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EFFECTIVE USE OF HIGH WATER TABLE AREAS FOR SANITARY LANDFILL

VTN, Inc.

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EFFECTIVE USE OF HIGH WATER TABLE AREAS FOR SANITARY LANDFILL

Second Annual Report

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U.S. ENVIRONMENTAL PROTECTION AGENCY

1973

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16. Abstracts Problems associated with solid waste disposal are particularly acute in areas such as the southeastern coastal area of the U.S. where the combination of relatively flat terrain and high ground water tables makes efficient construction of sanitary landfills a challenging problem. With Federal grant assistance, Orange County officials are, therefore, conducting a demonstration project in which certain portions of the disposal cite have been dewatered below the level of waste deposition. The environmental assessment of the operation is based on the quality of the ground water at the site and of the surface water that leaves it through an open drainage system. Details are presented on design and construction, operating procedures, equipment, sampling techniques, and tentative conclusions reached based on two years of experience.

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ACKNOWLEDGEMENT

This is a Report on the first two phases of a three-year demonstration project, authorized by the Board of County Commissioners, Orange County, Florida, and funded in part by Grant No. G06-EC-00309, from the Environmental Protection Agency, Office of Solid Waste Management Programs. It is an important element of the County's Solid Waste Disposal Program. The program was developed under the responsibility and authority of Mr. Roxy S. Howse, former Public Works Administrator, and under the supervision of Mr. C. L. Goode, former County Engineer. The project is now under the responsibility and authority of Mr. M. W. Hall, Superintendent, Solid Waste Disposal System.

Orange County retains VTN INC. for planning and engineering and management consultant services concerned with the orderly progress of the Solid Waste Disposal Program. These services include the master planning for the landfill site, the design of landfill improvements, the selection of equipment, and the formulation of recommendations for operational procedures.

The Solid Waste Disposal System, Orange County, provides the requisite personnel and equipment for the conduct of landfill operations and maintains accurate records concerning waste quantities handled and the construction and operation costs incurred. The Orange County Pollution Control Department, under the supervision of Mr. C. W. Sheffield, County Pollution Control Officer, has the responsibility for sampling and testing surface and ground waters.

Faculty and students at Florida Technological University, working under the direction of Dr. Waldron McLellon, monitor organic and bacteriological parameter changes resulting from sanitary landfill construction in a high water table area. The Florida Technological University participants have conducted a thorough literature search and reviewed available information on similar disposal operations.

The U. S. Department of Agriculture, Soil Conservation Service, at the request of the Board of County Commissioners, assisted in the preparation of geological and soil studies at the demonstration site. In support of these studies, Mr. L. Orlando Rowland, a certified consulting geologist, prepared a supplemental study. Additionally, Ardaman and Associates consulting soil scientists, prepared a report on surface soil, geological, and ground water conditions existing at the demonstration site. These studies together were utilized in planning landfill improvements. Portions of the findings are incorporated in this report.

The assistance and cooperation extended by the many local, state and Federal officials who were contacted in matters related to the demonstration project are gratefully acknowledged.

Ramon A. Beluche

Ramon A. Beluche, Ph.D.
Vice President, VTN INC., and
Demonstration Project Director

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SUMMARY

Recognizing the need for economy and efficiency in the handling of solid waste, the Board of County Commissioners for Orange County, Florida, is presently implementing a long-range program which will upgrade the Orange County solid waste disposal system.

Sanitary landfilling has and will be a continuing method of solid waste disposal. An early problem facing the program, however, was the lack of available information on sanitary landfill operations in areas where a high ground water table is a dominating feature. To overcome this informational blank, the Board of County Commissioners made application to the U.S. Environmental Protection Agency for a Solid Waste Demonstration Grant to enable the county to carry out a three-year program of tests and operations in a high water table area such as would be encountered within Orange County. The application was subsequently approved and tests and operations began. This is a report covering the first two years of progress for the approved Demonstration Project titled 'Effective Use of High Water Table Areas for Sanitary Landfill'.

During the first year of the project, major construction continued on the 1,500 acre Orange County landfill site, which was, and is the subject of the Demonstration Project. Consultants were employed to investigate the overall project area in terms of both surface topography and subsurface geology and hydrology. From these investigations, a master drainage plan was prepared which would govern the necessary excavations to permit the project area to be operated with certain portions dewatered below the level of refuse deposition. A future land use plan, as well as an operations plan, was prepared as the key to some assurance that maximum use could be made of the available land area. Within the project area a specific demonstration site was selected to serve as the initial site of refuse disposal for the Demonstration Project.

Prior to the beginning of landfill operations, an all-weather access road and the first components of the on-site circulatory road system were constructed. Subsequently, the initial phases of the on-site drainage network were completed in the area reserved for the landfill site. An outfall canal, connecting the site drainage network to the Little Econlockhatchee River, was then built. The construction of this canal completed the initial site improvements.

Following the construction of the site improvements, on-site facilities for the conduct of operations and maintenance were completed. These included a landfill site office, employee lounge, sanitary facilities, equipment maintenance shop, fuel storage area, transfer trailer washrack, scale and scale house, and a weather monitoring station. A well furnishing potable water was completed.

The environmental assessment of the model sanitary landfill is based on the water quality of the ground water at the landfill site and the surface water which leaves the site through an open drainage system. This assessment of the project is made through the joint efforts of biologists and chemists at Orange County Pollution Control Department and Florida Technological University.

Twelve wells were drilled - each to a 20-foot depth - in and adjacent to the demonstration site. The initial six wells were sampled extensively during the first year to provide baseline data on ground water quality. Subsurface water is now being monitored physically, chemically and biologically in 38 shallow wells ranging from 10 to 30 feet in depth. Since December 1970, data has been obtained from 21 shallow wells resulting in a knowledge of the natural water quality and normal fluctuations.

Twelve surface water sampling stations were originally established along the reaches of the receiving stream and the outfall canal leading from the demonstration site. Baseline samplings were completed. Presently, the surface water is monitored physically, chemically and biologically at 4 established locations in the landfill drainage system and 6 locations in the receiving waters of the drainage system, the Little Econlockhatchee River. Data collection began in October 1970 to establish the surface water quality of the receiving stream and the newly developed drainage system.

