 1 | -- | 450 | -- |
| " | F49 | 6.0 | 0.80 | 20.37 | 20 | 0.8 | 168 | 56 | 6.8 | 13 | 0.121 | 0.130 | 4 | 1 | -- | 420 | -- |
| " | F50 | 3.4 | 0.75 | 37.51 | 32 | 1.4 | 240 | 92 | 2.4 | 13 | 0.050 | 0.090 | 4 | 1 | -- | 500 | -- |
| " | F51 | 4.1 | 0.52 | 28.52 | 29 | 1.6 | 273 | 110 | 0.1 | 11 | 0.045 | 0.300 | 2 | 1 | -- | 560 | -- |
| " | F52 | 6.7 | 1.10 | 33.62 | 32 | 1.8 | 297 | 118 | 0.2 | 30 | 0.640 | 1.040 | 6 | 1 | -- | 660 | -- |
| " | F53 | 3.7 | 1.05 | 33.11 | 30 | 1.4 | 426 | 158 | 10.0 | 20 | 0.140 | 0.280 | 6 | 1 | -- | 960 | -- |
| " | F54 | 2.6 | 0.20 | 33.59 | 20 | 0.6 | -- | -- | -- | 20 | -- | -- | 9 | 1 | -- | -- | -- |
| 04/16 | 21B-1 | 6.8 | 0.54 | 12.60 | 28 | 2.8 | 77 | 31 | 0 | -- | 0.241 | 0.391 | -- | -- | -- | -- | -- |
| " | 21B-2 | 7.0 | 0.48 | 14.30 | 26 | 2.3 | 75 | 30 | 0 | -- | 0.075 | 0.238 | -- | -- | -- | -- | -- |
| " | 21B-3 | 7.0 | 1.60 | 18.50 | 24 | 2.1 | 90 | 36 | 0 | -- | 0.091 | 0.245 | -- | -- | -- | -- | -- |
| " | 21B-4 | 7.0 | 1.08 | 8.90 | 26 | 3.0 | 67 | 26 | 0.5 | -- | 0.629 | 0.978 | -- | -- | -- | -- | -- |
| " | 21B-6 | 7.1 | 1.05 | 25.20 | 30 | 3.8 | 163 | 58 | 5.6 | -- | 0.368 | 0.717 | -- | -- | -- | -- | -- |
| " | 21B-7 | 7.1 | 0.45 | 15.10 | 26 | 2.6 | 95 | 38 | 0 | -- | 0.326 | 0.686 | -- | -- | -- | -- | -- |
| " | 21B-8 | 7.2 | 1.52 | 18.50 | 27 | 4.3 | 101 | 40 | 0.2 | -- | 0.130 | -- | -- | -- | -- | -- | -- |
| " | 21B-9 | 7.2 | 2.88 | 30.40 | 40 | 5.1 | 274 | 82 | 16.8 | -- | 0.099 | 0.270 | -- | -- | -- | -- | -- |
| " | 21B-10 | 6.9 | 0.75 | 25.20 | 42 | 6.0 | 375 | 102 | 31.6 | -- | 0.284 | 0.443 | -- | -- | -- | -- | -- |
| 04/18 | 20C-1 | 7.2 | 0.355 | 14.20 | 22 | 2.1 | 144 | 46 | 7.1 | -- | 0.130 | 0.293 | -- | -- | -- | -- | -- |
| " | 20C-2 | 6.8 | 0.625 | 25.90 | 27 | 2.6 | 115 | 36 | 6.1 | -- | 0.075 | 0.245 | -- | -- | -- | -- | -- |
| " | 20C-3 | 2.9 | 0.010 | 11.65 | 37 | 2.3 | 96 | 36 | 1.5 | -- | 0.081 | 0.212 | -- | -- | -- | -- | -- |
| " | 20C-4 | 5.8 | 0.712 | 22.20 | 29 | 2.1 | 284 | 96 | 11.7 | -- | 0.058 | 0.212 | -- | -- | -- | -- | -- |
| " | 20C-5 | 5.9 | 0.530 | 44.00 | 36 | 4.9 | 211 | 70 | 8.8 | -- | 0.085 | 0.349 | -- | -- | -- | -- | -- |
| " | 20C-6 | 6.1 | 0.930 | 28.40 | 36 | 9.4 | 106 | 40 | 1.5 | -- | 0.055 | 0.489 | -- | -- | -- | -- | -- |
| " | 20C-7 | 6.2 | 0.765 | 22.00 | 30 | 2.8 | 144 | 58 | 0 | -- | 0.062 | 0.238 | -- | -- | -- | -- | -- |
| " | 20C-8 | 6.2 | 0.730 | 32.20 | 34 | 2.6 | 130 | 46 | 3.7 | -- | 0.055 | 0.200 | -- | -- | -- | -- | -- |
| " | 20C-9 | 6.2 | 0.750 | 24.80 | 30 | 3.6 | 115 | 24 | 13.5 | -- | 0.095 | 0.254 | -- | -- | -- | -- | -- |
| " | 20C-10 | 6.1 | 0.098 | 18.10 | 33 | 3.6 | 53 | 16 | 3.2 | -- | 0.058 | 0.228 | -- | -- | -- | -- | -- |
| 05/02 | F45 | 7.0 | 0.150 | 47.00 | 32 | 0.9 | 316 | 112 | 8.8 | 11.0 | 0.130 | 0.196 | -- | -- | -- | 480 | 175.0 |
| " | F46 | 6.6 | 0.600 | 49.50 | 25 | 1.5 | 264 | 98 | 4.6 | 11.0 | 0.042 | -- | -- | -- | 448 | 360 | 135.0 |
| " | F47 | 6.6 | 0.550 | 5.00 | 19 | 0.9 | 149 | 54 | 3.4 | 27.0 | 5.479 | 6.780 | -- | -- | 326 | 330 | 95.0 |
| " | F48 | 6.6 | 0.700 | 12.19 | 18 | 1.1 | 110 | 40 | 2.4 | 11.0 | 1.082 | 1.229 | -- | -- | -- | 210 | 70.0 |
| " | F49 | 6.6 | 0.800 | 11.40 | 14 | 0.6 | 96 | 36 | 1.5 | 5.0 | 0.049 | 0.196 | -- | -- | -- | 260 | 67.5 |
| " | F50 | 4.6 | 0.800 | 105.00 | 37 | 1.4 | 350 | 146 | 3.7 | 12.5 | 0.033 | -- | -- | -- | 968 | 500 | 117.5 |
| " | F51 | 6.1 | 0.650 | 6.92 | 31 | 0.3 | 168 | 74 | 4.1 | 7.5 | 0.023 | 0.176 | -- | -- | 606 | 460 | 115.0 |

TABLE A-21. (CONTD.)