The project was officially opened to selected commercial haulers on June 7, 1971. Full access to all began on October 4, 1971.

The amount of waste disposed of at the site has increased, on the average, from 150 to 400 tons per day. The maximum amount of waste recorded for a single day was 1,114 tons. The total tonnage received from June 7, 1971 through October 1, 1971, was estimated at 15,000 (scales were not then available, and estimates were based on 59,875 cubic yards at 500 pounds per cubic yard). From October 1, 1971 through July 31, 1972, with scales in use, solid waste received into the landfill site totalled 115,875 tons. Thus, since start of operations through July 31, 1972, total tonnage received was 130,875.

In the microbiological analyses total counts of microorganisms were used to detect leachate movement into ground water or the movement of microorganisms as a result of heavy rainfall. Fecal coliform counts (or enterococcus counts), *Salmonella* enrichment, and staphylococcus selection procedures were employed as attempts to detect introduction of pathogens into waters of the landfill area. Counts of both sulphur-oxiding and sulphur-reducing bacteria and fungi would be indicators of changes in native microbial populations due to leachate intrusion or effects of heavy rainfall.

Chemical analyses involved determination of such parameters as total organic carbon (and the carbon forms present), and analysis of lipids and similar offensive fragments where appropriate. These analyses are continuing and are being expanded for wells, such as Well 3, where contamination is occurring.

Preliminary results of the analyses are given in the data tables with brief comments in the section on Preliminary Conclusions.

INTRODUCTION

Community solid waste disposal problems over the years of civilization have been considered neither as acute nor dramatic, but simply as minor irritations of urban living. More recently, and in response to a highly increased standard of living and a commensurate increase in solid waste, there is the recognition of a major problem. And there is the further recognition that improper solid waste disposal can lead to a general degradation of the environment, waste natural land resources, and is a clear threat to health through the potential pollution of air and water as well as the harborage of vectors involved in disease transmission. Correction of existing and emergent problems will require innovative solutions.

The problems associated with solid waste disposal are particularly acute in areas such as the southeastern coastal region of the United States. In this region, high water table conditions prevail and elevations are fairly uniform with a minimum of rugged terrain suitable for sanitary landfill construction. Consequently, it is common to find solid waste being buried below the naturally occurring ground water table with varying degrees of ground water protection. And varying deposition practices have been noted through observation. These include the depositing of solid waste on the ground surface, directly into the ground water, and into temporarily dewatered working areas. In contrast, the Florida Department of Health and Rehabilitative Services, Division of Health, as governed by Chapter 10D-12, Florida Statutes, in regulating the disposal of garbage and rubbish, require -- when working in wet areas -- that trenches or pits be kept dewatered during operating periods. This requirement has particular application in central Florida.

The relatively flat topography of central Florida in combination with a very high ground water table makes efficient construction of sanitary landfills a particularly challenging problem. In addition, a recreation oriented population, with a deep concern for the maximum protection of the environment, suggests it is imperative that all possible control will be exercised in the construction and operation of a sanitary landfill in such areas. And Orange County officials encountered a very particular problem. While attempting to gather all available data for the proper design of solid waste disposal facilities, they soon recognized the need for further development of sanitary landfill construction technology for high water table areas. Specifically, information was needed on cell design, equipment selection, operating procedures, environmental protection, and costs for construction and operation. In an attempt to develop information not then available in current literature, the Board of County Commissioners for Orange County made application to the Bureau of Solid Waste Management, U. S. Public Health Service * for a Demonstration Grant titled, "Effective Use of High Water Table Areas for Sanitary Landfill". The grant was approved and designated as Project G06-EC-00309. This is the second annual progress report on that Demonstration Project.

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*After Federal reorganization, the funding agency is now the Office of Solid Waste Management Programs, U. S. Environmental Protection Agency.

Recommendations covering site selection for sanitary landfill operations suggest all filling be done where the filling operation will be above the water table. But this is virtually impossible in normal operation over a long period of time in the greater part of Florida without auxiliary drainage and perpetual pumping. Otherwise, it must be assumed two things will happen. First, there may be flooding at irregular times from storms and hurricanes. Secondly, the high rainfall prevalent throughout Florida will eventually bring the fill to field capacity with rapid decomposition and with subsequent rains causing leachate. Both conditions will prompt the passage of material to the surrounding ground water and/or surface water upon breakout. These conditions also will result in rapid decomposition of the refuse once it becomes wet. The process is inevitable, and unless controlled, the potential for contamination of ground waters is increased. Therefore, the objectives covering the Demonstration Project recognize this need for process control. The broad objectives are

... the demonstration that properly engineered drainage improvements - - combined with refuse cell construction which will prevent or minimize horizontal and vertical leaching of water through decomposing waste -- will prevent harmful degradation of both surface and ground waters within the project area

... the demonstration that the added cost of site improvements and cell construction in a high water table area to protect water resources is acceptable in relation to costs of alternate available methods such as incineration

... the demonstration that sanitary landfill construction equipment, properly selected to operate in relatively wet areas, is essential to the economic efficiency of this type of project

... the establishment of a practical, long term, well publicized example of sanitary landfill construction in 'wet' land which can serve as valuable guidance for similar projects in other areas of the nation.

The specific primary objectives of the Demonstration Project would be

... the development of design criteria and operating techniques for sanitary landfill construction in high ground water areas which take into full consideration the environmental impact and the cost of construction and operation

... the demonstration of feasibility and cost benefits of properly designed and operated landfills on sites in high ground water areas

... a well publicized example of landfill construction in high ground water areas.

As secondary objectives, the Demonstration Project should

. . . investigate the physical, chemical, and bacteriological characteristics of the aqueous environment in the refuse cells

. . . assist in strengthening the Environmental Sciences curriculum at Florida Technological University as a natural outgrowth of faculty and student participation in the conduct of the Demonstration Project.

In the reach for the project objectives, two basic approaches to landfilling were established, namely: (1) landfilling in non-dewatered trenches, and (2) landfilling in trenches having dry bottoms due to the lowering of the water table. The first condition cells are referred to as "control cells" since these would be typical of a non-ground water protection landfill operation. The second condition cells, or dry cells, are referred to as "demonstration cells" since the demonstration of a maximum resource protection landfilling operation is the specific purpose of the Demonstration Project.

The conduct of the Demonstration Project involves the time span covering the initial three year operation of the demonstration site. All refuse disposed of during the period covering the Demonstration Project will be landfilled in the "demonstration site", a portion of the 1,500 acre landfill site. Because of this distinction, all references to disposal areas and operations found within this report, unless otherwise noted or specified, refer to the "Demonstration Project" or "demonstration site".

Since Florida statutes do not authorize landfilling in non-dewatered conditions, specific approval was solicited and obtained from the State to construct and operate the "control cell" so as to permit comparative evaluations of dewatered and non-dewatered cell operations for the period of the grant.

PRELIMINARY CONCLUSIONS

Conclusions drawn through two years of construction and operation of the demonstration project suggest that, on the whole, functional operations and test results have been as anticipated. However, certain aspects should continue to be carefully monitored because of changes or conditions that have been observed.

Evidence is provided that "demonstration cell" designs for public use and for franchised refuse collectors are satisfactory. Procedures for added efficiency and economy in handling smaller public vehicles are being studied. Major difficulties were not encountered in filling "control cells" in accordance with the originally proposed methodology of control conditions. With respect to completed water quality investigations, there is conclusive evidence that ground and surface waters in and near the demonstration site were sampled sufficiently for documenting conditions that existed prior to the beginning of landfill operations.

The drainage system has proved to be effective in preventing flooding of the total project area during periods of intensified rainfall, and in lowering the water table in the "demonstration cell" area during "normal" rainfall conditions. However, intense rains have caused localized cell floodings. It is believed these cell floodings can be minimized if cell drainage ditches are maintained free of eroded silt and at the prescribed depth of eight feet. Experiments with pumping indicate a probable future solution to cell floodings brought about by heavy rains.

Sufficient data has been obtained from the monitoring program of the drainage system to detect any changes in water quality due to leaching from the landfill cells. Changes in the surface water quality as a result of the leaching of contaminated ground water have not been observed.

Water quality investigations of the Little Econlockhatchee River have shown it to be polluted from two separate areas of domestic waste effluents. One area is upstream from the point at which the landfill drainage canal enters the river and the other area is approximately eight miles downstream. The mixed flows from the outfall canal and the river remain relatively unchanged until the combined flow meets the highly nutrified Crane Strand Canal discharge. The then combined discharges flow northeastwardly to a meeting with the comparatively clean waters of the Big Econlockhatchee River, a tributary of the St. Johns River.

The biological background study of surface waters provided biota characterizations for each monitoring station for both winter 1971 and spring 1972 periods. Because of the additional pressures brought to the biota by the extreme low flow during 1971, the background study reflects an estimate of the worst "natural" condition which could be expected throughout the overall study.

The phytoplankton and periphyton investigations covering surface waters revealed a large variation in population size within the reaches of the canal and receiving river. The standing

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crop was high and variable in the river just above the outfall canal junction. Following downstream progression, the populations lessen in size and variation until another area of domestic waste effluent concentration is encountered (Crane Strand Canal). Here the population counts, as well as chlorophyll values, are again high and variable. The pond and outfall canal show a low standing crop quite common to soft acid waters.

The macroinvertebrate communities varied in size and density throughout the reaches of the canal and receiving river. For the river, pollution intolerant forms were limited primarily to the areas which had low algae standing crops or where water velocities were high. A limited but growing macroinvertebrate community was found in outfall canal waters.

Both the macroinvertebrate and algal communities support the variations in water quality found for each sampling station. Although the receiving river has areas of pollution sources both above and far below the entering area of the outfall canal, some recovery was found at Stations six and seven. These two stations located in the river proper will be instrumental in determining any adverse effects of the sanitary landfill operation. Although the aquatic life of the outfall canal has pressures exerted on them by just physical characteristics, there are many organisms found there which are intolerant or moderately tolerant of pollution. These particular organisms, as well as community composition will be highly indicative of the water quality in the continuing monitoring program.

It has been determined that a more limited monitoring program for the receiving water of the landfill canal and the pond should be initiated. A limited program should include the physical, chemical and biological analyses now investigated, but determinations should be made on a less frequent basis. Monitoring during high flow and low flow conditions should be adequate to determine the status of the receiving water. The pond and the outfall canal should continue to be monitored on a monthly basis to insure a more rapid detection of contaminated leachate and to be able to evaluate its effects on the water chemistry and aquatic life.

With one exception, the shallow well chemical sampling indicated pollution free water. The results provide excellent natural baseline information facilitating the detection of contamination from sanitary landfill leachate. Additionally, the results of all analyses made over a span of the several months involved indicate the water is acid and very low in solids, organics and microbial populations. A sulfur cycle seems to be operating as evidenced by the presence of H_2S in the sampled ground water. Fecal coliforms and other similar organisms of interest were not detected in ground water.

In the winter of 1971, contamination of the ground water was being detected from the Well 3 samplings. This well, enclosed in a burial cell, was observed to show an extreme increase in contamination rate through June 1972. This abrupt change in water quality was detected in a decrease in pH and an increase in acidity, dissolved solids, chlorides, hardness of ammonia nitrogen, organic nitrogen, temperature, chemical oxygen demand, conductivity, calcium, magnesium, iron, aluminum, sodium, potassium, and organic carbon. The failure to detect this contamination in other wells indicates the slow movement of water through the site as indicated in the initial geological investigations.

With this information on ground water movement and the chemical and bacterial characteristics of the contaminated leachate, a more limited but comprehensive monitoring program can be designed to include the more important inorganic, organic and bacterial characteristics. This program should concentrate on the wells near the filled area with only limited monitoring of the more remote wells.