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | Na | K | TOTAL HARDNESS $CaCO_3$ | Ca | Mg mg/ℓ | $SiO_2$ | ORTHO-P | TOTAL-P | TC | TOC | TDS | CON-DUC-TIVITY | $Cl_2$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03 | 10B-2 | 4.0 | 1.100 | 50.80 | 43 | 2.4 | -- | -- | -- | 15.0 | 0.042 | 0.192 | -- | -- | -- | -- | -- |
| " | 10B-4 | 6.5 | 1.135 | 103.00 | 52 | 3.0 | 380 | 132 | 12.2 | 16.0 | 0.163 | -- | -- | -- | -- | 520 | -- |
| " | 10B-6 | 6.2 | 0.726 | 47.50 | 33 | 2.0 | 153 | -- | -- | -- | 0.046 | -- | -- | -- | -- | 390 | -- |
| " | 10B-8 | 6.5 | 0.850 | 13.55 | 31 | 1.5 | 96 | 38 | 0.2 | 11.5 | 0.039 | -- | -- | -- | -- | -- | -- |
| " | 10B-10 | 3.2 | 1.000 | 19.20 | 25 | 1.7 | 134 | -- | -- | -- | 0.055 | -- | -- | -- | -- | -- | -- |
| " | 21B-1 | 6.6 | 1.250 | 5.70 | 31 | 1.8 | 91 | 36 | 0.0 | -- | 0.068 | 0.153 | -- | -- | 362 | 250 | 62.5 |
| " | 21B-2 | 6.5 | 1.304 | 5.15 | 26 | 1.2 | 82 | 20 | 7.8 | 10.5 | 0.027 | 0.166 | -- | -- | -- | -- | 88.0 |
| " | 21B-3 | 6.6 | 1.500 | 6.00 | 21 | 1.2 | 62 | 28 | 0.0 | 11.5 | 0.042 | 0.140 | -- | -- | 245 | 200 | 42.0 |
| " | 21B-4 | 6.6 | 0.900 | 0.23 | 19 | 1.2 | 53 | 20 | 0.7 | 12.5 | 0.042 | 0.147 | -- | -- | 220 | 180 | 52.0 |
| " | 21B-6 | 6.6 | 0.850 | 11.75 | 29 | 1.5 | 168 | 40 | 16.6 | 8.5 | 0.036 | 0.153 | -- | -- | 390 | 340 | 105.0 |
| " | 21B-7 | 5.8 | 1.410 | 11.70 | 32 | 1.8 | 110 | 42 | 1.2 | 8.0 | 0.033 | 0.153 | -- | -- | 500 | 320 | 92.5 |
| " | 21B-8 | 4.5 | 0.050 | 7.56 | 35 | 2.0 | 125 | 50 | 0.0 | 12.0 | 0.042 | 0.153 | -- | -- | 316 | 400 | 122.5 |
| " | 21B-9 | 6.7 | 2.500 | 15.75 | 42 | 8.4 | 144 | 44 | 8.3 | 40.5 | 4.443 | 4.466 | -- | -- | -- | 400 | 76.0 |
| " | 11C-2 | 6.6 | 1.250 | 41.70 | 50 | 3.6 | 177 | 60 | 6.6 | 16.0 | 0.042 | -- | -- | -- | -- | -- | -- |
| " | 11C-4 | 5.7 | 0.370 | 42.80 | 41 | 2.9 | 269 | 90 | 10.7 | 12.5 | 0.039 | -- | -- | -- | -- | 540 | 147.5 |
| " | 11C-6 | 6.6 | 0.650 | 30.30 | 38 | 2.3 | 216 | 78 | 5.1 | 11.0 | 0.078 | -- | -- | -- | -- | 440 | 70.0 |
| " | 11C-8 | 6.7 | 1.000 | 57.10 | 49 | 3.5 | 384 | 130 | 14.4 | 13.0 | 0.049 | 0.202 | -- | -- | -- | -- | -- |
| " | 11C-10 | 6.3 | 1.500 | 14.50 | 29 | 2.0 | 158 | -- | -- | 12.5 | 0.059 | 0.147 | -- | -- | -- | -- | -- |
| " | 20C-1 | 6.5 | 0.750 | 25.00 | 27 | 1.4 | 120 | 46 | 1.2 | 11.5 | 0.052 | 0.153 | -- | -- | -- | 310 | -- |
| " | 20C-2 | 6.6 | 0.635 | 13.90 | 21 | 1.7 | 101 | 44 | 4.0 | 11.5 | 0.055 | 0.163 | -- | -- | -- | 300 | 77.5 |
| " | 20C-3 | 6.7 | 0 050 | 6.47 | 31 | 2.1 | 87 | 32 | 1.7 | 12.5 | 0.052 | 0.147 | -- | -- | -- | 290 | -- |
| " | 20C-4 | 6.5 | 1.250 | 11.05 | 25 | 2.0 | 129 | 44 | 4.6 | 11.5 | 0.049 | 0.163 | -- | -- | -- | -- | 84.0 |
| " | 20C-5 | 6.5 | 0.850 | 22.30 | 29 | 3.5 | 260 | 88 | 9.8 | 17.5 | 0.668 | 0.766 | -- | -- | -- | 480 | 127.5 |
| " | 20C-6 | 6.5 | 2.100 | 16.30 | 29 | 6.2 | 202 | 68 | 7.8 | 10.0 | 0.055 | 0.153 | -- | -- | -- | 400 | -- |
| " | 20C-7 | 6.7 | 1.050 | 6.85 | 29 | 2.3 | 91 | 32 | 2.7 | 13.0 | 0.055 | 0.153 | -- | -- | -- | 280 | 65.0 |
| " | 20C-8 | 6.6 | 1.250 | 13.70 | 28 | 2.1 | 120 | 46 | 1.2 | 11.5 | 0.046 | 0.147 | -- | -- | 500 | 310 | 80.0 |
| " | 20C-9 | 6.5 | 1.300 | 16.90 | 27 | 2.7 | 134 | 48 | 3.4 | 18.0 | 0.359 | 0.443 | -- | -- | -- | 330 | 79.0 |
| " | 20C-10 | 6.6 | 0.100 | 6.27 | 26 | 2.4 | 72 | 30 | 0.7 | 12.5 | 0.055 | 0.173 | -- | -- | -- | 270 | 61.0 |
| 05/15 | 10B-2 | 6.7 | 1.500 | 21.70 | 44 | 1.1 | 173 | 66 | 2.0 | 12.0 | 0.326 | -- | -- | -- | -- | 440 | -- |
| " | 10B-4 | 6.6 | 1.500 | 92.70 | 50 | 2.6 | 331 | 128 | 3.7 | 13.0 | 0.326 | -- | -- | -- | -- | 530 | 126.0 |
| " | 10B-6 | 7.0 | 0.750 | 44.30 | 44 | 1.5 | 158 | 58 | 3.2 | 12.5 | 0.326 | -- | -- | -- | -- | 390 | -- |
| " | 10B-8 | 6.7 | 0.650 | 13.80 | 32 | 1.5 | 326 | 46 | -- | 12.0 | 0.326 | -- | -- | -- | -- | -- | 155.0 |
| " | 10B-10 | 7.0 | 1.250 | 19.60 | 42 | 1.7 | 120 | 44 | 2.4 | 9.0 | 0.326 | -- | -- | -- | -- | 350 | -- |

TABLE A-21. (CONTD.)

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | Na | K | TOTAL HARDNESS $CaCO_3$ | Ca | Mg | $SiO_2$ | ORTHO-P | TOTAL-P | TC | TOC | TDS | CON-DUC-TIVITY | $Cl_2$ mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | mg/ℓ | | | | | | | | |
| 05/15 | 11C-2 | 6.5 | 1.850 | 46.70 | 59 | 4.5 | 158 | 56 | 4.4 | 14.0 | 0.326 | -- | -- | -- | -- | 460 | 141.0 |
| " | 11C-4 | 6.6 | 2.100 | 52.00 | 41 | 1.5 | 216 | 68 | 11.2 | 11.0 | 0.326 | -- | -- | -- | -- | 500 | 142.0 |
| " | 11C-6 | 6.7 | 0.375 | 14.30 | 40 | 0.9 | 269 | 84 | 14.4 | 8.5 | -- | -- | -- | -- | -- | 400 | 156.0 |
| " | 11C-8 | 6.4 | 0.250 | 88.50 | 54 | 4.2 | 173 | 23 | — | 12.5 | 0.326 | -- | -- | -- | -- | -- | 130.0 |
| " | 11C-10 | 6.6 | 1.040 | 23.80 | 43 | 1.2 | 168 | 58 | 5.6 | 10.0 | 0.326 | -- | -- | -- | -- | 450 | -- |
| " | 21B-1 | 6.2 | 0.850 | 7.90 | 44 | 2.7 | 326 | 114 | 10.0 | 12.0 | 0.326 | -- | -- | -- | -- | 390 | 181.0 |
| " | 21B-2 | 6.2 | 0.400 | 6.50 | 53 | 4.8 | 178 | -- | -- | 7.5 | 0.326 | -- | -- | -- | -- | 400 | 146.0 |
| " | 21B-3 | 6.1 | 1.900 | 14.40 | 44 | 8.6 | 182 | 62 | 6.6 | 12.0 | 0.326 | -- | -- | -- | 736 | 430 | 225.0 |
| " | 21B-4 | 6.5 | 1.500 | 10.00 | 33 | 1.1 | 220 | 78 | 6.1 | 11.5 | 0.326 | -- | -- | -- | 350 | 290 | 301.0 |
| " | 21B-6 | 3.6 | 0.730 | 31.20 | 55 | 4.4 | 230 | 80 | 7.3 | 6.5 | 0.326 | -- | -- | -- | 1186 | 600 | 750.0 |
| " | 21B-7 | 5.8 | 1.250 | 27.30 | 65 | 2.3 | 115 | 32 | 8.5 | 10.0 | 0.326 | -- | -- | -- | 2024 | 900 | 605.0 |
| " | 21B-8 | 6.1 | 1.050 | 34.40 | 89 | 57.6 | 144 | -- | -- | 8.5 | 0.550 | -- | -- | -- | -- | -- | 607.0 |
| " | 21B-9 | 6.2 | 3.750 | 34.40 | 88 | 7.5 | 264 | 41 | 39.4 | 24.0 | 0.196 | -- | -- | -- | 778 | 640 | 180.0 |
| " | 21B-10 | 6.5 | 1.050 | 55.10 | 56 | 9.0 | 403 | 51 | 67.2 | 15.0 | 0.049 | -- | -- | -- | 856 | 600 | 170.0 |
| " | 21C-1 | 7.1 | 1.025 | 28.00 | 41 | 1.5 | 178 | 20 | 31.2 | 11.0 | 0.042 | -- | -- | -- | -- | 440 | 82.5 |
| " | 21C-2 | 7.1 | 1.500 | 21.70 | 41 | 1.7 | 226 | 38 | 31.7 | 10.0 | 0.055 | -- | -- | -- | -- | 460 | 160.0 |
| " | 21C-3 | 6.9 | 0.850 | 11.50 | 49 | 3.6 | 149 | 21 | 23.5 | 11.0 | 0.065 | -- | -- | -- | -- | 500 | 117.5 |
| " | 21C-4 | 6.7 | 1.750 | 20.40 | 51 | 2.9 | 278 | 40 | 43.4 | 10.5 | 0.456 | -- | -- | -- | -- | 680 | 202.5 |
| " | 21C-5 | 7.0 | 1.500 | 21.80 | 44 | 1.7 | 312 | 39 | 52.3 | 15.0 | 0.042 | -- | -- | -- | -- | 680 | 195.0 |
| " | 21C-6 | 7.0 | 1.350 | 20.50 | 50 | 3.6 | 235 | 36 | 35.4 | 8.0 | 0.046 | -- | -- | -- | -- | -- | 198.0 |
| " | 21C-7 | 6.8 | 1.050 | 15.10 | 43 | 6.3 | 221 | 26 | 38.1 | 13.0 | 0.042 | -- | -- | -- | 552 | 500 | 150.0 |
| " | 21C-8 | 6.8 | 2.150 | 18.00 | 42 | 2.7 | 158 | 24 | 23.9 | 11.0 | 0.460 | -- | -- | -- | 542 | 500 | 125.0 |
| " | 21C-9 | 6.9 | 1.150 | 16.70 | 41 | 1.7 | 163 | 24 | 25.1 | 16.0 | 0.075 | -- | -- | -- | 586 | 500 | 128.0 |
| " | 21C-10 | 6.6 | 0.750 | 14.90 | 41 | 2.7 | 125 | 18 | 19.5 | 12.5 | 0.065 | -- | -- | -- | 412 | 340 | 110.0 |
| 05/17 | F45 | 6.8 | 0.500 | 18.60 | 33 | 0.7 | 307 | 48 | 45.6 | 7.5 | 0.046 | -- | -- | -- | 816 | 640 | 200.0 |
| " | F46 | 6.4 | 0.450 | 30.90 | 26 | 0.8 | 312 | 47 | 47.5 | 8.5 | 0.466 | -- | -- | -- | 818 | 540 | 175.0 |
| " | F47 | 6.7 | 0.400 | 5.80 | 20 | 1.3 | 254 | 38 | 38.8 | 21.0 | 9.617 | -- | -- | -- | -- | 420 | 175.0 |
| " | F48 | 6.6 | 0.750 | 3.80 | 20 | 0.4 | 154 | 24 | 22.9 | 15.0 | 0.075 | -- | -- | -- | 509 | 380 | 105.0 |
| " | F49 | 6.6 | 1.000 | 16.90 | 30 | 0.9 | 154 | 25 | 22.3 | 8.5 | 0.052 | -- | -- | -- | 472 | 380 | 83.0 |
| " | F50 | 4.5 | 0.700 | 59.80 | 53 | 0.2 | 350 | 56 | 51.2 | 10.0 | 0.042 | -- | -- | -- | 964 | 640 | 108.0 |
| " | F51 | 5.9 | 0.550 | 18.70 | 29 | 1.6 | 408 | 53 | 67.2 | 5.0 | 0.075 | -- | -- | -- | -- | 600 | 263.0 |
| " | F52 | 6.7 | 0.350 | 43.50 | 80 | 3.8 | 298 | -- | -- | -- | 0.153 | -- | -- | -- | -- | -- | 68.0 |
| " | F53 | 6.1 | 9.500 | 86.40 | 26 | 0.7 | 754 | 97 | 126.0 | 6.0 | 0.091 | -- | -- | -- | 1348 | 800 | 355.0 |
| " | F54 | 5.2 | 1.850 | 14.40 | 25 | 0.7 | -- | -- | -- | -- | 0.822 | -- | -- | -- | -- | -- | 190.0 |