On the basis of Florida Technological University analyses, the preliminary conclusion is that degeneration of organics is occurring rapidly in cells. However, in accordance with the geologic reports, little movement horizontally is occurring. This may be in part due to the fact that two low rainfall years have existed in the two years of the project. With normal rainfall more apparent differences may have occurred. Other wells close to cells may show gross contamination in future third year sampling based on preliminary indications.

Total Model Landfill expenditures during FY 1971-1972 (October 1, 1971 through September 30, 1972) to process 138,461 tons of refuse showed a cost/ton ratio of $3.37 for the period. On the basis of the FY 1972-1973 budgeting and expected tonnages, this cost is expected to decrease to $2.81 per ton. This decrease can be attributed to stability of operating techniques, improvements in equipment maintenance, and growing personnel experience in landfill procedures. Increased tonnages expected as a result of closing the County's Porter Landfill during 1973 may serve to further reduce the ratio to approximately $2.35/ton. Continued procedural refinements and techniques of operation should eventually stabilize costs in the vicinity of $2.00/ton.

In the consideration of direct costs applicable to individual cell construction, filling and covering, sufficiently reliable data is not presently available with which to realistically determine cost ratios. Of difficulty is the determination of those costs not contributing directly to the operation. However, a preliminary estimate of $1.35/ton has been made by the County. This figure does not include indirect costs such as management, water quality monitoring, weighmasters, watchmen, clerical and billing, some office supplies, maintenance and administrative vehicles. This figure will be refined in subsequent reporting for each type cell construction as cost becomes meaningful.

Problems of personnel stability are decreasing, equipment maintenance is being improved to lessen down-time and operating procedures are being tested to determine optimum landfill operation under the existing high water table conditions. Customer cooperation has been good, giving every indication of community acceptance of the landfill operation as a superior method of solid waste disposal over prior methods within Orange County.

SITE SELECTION

The proposed Demonstration Project would require a particular area. Accordingly, a number of factors had to be considered during the selection process. These factors offered a variety of limitations and restrictions. Working within the frame of these limitations and restrictions, a number of possible landfill sites were evaluated. Following this evaluation, an area was chosen for the Demonstration Project Area within the acreage purchased for the sanitary landfill operation.

Preliminary Considerations

Orange County, located in rapidly growing Central Florida, extends some 48 miles from east to west with a maximum north-south width of 30 miles (see Figure 1). It is bounded on the north by Seminole and Lake Counties, on the west by Lake County, and on the south by Osceola County. The eastern boundary is the St. Johns River which separates Orange from Brevard County.

According to the 1970 Census of Population, the latest population count for Orange County was 344,695. Approximately one-third of these resided in the City of Orlando. Major on-going and planned developments within the county, such as Walt Disney World, are expected to have a major impact upon the overall development of the area. Consequently, it is anticipated the present population will double in numbers during the next 15 to 20 year period. Solid waste volumes should increase accordingly from the presently estimated yearly quantity of about 1.3 million cubic yards to an estimated 2.9 million cubic yards by 1990 (Figure 2).

There is sufficient evidence of serious concern by Orange County officials regarding the proper management of solid wastes. Various in-house studies have been prepared during the last decade. The Orange County Planning Department, in April 1967, issued a report titled *Proposed Solid Waste Disposal Program for Orange County, Florida.* This report was the proposed implementation program covering recommendations made in an earlier in-house report entitled Solid Waste Disposal Study. It provided the design of a program for the efficient and sanitary disposal of solid waste within Orange County.

The basic overall recommendations of the completed studies suggest the closing of existing dumps, the abandonment of small landfill operations, and the consolidation of operations in an engineered system including a major landfill and a network of transfer stations. It was further recommended that the site selected for the central landfill operation have enough capacity to serve through the year 1990. It should, ideally, be located in an area where other vacant land would be available for expansion.

Even though Orange County does not provide waste collection services, the overall cost to the residents of the area for the handling of solid waste was a primary concern. Thus, a system of transfer stations sufficient to serve a widely scattered populace was recommended.

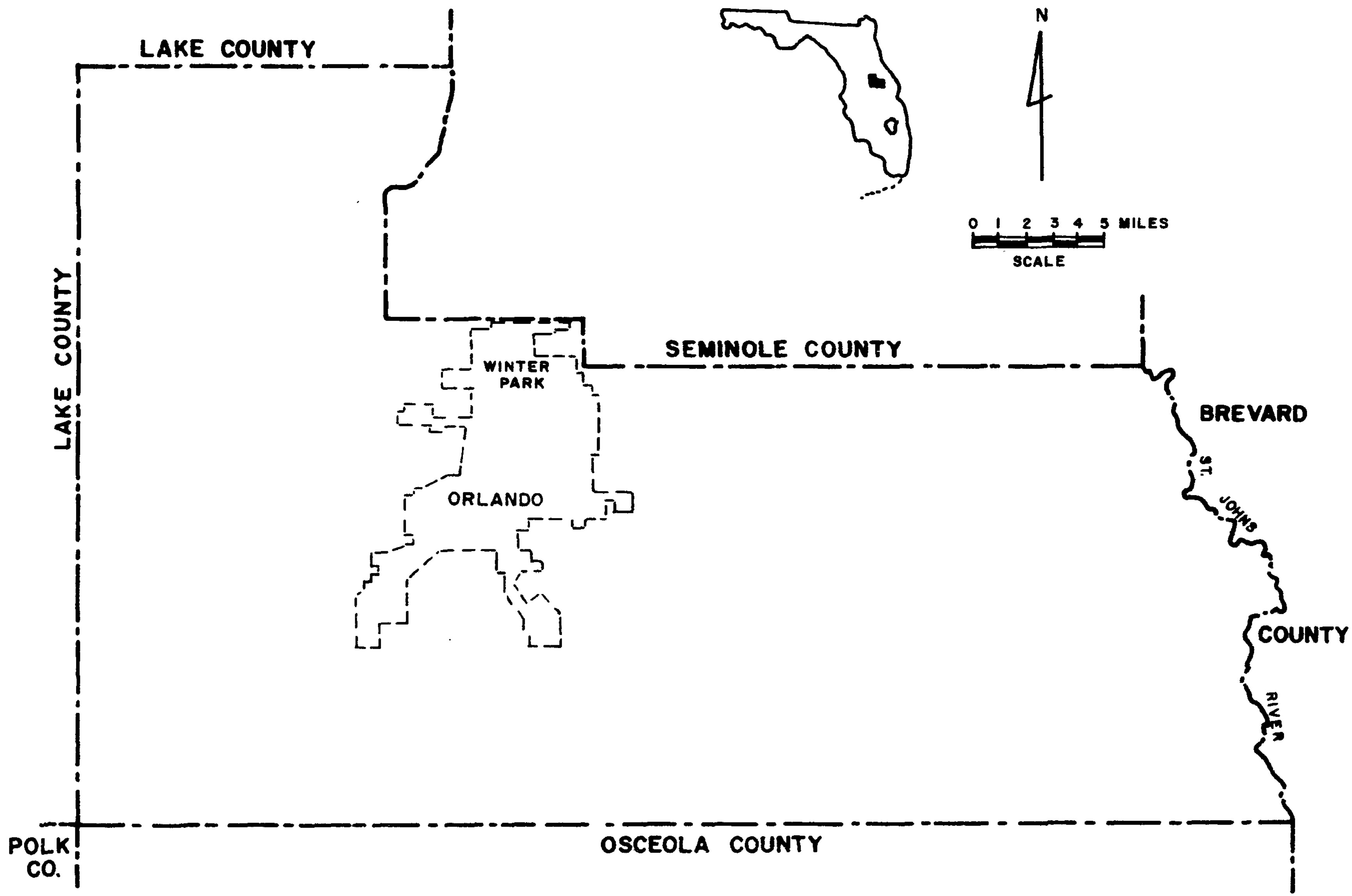

FIGURE I. Vicinity Map of Orange County, Florida.

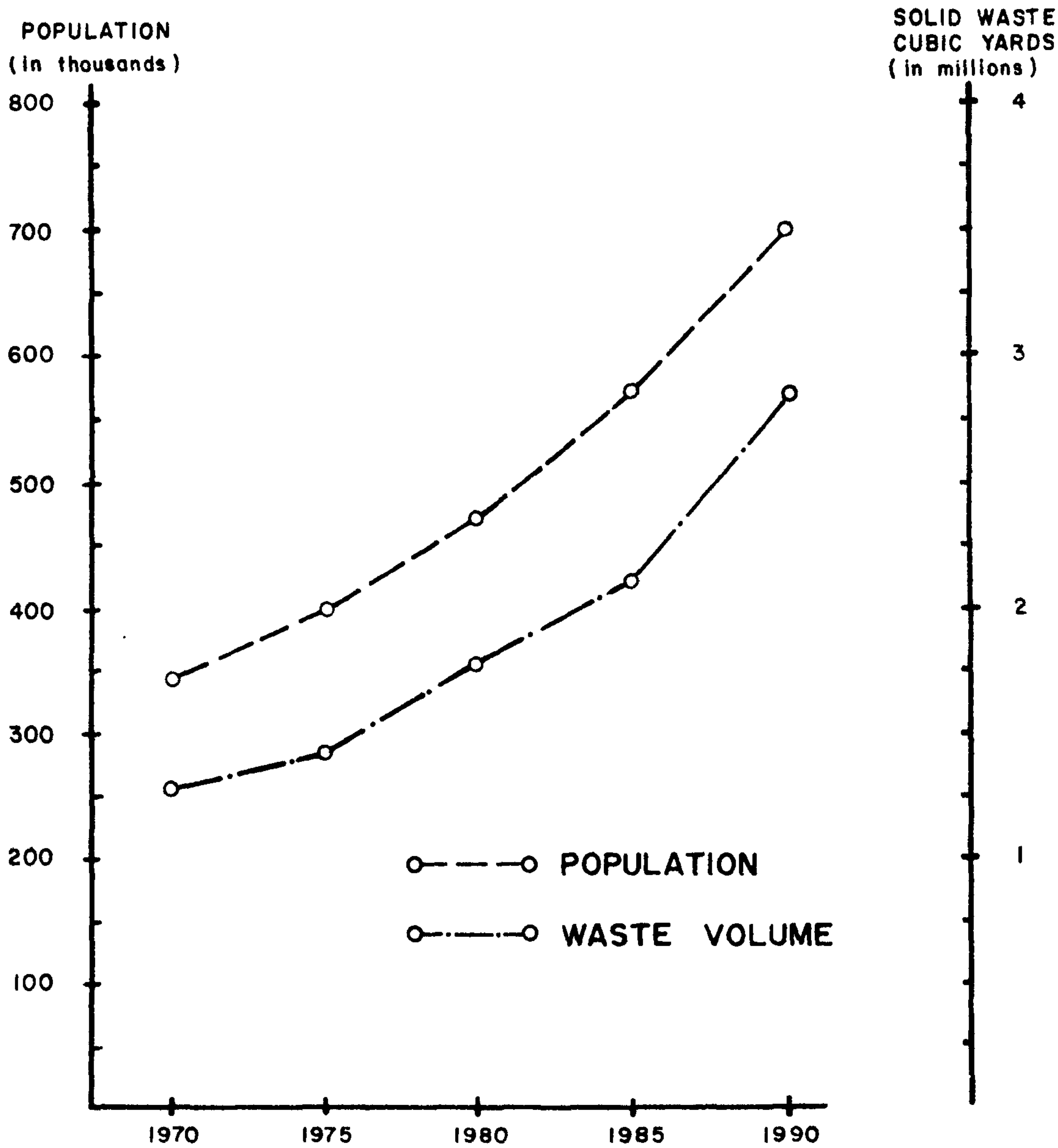

FIGURE 2. Population & Solid Waste Generation Projection, Orange County, Florida.

SOURCE : 1970 Preliminary Census Count, U.S. Department of Commerce (Special unpublished report), Atlanta Georgia.

Population Forecasts, East Central Florida Regional Planning Council.