TABLE A-21. (CONTD.)

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | $Cl_2$ | Na | K | TOTAL HARDNESS $CaCO_3$ | Ca | Mg | $SiO_2$ | ORTHO-P | TOC | CON-DUC-TIVITY | TC | TOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  | mg/ℓ |  |
| 05/17 | 19A-1 | 6.4 | 7.500 | 19.10 | 88.0 | 17 | 5.4 | 130 | 19 | 20.1 | 10.0 | 0.075 | 514 | 350 | -- | -- |
| " | 19A-2 | 4.6 | 1.250 | 18.50 | 83.0 | 19 | 2.3 | 120 | 17 | 18.9 | 10.0 | -- | 376 | 300 | -- | -- |
| " | 19A-3 | 6.4 | 0.350 | 28.00 | 115.0 | 22 | 6.6 | 202 | 30 | 30.9 | 11.0 | 0.065 | 796 | 400 | -- | -- |
| " | 19A-4 | 6.3 | 0.550 | 21.50 | 78.0 | 15 | 2.3 | 149 | 28 | 19.3 | 11.0 | 0.052 | -- | 300 | -- | -- |
| " | 19A-5 | 6.3 | 5.500 | 13.70 | 70.0 | 16 | 4.2 | 115 | 18 | 17.1 | 12.0 | 0.293 | 426 | 320 | -- | -- |
| " | 19A-6 | 6.5 | 2.600 | 17.20 | 138.0 | 21 | 10.5 | 187 | 29 | 27.9 | 8.0 | 0.065 | 550 | 500 | -- | -- |
| " | 19A-7 | 6.6 | 1.750 | 13.90 | 50.0 | 16 | 2.6 | 77 | 11 | 12.1 | 7.5 | 0.052 | 284 | 200 | -- | -- |
| " | 19A-8 | 6.4 | 3.000 | 32.10 | 203.0 | 35 | 7.2 | 312 | 45 | 48.7 | 10.5 | 0.062 | 938 | 610 | -- | -- |
| " | 19A-10 | 6.5 | 5.250 | 32.00 | -- | 23 | 3.1 | 154 | 22 | 24.2 | 6.5 | 0.049 | 486 | 440 | -- | -- |
| 05/30 | 21B-1 | 6.5 | 1.150 | 21.31 | -- | 60 | 1.1 | 168 | 52 | 9.3 | 10.0 | 0.081 | -- | 500 | 14 | 3 |
| " | 21B-2 | 6.5 | 5.250 | 47.56 | 247.5 | 78 | 2.9 | 360 | 108 | 22.0 | 5.5 | 0.065 | -- | 800 | 10 | 3 |
| " | 21B-3 | 6.7 | 0.800 | 10.21 | 108.0 | 40 | 1.2 | 134 | 40 | 8.3 | 9.5 | 0.074 | 438 | 400 | 15 | 3 |
| " | 21B-4 | 6.8 | 1.950 | 8.68 | 80.0 | 40 | 0.4 | 82 | 24 | 5.4 | 8.0 | 0.065 | 344 | 300 | 12 | 3 |
| " | 21B-6 | 6.7 | 0.800 | 54.69 | 160.0 | 65 | 0.5 | 293 | 84 | 20.3 | 6.5 | 0.065 | 708 | 630 | 8 | 5 |
| " | 21B-7 | 6.4 | 0.000 | 31.50 | 225.0 | 54 | 13.1 | 312 | 92 | 20.0 | 9.5 | 0.065 | 876 | 650 | 5 | 2 |
| " | 21B-8 | 6.6 | 1.950 | 85.17 | 280.0 | 100 | 7.1 | 773 | 230 | 48.3 | 10.0 | 0.065 | -- | 450 | 9 | 3 |
| " | 21B-9 | 6.7 | 4.500 | 30.10 | 92.5 | 45 | 4.7 | 158 | 48 | 9.3 | 24.0 | 1.144 | 566 | 500 | 12 | 4 |
| " | 21B-10 | 6.9 | 0.100 | 71.08 | 110.0 | 58 | 1.1 | 302 | 68 | 32.2 | 9.5 | 0.146 | 746 | 660 | 10 | 6 |
| " | 11C-2 | 6.6 | 2.950 | 66.30 | 105.0 | 65 | 4.3 | 240 | 68 | 17.1 | 14.0 | 0.058 | 664 | 650 | 8 | 4 |
| " | 11C-4 | 6.9 | 0.800 | 27.80 | -- | 41 | 0.5 | 182 | 56 | 10.2 | 6.5 | 0.058 | -- | 500 | 10 | 2 |
| " | 11C-6 | 6.9 | 0.050 | 36.94 | -- | 45 | 0.4 | 192 | 58 | 11.5 | 10.0 | 0.058 | -- | 660 | 12 | 5 |
| " | 11C-8 | 6.6 | 1.900 | 69.91 | -- | 64 | 3.4 | 355 | 106 | 22.0 | 14.5 | 0.058 | -- | 800 | 8 | 4 |
| " | 11C-10 | 6.1 | 0.050 | 47.56 | -- | 63 | 0.8 | 259 | 76 | 16.8 | 7.5 | 0.058 | -- | 600 | 9 | 4 |
| " | 20C-1 | 6.8 | 0.050 | 51.71 | 75.0 | 51 | 1.0 | 202 | 58 | 13.9 | 10.5 | 0.058 | -- | 500 | 11 | 3 |
| " | 20C-2 | 6.8 | 0.000 | 34.46 | 112.5 | 44 | 0.8 | 187 | 58 | 10.2 | 7.5 | 0.058 | -- | 500 | 32 | 2 |
| " | 20C-3 | 7.0 | 0.900 | 19.30 | 85.0 | 49 | 1.1 | 130 | 38 | 8.5 | 9.5 | 0.058 | 378 | 400 | 14 | 3 |
| " | 20C-4 | 7.0 | 0.100 | 40.58 | 152.5 | 50 | 1.5 | 274 | 80 | 18.1 | 10.0 | 0.058 | 688 | 680 | 10 | 6 |
| " | 20C-5 | 6.9 | 0.500 | 62.10 | 195.0 | 74 | 0.6 | 379 | 118 | 20.5 | 9.5 | 0.033 | -- | 880 | 13 | 8 |
| " | 20C-6 | 6.9 | 0.050 | 23.16 | -- | 55 | 0.8 | 192 | 56 | 12.7 | 6.0 | 0.074 | -- | 540 | 8 | 4 |
| " | 20C-7 | 6.9 | 0.800 | 12.60 | 60.0 | 40 | 2.7 | 86 | 26 | 5.1 | 14.5 | 0.074 | 296 | 360 | 11 | 6 |
| " | 20C-8 | 6.8 | 1.800 | 24.46 | 65.0 | 42 | 1.4 | 130 | 38 | 8.5 | 13.0 | 0.074 | 340 | 400 | 30 | 4 |
| " | 20C-9 | 6.8 | 0.045 | 20.45 | 80.0 | 46 | 0.6 | 130 | 50 | 1.2 | 12.0 | 0.270 | -- | 400 | 14 | 6 |
| " | 20C-10 | 6.9 | 0.800 | 16.42 | 77.5 | 49 | 1.5 | 110 | 22 | 13.4 | 14.5 | 0.081 | 448 | 440 | 28 | 5 |