Fortunately, a modern road system existed throughout Orange County. This road system made the transportation of wastes from transfer stations to a centralized landfill operation a ready possibility.

The overall relationship of the road system to available lands was important to area selection. The existence of these roadways would minimize access right-of-way acquisitions.

Electric power and telephone services are available to all sections of Orange County. Therefore, availability of these services to any area selected could be assumed. It was assumed further that potable water would be available. Where a municipal source would not be available, local ground water resources were readily developable.

The then existing solid waste disposal system servicing Orange County included three dumps, six landfills (two located in Seminole County), one transfer station and two incinerators (Figure 3). Some of these facilities (incinerators, transfer station and landfills in Seminole County) are not under the jurisdiction of the Orange County Board of County Commissioners. The proposed system, now under the program of implementation, is shown in Figure 4. The site shown in Figure 5 was chosen as the central sanitary landfill and as the demonstration site.

Site Considerations

The more important considerations were those concerned with geographical location, climatology, geology and hydrology. The more important aspects of each of these considerations are discussed in the following paragraphs.

Geographical Location. The site selected for the Demonstration Project is in central Orange County some ten miles southeast of Orlando. It covers an area of 1,500 acres. The covered area is considered as marginal flat land with a high water table. Pine and palmetto growth and native grasses are the predominant vegetation. There are some swamp areas, which include cypress stands as well as mixtures of ordinary trees and shrubs (Figure 6). Ground elevations range from approximately 78 to 92 feet above mean sea level (MSL), as shown in Figure 7.

Climatology. The climate of Orange County is considered subtropical. Temperatures are greatly modified by winds blowing across the area from either the Gulf of Mexico or the Atlantic Ocean. The summers are warm and humid. Thunderstorms occur almost every afternoon during the summer months. Winters are short and mild with many days of bright sun and little precipitation. However, short cold spells can be expected occasionally during the winter months. The average annual temperature is 72.5 F, with an average winter temperature of 62.6 F and an average of 81.8 for the summer months. The estimated rate of evapotranspiration in the area is about equal to the average annual rainfall of 50 to 51 inches.

The nearest complete weather station is located at Herndon Airport, some eight miles from the project area. Due to wind variations in local weather patterns, it would be erroneous

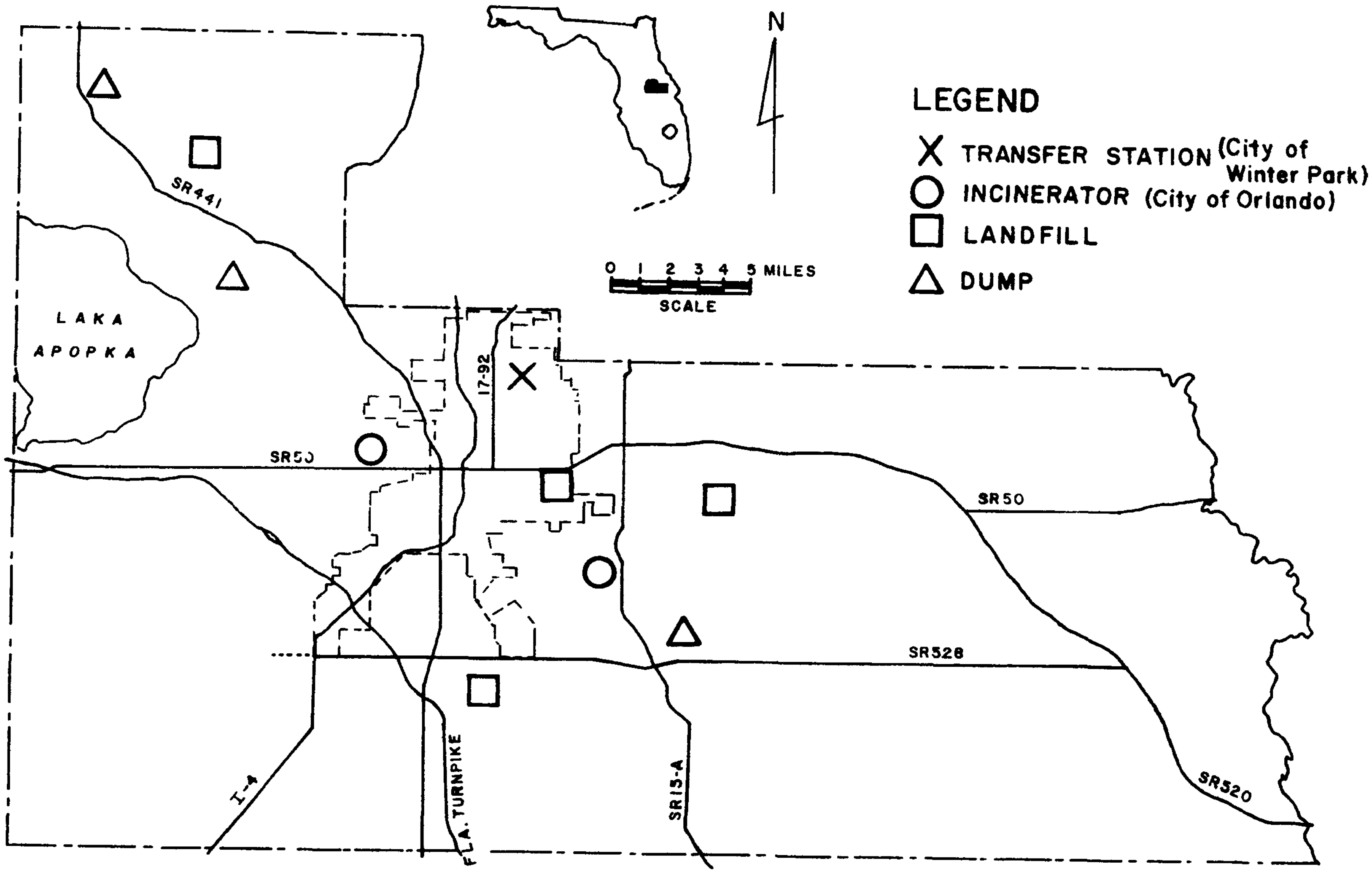

FIGURE 3. Previously Existing Solid Waste Disposal System, Orange County, Florida.

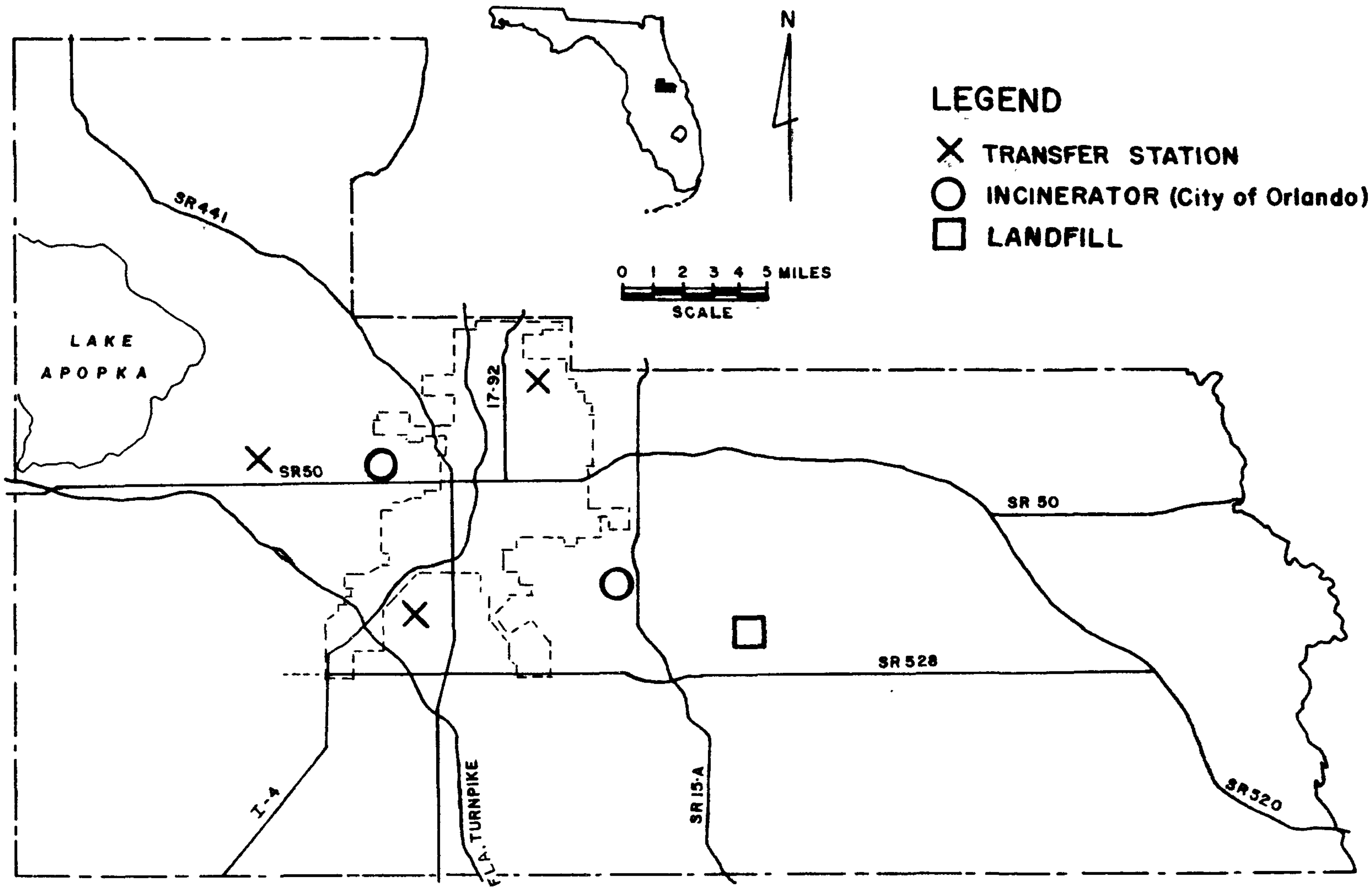

FIGURE 4. Proposed Solid Waste Disposal System, Orange County, Florida.