TABLE A-21. (CONTD.)

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | $Cl_2$ | Na | K | TOTAL HARDNESS $CaCO_3$ | Ca | Mg | $SiO_2$ | ORTHO-P | TDS | CON-DUC-TIVITY | TC | TOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | mg/ℓ |  |  |  |  |  |  |  |  |  |  |  | mg/ℓ |  |
| 05/30 | 10B-2 | 6.9 | 0.100 | 12.10 | -- | 50 | 0.6 | -- | -- | -- | 8.2 | 0.065 | -- | 320 | 8 | 2 |
| " | 10B-4 | 6.4 | 0.500 | 78.81 | 125.0 | 54 | 2.7 | 336 | 104 | 18.5 | 12.0 | 0.065 | 784 | 800 | 5 | 2 |
| " | 10B-6 | 6.5 | 0.100 | 81.41 | 97.5 | 67 | 1.1 | 336 | 104 | 18.5 | 10.5 | 0.058 | -- | 800 | 5 | 2 |
| " | 10B-8 | 6.8 | 0.120 | 33.41 | 117.5 | 50 | 1.0 | 178 | 56 | 9.3 | 10.0 | 0.130 | 490 | 500 | 7 | 3 |
| " | 10B-10 | 6.9 | 0.100 | 72.52 | -- | 45 | 0.8 | 302 | 88 | 29.3 | 14.0 | 0.058 | -- | 700 | 6 | 2 |
| 05/31 | F45 | 7.0 | 0.050 | 31.30 | 122.5 | 26 | 0.1 | 240 | 78 | -- | 6.0 | 0.058 | 608 | 540 | 10 | 3 |
| " | F46 | 6.6 | 0.050 | 80.43 | 105.0 | 29 | 1.1 | 538 | 170 | 27.6 | 10.0 | 0.058 | 842 | 920 | 2 | 1 |
| " | F47 | 6.7 | 0.000 | 20.20 | 137.5 | 26 | 0.2 | 259 | 80 | 14.4 | 16.0 | 4.401 | 634 | 520 | 9 | 2 |
| " | F48 | 6.5 | 0.150 | 25.25 | 62.5 | 18 | 0.2 | 154 | 52 | 5.9 | 16.0 | -- | 458 | 380 | 7 | 1 |
| " | F49 | 6.6 | 0.200 | 51.47 | 62.5 | 19 | 0.1 | 202 | 68 | 7.8 | 8.0 | 0.130 | 542 | 420 | 5 | 1 |
| " | F50 | 6.0 | 0.050 | 74.09 | 157.5 | 33 | 0.6 | 437 | 148 | 24.2 | 4.0 | 0.074 | 1121 | 700 | 4 | 1 |
| " | F51 | 6.3 | 0.100 | 61.03 | 250.0 | 65 | 0.1 | 427 | 136 | 21.2 | 2.8 | 0.058 | 1086 | 800 | 2 | 1 |
| " | F52 | 6.7 | 0.375 | 75.83 | 120.0 | 49 | 0.9 | 360 | 130 | 8.5 | 5.0 | 0.091 | -- | 680 | 3 | 1 |
| " | F53 | 6.4 | 0.400 | 82.57 | 155.0 | 52 | 0.2 | 499 | 170 | 18.1 | 3.5 | 0.130 | 1154 | 760 | 15 | 2 |
| " | F54 | 6.7 | 0.300 | 65.51 | 192.5 | 56 | 10.8 | 394 | 126 | 19.3 | 7.0 | 0.792 | 1026 | 700 | 8 | 1 |
| " | 19A-1 | 6.7 | 0.050 | 39.10 | 65.0 | 16 | 1.5 | 154 | 46 | 9.5 | 11.5 | 0.081 | 420 | 400 | 5 | 2 |
| " | 19A-2 | 6.7 | 0.100 | 16.04 | 50.0 | 14 | 0.7 | 82 | 24 | 5.4 | 9.0 | 0.058 | 264 | 240 | 5 | 2 |
| " | 19A-3 | 6.4 | 2.600 | 87.07 | 50.0 | 30 | 7.8 | 566 | 166 | 36.8 | 12.5 | -- | 1184 | 1000 | 4 | 1 |
| " | 19A-4 | 6.9 | 1.350 | 31.94 | 67.5 | 16 | 2.6 | 173 | 58 | 6.8 | 10.0 | 0.058 | 496 | 380 | 6 | 1 |
| " | 19A-5 | 6.6 | 0.500 | 33.67 | 67.5 | 15 | 1.5 | 125 | 40 | 6.1 | 13.5 | 0.293 | 340 | 300 | 6 | 2 |
| " | 19A-6 | 6.5 | 1.120 | 29.18 | 60.0 | 18 | 5.1 | 130 | 42 | 6.1 | 7.0 | 0.048 | 450 | 270 | 4 | 2 |
| " | 19A-7 | 6.6 | 0.310 | 19.33 | 30.0 | 14 | 0.8 | 82 | 26 | 4.1 | 7.0 | 0.052 | 216 | 220 | 4 | 1 |
| " | 19A-8 | 6.6 | 0.105 | 38.93 | 125.0 | 29 | 0.6 | 235 | 74 | 12.2 | 7.5 | 0.048 | 552 | 600 | 5 | 2 |
| " | 19A-9 | 6.1 | 0.100 | 80.43 | 32.5 | 22 | 1.8 | 274 | 84 | 15.6 | 13.5 | 0.358 | 774 | 500 | 4 | 1 |
| " | 19A-10 | 6.1 | 0.100 | 69.97 | 37.5 | 22 | 1.8 | 245 | 80 | 11.0 | 9.5 | 0.058 | 602 | 600 | 4 | 1 |
| 06/12 | 19A-1 | 7.1 | -- | 3.8 | 48 | 22 | 7.5 | 82 | 15 | 10.8 | 16.0 | 0.260 | 227 | 220 | -- | -- |
| " | 19A-2 | 7.1 | -- | 3.4 | 26.5 | 23 | 1.0 | 48 | 12 | 4.4 | 8.2 | 0.081 | 124 | 140 | -- | -- |
| " | 19A-3 | 6.9 | -- | 73.4 | 41.0 | 21 | 6.5 | 322 | 91 | 22.9 | 14.3 | 0.081 | 765 | 500 | -- | -- |
| " | 19A-4 | 6.8 | -- | 18.9 | 20.0 | 13 | 2.5 | 72 | 35 | -- | 11.9 | 0.081 | 344 | 280 | -- | -- |
| " | 19A-5 | 6.8 | -- | 4.5 | 24.0 | 9 | 1.0 | 38 | 11 | 2.7 | 12.8 | 0.896 | 142 | 116 | -- | -- |
| " | 19A-6 | 7.0 | -- | 4.4 | 29.0 | 11 | 1.3 | 43 | 11 | 3.8 | 6.8 | 0.081 | 150 | 132 | -- | -- |
| " | 19A-7 | 7.0 | -- | 3.9 | 65.0 | 10 | 0.8 | 34 | 8 | 3.3 | 8.1 | 0.083 | 104 | 110 | -- | -- |

TABLE A-21. (CONTD.)

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | $Cl_2$ | Na | K | TOTAL HARDNESS $CaCO_3$ | Ca | Mg | $SiO_2$ | ORTHO-P | TDS | CON- DUC- TIVITY | TC | TOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/ℓ | | | | | | | | | | | | mg/ℓ | |
| 06/12 | 19A-8 | 6.5 | -- | 15.5 | 74.4 | 23 | 0.4 | 129.6 | 37 | 9.05 | 7.6 | 0.081 | 350 | 320 | — | — |
| " | 19A-9 | 6.5 | -- | 23.0 | 24.0 | 13 | 0.4 | 96.0 | 25 | 8.17 | 13.0 | 0.358 | 338 | 240 | -- | — |
| " | 19-10 | 6.3 | -- | 23.6 | 29.0 | 17 | 0.4 | 91.2 | 24 | 7.61 | 7.8 | 0.065 | 342 | 250 | -- | -- |
| " | F45 | 7.3 | — | 13.7 | 108.0 | 26 | 0.4 | 201.6 | 58 | 13.81 | 8.6 | 0.065 | -- | 400 | -- | -- |
| " | F46 | 7.2 | — | 78.7 | 84.0 | 26 | 1.3 | 374.4 | 99 | 30.96 | 10.6 | 0.065 | 894 | 600 | — | — |
| " | F47 | 7.1 | — | 2.9 | 137.0 | 25 | 0.8 | 211.2 | 67 | 10.66 | 16.0 | 3.749 | 548 | 460 | — | — |
| " | F48 | 7.1 | — | 9.4 | 55.2 | 18 | 0.8 | 110.4 | 31 | 8.03 | 14.1 | 1.206 | 362 | 260 | -- | -- |
| " | F49 | 6.8 | — | 10.1 | 26.4 | 13 | 0.8 | 86.4 | 23 | 7.05 | 11.5 | 0.831 | 252 | 220 | — | -- |
| " | F50 | 7.2 | -- | 56.4 | 202.0 | 38 | 0.8 | 489.6 | 148 | 29.18 | 6.3 | 0.081 | 1166 | 600 | — | — |
| " | F51 | 7.3 | -- | 33.6 | 158.4 | 50 | 0.8 | 264.0 | 93 | 7.69 | 5.8 | 0.114 | 762 | 500 | — | — |
| " | F52 | 7.1 | — | 52.2 | 106.0 | 40 | 0.4 | 268.8 | 91 | 10.08 | 9.3 | 0.081 | -- | 500 | — | — |
| " | F53 | 6.8 | — | 57.2 | 101.0 | 47 | 0.3 | 249.6 | 81 | 11.49 | 10.5 | 0.130 | 712 | 530 | — | -- |
| " | F54 | 7.2 | -- | 14.4 | 118.0 | 45 | 1.2 | 177.6 | 52 | 11.61 | 18.4 | 2.966 | 532 | 418 | — | — |
| " | 20C-1 | 7.3 | -- | 30.0 | 76.8 | 50 | 11.0 | 158.4 | 40 | 14.25 | 14.3 | 0.130 | 488 | 412 | — | — |
| " | 20C-2 | 6.9 | -- | 13.8 | 91.2 | 41 | 1.3 | 129.6 | 33 | 11.49 | 10.8 | 0.130 | 318 | 380 | -- | -- |
| " | 20C-3 | 7.2 | — | 11.1 | 211.0 | 46 | 0.8 | 115.2 | 25 | 6.76 | 13.3 | 0.097 | 258 | 372 | -- | -- |
| " | 20C-4 | 7.1 | -- | 19.4 | 137.0 | 52 | 1.3 | 460.8 | 59 | 76.44 | 9.0 | 0.114 | -- | 514 | — | -- |
| " | 20C-5 | 7.1 | -- | 20.6 | 166.0 | 67 | 0.8 | 144.0 | 72 | -- | 11.3 | 0.326 | -- | 580 | — | — |
| " | 20C-6 | 7.2 | -- | 16.8 | 125.0 | 52 | 0.8 | 72.0 | 42 | — | 7.1 | 0.033 | -- | 412 | -- | -- |
| " | 20C-7 | 7.2 | — | 15.8 | 46.0 | 34 | 0.8 | 86.4 | 20 | 8.88 | 16.0 | 0.040 | 188 | 188 | — | — |
| " | 20C-8 | 7.0 | — | 7.8 | 50.0 | 34 | — | -- | 24 | — | 13.5 | 0.033 | 226 | 280 | -- | -- |
| " | 20C-9 | 7.0 | — | 18.2 | 79.0 | 47 | 1.3 | 86.4 | 37 | -- | 14.3 | 0.326 | -- | 406 | -- | -- |
| " | 20C-10 | 7.1 | -- | 9.1 | 84.0 | 53 | 1.3 | 168.0 | 26 | 25.13 | 11.8 | 0.048 | 296 | 370 | — | — |
| " | 10B-2 | 6.9 | -- | 6.3 | 175.0 | 57 | 0.3 | 168.0 | 60 | 4.39 | 10.9 | 0.033 | -- | — | -- | — |
| " | 10B-4 | 6.8 | -- | 87.3 | 101.0 | 50 | 0.3 | 350.4 | 97 | 10.79 | 14.8 | 0.033 | -- | 650 | -- | -- |
| " | 10B-6 | 7.2 | — | 52.3 | 103.0 | 67 | 2.5 | 254.4 | 90 | 7.17 | 11.3 | 0.033 | -- | 544 | -- | -- |
| " | 10B-8 | 7.4 | — | 24.0 | 110.0 | 50 | 0.8 | 148.8 | 47 | 7.64 | 11.9 | 0.033 | 556 | 348 | -- | -- |
| " | 10B-10 | 6.9 | — | 44.2 | 84.0 | 38 | 0.8 | 240.0 | 72 | 14.40 | 9.8 | 0.033 | -- | 468 | — | -- |
| " | 11C-2 | 6.8 | — | 78.1 | 98.5 | 66 | 0.8 | 259.2 | 83 | 126.1 | 16.3 | 0.048 | 886 | 460 | — | — |
| " | 11C-4 | 7.2 | — | 14.7 | 89.0 | 36 | 2.2 | 124.8 | 38 | 7.27 | 8.1 | 0.033 | -- | 332 | -- | -- |
| " | 11C-6 | 7.2 | -- | 16.3 | 65.0 | 36 | 0.8 | 105.6 | 29 | 8.08 | 11.5 | 0.081 | — | 310 | -- | -- |
| " | 11C-8 | 6.8 | — | 79.3 | 125.0 | 73 | 0.8 | 403.2 | 99 | 37.99 | 11.0 | 0.048 | 1258 | 720 | -- | -- |
| " | 11C-10 | 6.4 | — | 27.7 | 156.0 | 65 | 1.3 | 211.2 | 65 | 11.86 | -- | 0.048 | — | — | — | — |

TABLE A-21. (CONTD.)

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | $Cl_2$ | Na | K | TOTAL HARDNESS $CaCO_3$ | Ca | Mg | $SiO_2$ | ORTHO-P | TDS | CON-DUC-TIVITY | TC | TOC | SUL-PHATES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | mg/ℓ | | | | | | mg/ℓ | | |
| 06/12 | 21B-1 | 6.9 | -- | 14.4 | 149.0 | 66 | 2.3 | 163 | 54 | 6.9 | 7.4 | 0.195 | -- | 500 | -- | -- | -- |
| " | 21B-2 | 6.9 | -- | 42.2 | 233.0 | 80 | 1.3 | 173 | 100 | -- | 10.8 | 0.033 | -- | 720 | -- | -- | -- |
| " | 21B-3 | 7.1 | -- | 9.7 | 67.0 | 35 | 1.3 | 91 | 26 | 6.4 | 11.0 | 0.033 | 322 | 306 | -- | -- | -- |
| " | 21B-4 | 7.2 | -- | 9.1 | 72.0 | 41 | 1.3 | 77 | 25 | 3.5 | 9.2 | 0.033 | 340 | 300 | -- | -- | -- |
| " | 21B-6 | 6.8 | -- | 23.2 | 130.0 | 50 | 1.3 | 182 | 62 | 6.7 | 6.7 | 0.024 | 578 | 476 | -- | -- | -- |
| " | 21B-7 | 7.1 | -- | 12.4 | 156.0 | 42 | 1.3 | 192 | 70 | 4.2 | 10.0 | 0.024 | 620 | 462 | -- | -- | -- |
| " | 21B-8 | 7.1 | -- | 69.1 | 161.0 | 77 | 6.8 | 398 | 100 | 36.2 | 9.3 | 0.033 | 1134 | 500 | -- | -- | -- |
| " | 21B-9 | 7.0 | -- | 12.0 | 82.0 | 46 | 1.0 | 115 | 27 | 11.6 | 26.8 | 1.304 | 464 | 368 | -- | -- | -- |
| " | 21B-10 | 7.3 | -- | 37.4 | 94.0 | 50 | 2.0 | 178 | 54 | 10.4 | 8.2 | 0.081 | 626 | 500 | -- | -- | -- |
| 06/26 | 19A-1 | 7.0 | 0.90 | 5.02 | 122.3 | 40 | 3.2 | 158 | 31 | 19.7 | 23.8 | 1.124 | 534 | 480 | 145 | 125 | — |
| " | 19A-2 | 6.9 | 0.90 | 3.31 | 107.6 | 18 | 1.1 | 125 | 44 | 3.6 | 7.6 | 0.081 | 472 | 366 | 25 | 12 | 3.5 |
| " | 19A-3 | 6.7 | 1.35 | 35.52 | 168.8 | 24 | 7.2 | 326 | 98 | 19.8 | 12.5 | 0.048 | -- | 600 | 68 | 65 | 2.5 |
| " | 19A-4 | 7.0 | 1.95 | 8.29 | 70.9 | 14 | 1.8 | 143 | 36 | 13.0 | 11.2 | 0.048 | -- | 300 | 34 | 18 | 11.5 |
| " | 19A-5 | 6.6 | 1.85 | 4.38 | 114.9 | 19 | 2.5 | 149 | 50 | 8.8 | 10.8 | 0.097 | 435 | 340 | 30 | 21 | 6.6 |
| " | 19A-6 | 6.5 | 2.90 | 3.28 | 154.1 | 21 | 8.6 | 182 | 68 | 3.0 | 6.3 | 0.016 | 492 | 400 | 30 | 28 | 3.5 |
| " | 19A-7 | 6.6 | 1.10 | 2.42 | 100.3 | 22 | 1.1 | 106 | 35 | 4.4 | 5.3 | 0.016 | 363 | 340 | 31 | 30 | 2.0 |
| " | 19A-8 | 6.6 | 1.85 | 4.58 | 428.0 | 46 | 24.7 | 494 | 192 | 3.5 | 6.5 | 0.002 | -- | 800 | 120 | 108 | 2.5 |
| " | 19A-9 | 6.5 | 1.25 | 6.11 | 281.3 | 29 | 8.2 | 346 | 100 | 23.3 | 10.6 | 0.033 | 836 | 586 | 31 | 11 | 3.4 |
| " | 19A-10 | 6.1 | 1.10 | 9.47 | 1303.7 | 66 | 34.0 | 1363 | 400 | 88.5 | 6.9 | 0.133 | 3429 | 1800 | 110 | 92 | 1.6 |
| " | F45 | 7.1 | 1.00 | 6.96 | 151.6 | 29 | 1.4 | 216 | 83 | 2.1 | 8.1 | 0.048 | -- | 550 | 31 | 27 | 7.5 |
| " | F46 | 7.0 | 1.85 | 26.79 | 129.6 | 26 | 1.1 | 211 | 91 | -- | 9.0 | 0.033 | 786 | 540 | 70 | 60 | 8.0 |
| " | F47 | 6.9 | 0.50 | 4.16 | 132.1 | 23 | 0.2 | 45 | 64 | 20.7 | 15.2 | 2.738 | -- | 320 | 10 | 5 | 21.2 |
| " | F48 | 6.9 | 0.90 | 3.43 | 68.5 | 18 | 0.2 | 120 | 30 | 10.9 | 12.8 | 0.782 | 416 | 340 | 10 | 5 | 13.2 |
| " | F49 | 7.0 | 2.10 | 3.07 | 24.5 | 9 | 0.0 | 62 | 15 | 6.1 | 11.6 | 0.847 | 128 | 186 | 6 | 5 | 21.2 |
| " | F50 | 6.8 | 1.25 | 4.35 | 90.5 | 19 | 0.2 | 149 | 45 | 8.9 | 5.4 | 0.065 | 374 | 320 | 6 | 4 | 15.5 |
| " | F51 | 6.8 | 2.50 | 13.28 | 158.9 | 60 | 5.6 | 182 | 59 | 8.5 | 10.9 | 0.041 | 999 | 500 | 14 | 10 | 14.0 |
| " | F52 | 7.0 | 0.90 | 19.11 | 195.7 | 57 | 0.7 | 269 | 91 | 10.1 | 10.8 | 0.309 | -- | 700 | 30 | 12 | 22.7 |
| " | F53 | 6.9 | 1.20 | 24.47 | 102.7 | 49 | 0.5 | 178 | 55 | 9.8 | 13.7 | 0.863 | 500 | 500 | 27 | 10 | 19.5 |
| " | F54 | 6.8 | 0.80 | 14.78 | 136.9 | 52 | 2.1 | 163 | 42 | 14.2 | 21.9 | -- | 516 | 500 | 33 | 15 | 38.7 |
| " | 20C-1 | 6.9 | 0.80 | 20.92 | 78.3 | 49 | 1.1 | 120 | 30 | 10.9 | 13.1 | 0.033 | 432 | 400 | 42 | 35 | 17.5 |
| " | 20C-2 | 6.9 | 1.50 | 12.99 | 78.3 | 42 | 0.4 | 110 | 27 | 10.5 | 9.9 | 0.033 | 410 | 400 | 70 | 60 | 14.2 |
| " | 20C-3 | 7.1 | 1.00 | 9.69 | 75.8 | 45 | 0.7 | 110 | 22 | 13.5 | 12.9 | 0.033 | 415 | 400 | 11 | 6 | 13.5 |
| " | 20C-4 | 7.1 | 1.50 | 12.40 | 110.1 | 49 | 0.5 | 154 | 35 | 16.1 | 9.7 | 0.033 | -- | 520 | 10 | 5 | 16.7 |

TABLE A-21. (CONTD.)

| DATE 1973 | SAMPLE | pH | $NH_3$-N | $NO_2$+ $NO_3$-N | $Cl_2$ | Na | K | TOTAL HARDNESS $CaCO_3$ | Ca | Mg | $SiO_2$ | ORTHO-P | TDS | CON-DUC-TIVITY | TC | TOC | SUL-PHATES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/ℓ | | | | | | | | | | | | mg/ℓ | | |
| 06/26 | 20C-5 | 7.3 | 0.50 | 14.17 | 149.2 | 68 | 0.5 | 220 | 54 | 22.1 | 11.1 | 0.169 | -- | 400 | 15 | 10 | 18.7 |
| " | 20C-6 | 7.1 | 1.20 | 9.60 | 110.1 | 50 | 0.5 | 115 | 31 | 9.2 | 10.8 | 0.033 | -- | 480 | 20 | 15 | 9.5 |
| " | 20C-7 | 7.0 | 0.90 | 7.46 | 102.3 | 38 | 1.4 | 67 | 16 | 6.6 | 11.5 | 0.065 | 352 | 380 | 20 | 16 | 16.0 |
| " | 20C-8 | 7.3 | 1.85 | 8.04 | 66.0 | 41 | 0.9 | 77 | 19 | 7.2 | 15.2 | 0.048 | 370 | 360 | 75 | 65 | 18.7 |
| " | 20C-9 | 7.1 | 0.90 | 12.33 | 97.8 | 50 | 0.5 | 135 | 28 | 15.8 | 13.1 | 0.146 | -- | 500 | 6 | 5 | 23.5 |
| " | 20C-10 | 6.8 | 1.35 | 9.81 | 85.6 | 50 | 1.1 | 72 | 17 | 7.2 | 14.6 | 0.048 | 328 | 300 | 52 | 45 | 21.2 |
| " | 10B-2 | 6.8 | 0.45 | 10.74 | 149.2 | 66 | 1.4 | 144 | 42 | 9.5 | 13.3 | 0.048 | 832 | 600 | 15 | 5 | 11.5 |
| " | 10B-4 | 6.6 | 1.25 | 78.18 | 232.4 | 75 | 6.0 | 432 | 140 | 20.0 | 14.3 | 0.048 | -- | 1200 | 10 | 5 | 13.2 |
| " | 10B-6 | 6.9 | 1.00 | 68.63 | 176.1 | 84 | 2.5 | 322 | 98 | 18.7 | 12.7 | 0.048 | -- | 580 | 12 | 10 | 14.7 |
| " | 10B-8 | 6.9 | 0.45 | 21.52 | 273.9 | 78 | 7.0 | 307 | 97 | 15.8 | 13.1 | 0.041 | 610 | 500 | 11 | 10 | 16.0 |
| " | 10B-10 | 7.1 | 0.50 | 50.12 | 217.7 | 63 | 3.5 | 360 | 100 | 26.8 | 9.1 | 0.048 | -- | 540 | 20 | 15 | 16.8 |
| " | 11C-2 | 6.9 | 1.05 | 58.99 | 105.2 | 63 | 2.8 | 216 | 66 | 12.4 | 15.5 | 0.048 | -- | 460 | 25 | 20 | 12.2 |
| " | 11C-4 | 7.1 | 1.00 | 18.69 | 73.4 | 37 | 0.4 | -- | 26 | -- | 7.9 | 0.041 | 320 | 300 | 45 | 42 | 10.0 |
| " | 11C-6 | 7.1 | 0.25 | 20.18 | 68.5 | 40 | 0.4 | -- | 25 | -- | 12.3 | 0.057 | 410 | 400 | 10 | 4 | 13.8 |
| " | 11C-8 | 7.2 | 0.10 | 72.24 | 149.2 | 92 | 0.7 | -- | 95 | -- | 9.1 | 0.065 | -- | 1000 | 6 | 4 | 10.8 |
| " | 11C-10 | 7.5 | 0.90 | 15.44 | 156.5 | 68 | 0.5 | -- | 47 | -- | 9.1 | 0.048 | 420 | 400 | 11 | 5 | -- |
| " | 21B-1 | 6.8 | 0.90 | 10.59 | 146.8 | 66 | 7.0 | 154 | 38 | 14.3 | 14.9 | 0.114 | 552 | 500 | 85 | 75 | 18.0 |
| " | 21B-2 | 6.8 | 4.50 | 34.64 | 190.8 | 70 | 1.1 | 274 | 92 | 10.6 | 8.2 | 0.033 | 980 | 1000 | 90 | 56 | 10.2 |
| " | 21B-3 | 7.2 | 1.00 | 9.41 | 83.2 | 43 | 0.9 | 110 | 26 | 11.1 | 11.9 | 0.041 | -- | 500 | 25 | 18 | 16.5 |
| " | 21B-4 | 7.0 | 3.20 | 10.35 | 80.7 | 49 | 0.4 | 91 | 25 | 7.0 | 8.0 | 0.033 | 536 | 380 | 27 | 16 | 11.6 |
| " | 21B-6 | 7.0 | 1.50 | 24.47 | 112.5 | 61 | 0.7 | 158 | 44 | 11.8 | 6.4 | 0.002 | 502 | 360 | 15 | 10 | 14.2 |
| " | 21B-7 | 6.5 | 1.50 | 18.78 | 110.1 | 43 | 3.5 | 134 | 42 | 7.2 | 9.1 | 0.016 | -- | 340 | 10 | 8 | 21.0 |
| " | 21B-8 | 6.7 | 0.25 | 39.73 | 176.1 | 66 | 1.1 | 283 | 91 | 13.6 | 8.0 | 0.002 | -- | 800 | 29 | 25 | 24.0 |
| " | 21B-9 | 6.9 | 6.50 | 10.96 | 88.0 | 52 | 3.9 | 101 | 24 | 10.3 | 25.8 | 1.092 | -- | 350 | 16 | 10 | 6.0 |
| " | 21B-10 | 7.0 | 0.50 | 25.74 | 75.8 | 54 | 0.4 | 129 | 33 | 11.5 | 8.5 | 0.081 | 320 | 240 | 15 | 10 | 10.3 |

NOTE: REFER TO FIGURE 5; DESIGNATION NUMBERS CORRESPOND TO INDIVIDUAL PLOTS. POINT SAMPLERS ARE LOCATED IN THE MID-ROW FURROWS OF THE REFERENCED PLOT IN THE SEQUENCE (1, 2, 3, ETC.): ODD NUMBERS AFTER THE TEST PLOT DESIGNATION ARE SET AT THE 9-12 INCH (23-30 cm) DEPTH (ABOVE THE TILLAGE PAN) AND EVEN NUMBERS ARE SET AT THE 18-21 INCH (46-51 cm) DEPTH (APPROXIMATELY 6 INCHES [15 cm] BELOW THE TILLAGE PAN). THE DESIGNATION "F" REFERS TO A LOCATION IN OCS FIELD NO. 246 ADJACENT TO TEST PLOTS 20 AND 22 (FIG. 5). F45-F51 ARE LOCATED IN FURROWS THAT RECEIVE DITCH WATER APPLICATIONS, WHEREAS, F52-F54 ARE IN FURROWS THAT RECEIVE APPLICATION OF SECONDARY SEWAGE.

TABLE A-22. SUGARCANE SHOOT COUNT: OSC FIELD NO. 246.

40 ft x 4 LINES = 160 ft. DATE COUNTED: 4-12-73 AT 2.1 mos.

| PLOT NO. | TREATMENT | LINE NUMBER COUNTED | | | | TOTAL SHOOTS | SHOOTS/ft OF ROW |
|---|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | | |
| 16-A | DITCH WATER | 16 | 26 | 81 | 88 | 211 | 1.32 |
| 14-A | only, | 122 | 102 | 61 | 28 | 313 | 1.96 |
| 5-A | 24 mos. | 60 | 53 | 71 | 78 | 262 | 1.64 |
| 8-A | | 51 | 51 | 64 | 71 | 237 | 1.48 |
| 9-A | | 85 | 100 | 72 | 82 | 339 | 2.12 |
| 12-A | | 151 | 139 | 83 | 66 | 439 | 2.74 |
| 19-A | | 116 | 104 | 63 | 75 | 358 | 2.24 |
| 23-A | | 85 | 111 | 87 | 111 | 394 | 2.46 |
| 30-A | | 27 | 32 | 69 | 96 | 224 | 1.40 |
| 28-A | | 62 | 83 | 114 | 85 | 344 | 2.15 |
| | | | | | | AVERAGE: | 1.95 |
| 15-B | EFFLUENT, | 30 | 34 | 98 | 90 | 252 | 1.58 |
| 17-B | 12 mos.; | 159 | 97 | 63 | 50 | 369 | 2.31 |
| 4-B | DITCH WATER | 93 | 92 | 68 | 90 | 343 | 2.14 |
| 6-B | 12 mos. | 78 | 138 | 95 | 94 | 405 | 2.53 |
| 10-B | | 40 | 116 | 98 | 85 | 339 | 2.12 |
| 13-B | | 111 | 43 | 85 | 122 | 361 | 2.26 |
| 21-B | | 55 | 101 | 99 | 91 | 346 | 2.16 |
| 22-B | | 105 | 76 | 55 | 54 | 290 | 1.81 |
| 26-B | | 23 | 38 | 76 | 87 | 224 | 1.40 |
| 27-B | | 62 | 80 | 44 | 64 | 250 | 1.56 |
| | | | | | | AVERAGE: | 1.99 |
| 1-C | EFFLUENT | 31 | 75 | 56 | 144 | 306 | 1.91 |
| 2-C | only, | 145 | 95 | 56 | 50 | 346 | 2.16 |
| 3-C | 24 mos. | 74 | 80 | 82 | 81 | 317 | 1.98 |
| 7-C | | 53 | 95 | 64 | 63 | 275 | 1.72 |
| 11-C | | 69 | 67 | 77 | 80 | 293 | 1.83 |
| 18-C | | 118 | 88 | 53 | 69 | 328 | 2.05 |
| 20-C | | 63 | 43 | 66 | 80 | 252 | 1.58 |
| 24-C | | 88 | 128 | 50 | 38 | 304 | 1.90 |
| 25-C | | 24 | 33 | 64 | 79 | 200 | 1.25 |
| 29-C | | 74 | 85 | 64 | 44 | 267 | 1.67 |
| | | | | | | AVERAGE: | 1.81 |

NOTE: SOME PLOTS WITH POOR LINES IN FINAL HARVEST AREA--REPLANTS ARE NOT UP YET. ALL PLOTS VERY WEEDY.

40 ft x 4 LINES = 160 ft. DATE COUNTED: 6-04-73 AT 4.0 mos.

| PLOT NO. | TREATMENT | LINE NUMBER COUNTED | | | | TOTAL SHOOTS | SHOOTS/ft OF ROW |
|---|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | | |
| 16-A | DITCH WATER | 175 | 190 | 219 | 280 | 864 | 5.40 |
| 14-A | only, | 320 | 273 | 289 | 193 | 1075 | 6.72 |
| 5-A | 24 mos. | 266 | 278 | 332 | 288 | 1164 | 7.28 |
| 8-A | | 257 | 246 | 256 | 247 | 1006 | 6.29 |
| 9-A | | 291 | 290 | 272 | 283 | 1136 | 7.10 |
| 12-A | | 325 | 313 | 303 | 242 | 1183 | 7.39 |
| 19-A | | 289 | 287 | 241 | 222 | 1039 | 6.49 |
| 23-A | | 319 | 295 | 268 | 306 | 1188 | 7.43 |
| 30-A | | 307 | 226 | 209 | 333 | 1075 | 6.72 |
| 28-A | | 278 | 252 | 272 | 266 | 1068 | 6.68 |
| | | | | | | AVERAGE: | 6.75 |
| 15-B | EFFLUENT, | 289 | 266 | 322 | 304 | 1181 | 7.38 |
| 17-B | 12 mos.; | 474 | 395 | 256 | 254 | 1369 | 8.56 |
| 4-B | DITCH WATER, | 285 | 309 | 261 | 344 | 1199 | 7.49 |
| 6-B | 12 mos. | 333 | 340 | 342 | 335 | 1350 | 8.44 |
| 10-B | | 240 | 340 | 347 | 309 | 1236 | 7.73 |
| 13-B | | 302 | 319 | 336 | 399 | 1356 | 8.48 |
| 21-B | | 297 | 320 | 324 | 336 | 1277 | 7.98 |
| 22-B | | 340 | 281 | 249 | 237 | 1107 | 6.92 |
| 26-B | | 278 | 290 | 347 | 281 | 1196 | 7.48 |
| 27-B | | 326 | 365 | 272 | 290 | 1253 | 7.83 |
| | | | | | | AVERAGE: | 7.83 |
| 1-C | EFFLUENT | 300 | 328 | 293 | 362 | 1283 | 8.02 |
| 2-C | only, | 351 | 293 | 258 | 243 | 1145 | 7.16 |
| 3-C | 24 mos. | 306 | 291 | 321 | 311 | 1229 | 7.68 |
| 7-C | | 284 | 287 | 350 | 309 | 1230 | 7.69 |
| 11-C | | 299 | 289 | 302 | 321 | 1211 | 7.57 |
| 18-C | | 333 | 264 | 248 | 259 | 1104 | 6.90 |
| 20-C | | 240 | 233 | 259 | 263 | 995 | 6.22 |
| 24-C | | 316 | 327 | 233 | 193 | 1069 | 6.68 |
| 25-C | | 286 | 270 | 285 | 324 | 1165 | 7.28 |
| 29-C | | 318 | 325 | 302 | 272 | 1217 | 7.61 |
| | | | | | | AVERAGE: | 7.28 |

## TABLE A-23. ANALYSIS OF CROP LOG SAMPLES: OSC FIELD NO. 246.

| TREATMENT N lb/ac | PLOT | AVG. SHEATH wt/stk | SHEATH $H_2O$ | BLADE N | SHEATH | | | | | | SPI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | P-IX. | K-IX. | CA-IX. | MG-IX. | T.S. | K-$H_2O$ | |
| | | | PCT | | | | | | | | |
| A<br>375<br>DITCH WATER,<br>24 mos. | 16 | 73.4 | 86.1 | 2.38 | 0.142 | 1.98 | 0.40 | 0.347 | 15.3 | 0.27 | 0 |
| | 14 | 74.8 | 86.6 | 2.30 | 0.134 | 2.72 | 0.38 | 0.312 | 14.2 | 0.36 | 0 |
| | 05 | 63.0 | 87.3 | 2.64 | 0.175 | 3.10 | 0.38 | 0.299 | 14.9 | 0.38 | 0 |
| | 08 | 65.0 | 85.7 | 2.56 | 0.151 | 3.08 | 0.39 | 0.294 | 15.0 | 0.43 | 0 |
| | 09 | 69.0 | 86.9 | 2.68 | 0.157 | 3.06 | 0.42 | 0.327 | 12.0 | 0.40 | 0 |
| | 12 | 80.4 | 86.5 | 2.42 | 0.140 | 2.62 | 0.39 | 0.325 | 14.0 | 0.35 | 0 |
| | 19 | 75.2 | 86.6 | 2.50 | 0.151 | 2.40 | 0.43 | 0.364 | 13.4 | 0.32 | 0 |
| | 23 | 72.8 | 86.5 | 2.28 | 0.138 | 2.63 | 0.39 | 0.308 | 14.3 | 0.35 | 0 |
| | 30 | 78.6 | 87.2 | 2.54 | 0.154 | 3.43 | 0.41 | 0.248 | 11.6 | 0.44 | 0 |
| | 28 | 87.0 | 86.8 | 2.44 | 0.132 | 2.26 | 0.41 | 0.309 | 13.4 | 0.29 | 0 |
| AVERAGE: | | 73.9 | 86.6 | 2.48 | 0.147 | 2.73 | 0.40 | 0.313 | 13.8 | 0.36 | 0 |
| B<br>375<br>EFFLUENT,<br>12 mos.;<br>DITCH WATER,<br>12 mos. | 15 | 78.6 | 87.1 | 2.44 | 0.161 | 3.08 | 0.40 | 0.301 | 13.1 | 0.39 | 0 |
| | 17 | 78.0 | 86.4 | 2.50 | 0.155 | 2.80 | 0.39 | 0.308 | 13.1 | 0.38 | 0 |
| | 04 | 75.6 | 86.6 | 2.86 | 0.169 | 2.97 | 0.39 | 0.327 | 14.6 | 0.39 | 0 |
| | 06 | 72.2 | 86.5 | 2.70 | 0.167 | 2.92 | 0.41 | 0.349 | 15.9 | 0.38 | 0 |
| | 10 | 82.6 | 87.7 | 2.86 | 0.177 | 3.13 | 0.42 | 0.327 | 14.4 | 0.37 | 0 |
| | 13 | 85.6 | 86.2 | 2.54 | 0.117 | 2.80 | 0.35 | 0.273 | 13.1 | 0.39 | 0 |
| | 21 | 84.6 | 87.2 | 2.54 | 0.159 | 3.05 | 0.40 | 0.296 | 14.1 | 0.38 | 0 |
| | 22 | 82.4 | 86.7 | 2.60 | 0.131 | 2.81 | 0.43 | 0.313 | 12.5 | 0.37 | 0 |
| | 26 | 76.6 | 86.7 | 2.58 | 0.142 | 2.95 | 0.38 | 0.296 | 13.9 | 0.38 | 0 |
| | 27 | 80.8 | 87.0 | 2.46 | 0.135 | 2.70 | 0.37 | 0.324 | 13.6 | 0.34 | 0 |
| AVERAGE: | | 79.7 | 86.8 | 2.60 | 0.151 | 2.92 | 0.39 | 0.311 | 13.8 | 0.38 | 0 |
| C<br>400<br>EFFLUENT,<br>24 mos. | 01 | 66.6 | 87.8 | 2.64 | 0.160 | 4.17 | 0.39 | 0.271 | 14.7 | 0.49 | 0 |
| | 02 | 89.0 | 87.6 | 2.38 | 0.146 | 3.78 | 0.36 | 0.233 | 14.5 | 0.45 | 0 |
| | 03 | 67.8 | 87.6 | 2.64 | 0.198 | 3.74 | 0.36 | 0.287 | 15.0 | 0.45 | 0 |
| | 07 | 66.4 | 86.4 | 2.56 | 0.172 | 2.77 | 0.46 | 0.349 | 15.8 | 0.36 | 0 |
| | 11 | 80.2 | 86.2 | 2.46 | 0.150 | 2.19 | 0.44 | 0.369 | 14.5 | 0.30 | 0 |
| | 18 | 76.6 | 86.4 | 2.44 | 0.156 | 2.25 | 0.45 | 0.371 | 15.0 | 0.30 | 0 |
| | 20 | 72.4 | 86.8 | 2.54 | 0.176 | 2.25 | 0.46 | 0.390 | 13.8 | 0.29 | 0 |
| | 24 | 80.4 | 86.7 | 2.56 | 0.147 | 2.96 | 0.38 | 0.298 | 13.7 | 0.39 | 0 |
| | 25 | 73.6 | 86.5 | 2.38 | 0.139 | 3.25 | 0.36 | 0.288 | 13.4 | 0.44 | 0 |
| | 29 | 75.4 | 87.2 | 2.56 | 0.141 | 3.28 | 0.38 | 0.280 | 11.8 | 0.42 | 0 |
| AVERAGE: | | 74.8 | 86.9 | 2.51 | 0.159 | 3.07 | 0.40 | 0.314 | 14.2 | 0.39 | 0 |

SOURCE: HAWAIIAN SUGAR PLANTERS' ASSOCIATION AGRONOMY DEPARTMENT.

NOTE: OAHU SUGAR COMPANY, LTD. DATE SAMPLED - 06/15/73
EXPT. 338 WD - SEWAGE EFFLUENT SERIES 1 DATE RECEIVED - 06/22/73
FLD. 246 CROP AGE 4.2 mos. DATE OF REPORT - 07/06/73

lb/acre x 1.21 = kg/ha.

TABLE A-24. SOLAR ENERGY: MILILANI STP.

| DAY | 1973<br>APRIL<br>ly/day | <br>MAY<br>ly/day | <br>JUNE<br>ly/day |
|---|---|---|---|
| 1 | 2.77 | 6.21 | 4.59 |
| 2 | 3.68 | 6.03 | 5.95 |
| 3 | 4.15 | 4.53 | 3.71 |
| 4 | 2.65 | 6.05 | 4.10 |
| 5 | 4.04 | 6.86 | 6.75 |
| 6 | 6.52 | 5.04 | 4.66 |
| 7 | 4.59 | 7.58 | 4.97 |
| 8 | 4.73 | 4.06 | 3.56 |
| 9 | 6.59 | 6.11 | 5.85 |
| 10 | 3.41 | 5.37 | 5.76 |
| 11 | 4.26 | 6.16 | 4.94 |
| 12 | 4.56 | 5.11 | 4.90 |
| 13 | 7.52 | 7.54 | 4.51 |
| 14 | 4.77 | 4.33 | 5.28 |
| 15 | 3.31 | 5.15 | 5.23 |
| 16 | 4.30 | 5.56 | 3.92 |
| 17 | 5.60 | 2.68 | 6.14 |
| 18 | 6.51 | 4.55 | 5.84 |
| 19 | 4.58 | 5.86 | 5.64 |
| 20 | 3.90 | 5.78 | 5.67 |
| 21 | 3.96 | 6.26 | 5.28 |
| 22 | 7.54 | 6.74 | 3.75 |
| 23 | 5.89 | 5.04 | 7.14 |
| 24 | 7.60 | 6.90 | 6.35 |
| 25 | 5.34 | 6.53 | 4.88[a] |
| 26 | 4.28 | 2.83 | 3.41 |
| 27 | 7.22 | 7.12 | 5.22 |
| 28 | 4.31 | 4.44 | 5.62 |
| 29 | 4.60 | 6.90 | 5.09 |
| 30 | 6.13 | 6.53 | 4.35 |
| 31 | -- | 4.55 | -- |
| TOTAL | 149.31 | 174.40 | 153.06 |

[a] VALUE MISSING: MEAN OF PRECEDING AND SUCCEEDING DAY.

# APPENDIX B. PUBLICATIONS AND PRESENTATIONS.

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

Lau, L.S. 1972. Technical session: In the matter of pollution of the navigable waters of Pearl Harbor and its tributaries--Hawaii. Testimony presented by L.S. Lau, in *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. *Journal WPCF* 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, Los Angeles, California, 21-25 January 1974, 28 p.

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

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