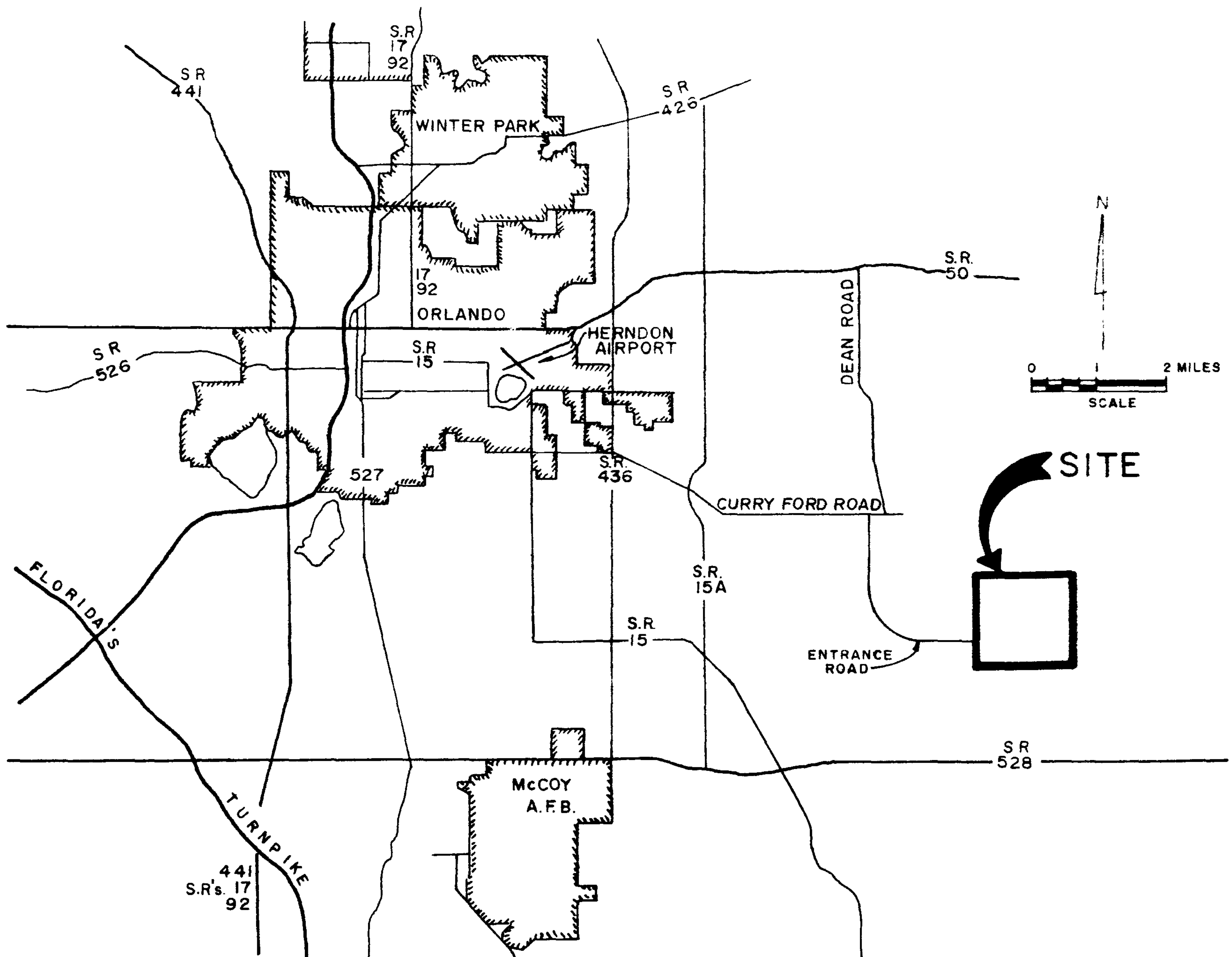

FIGURE 5. Vicinity Map of the Orange County Sanitary Landfill.

FIGURE 6 Cypress Grove in Swampy Area of Landfill Site Prior to Drainage Improvements.

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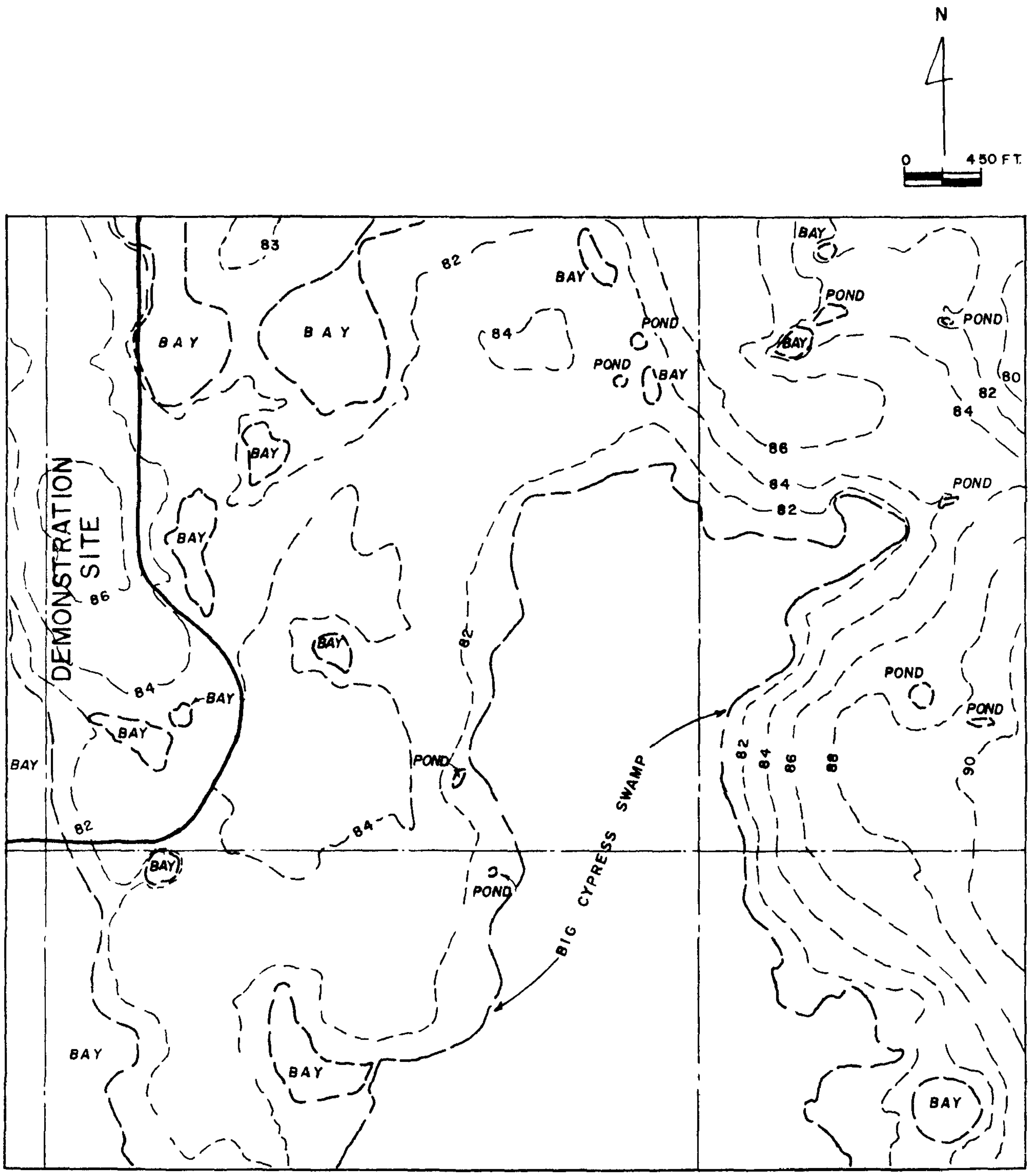

FIGURE 7 Topographic Map of Landfill Site, Orange County, Florida.

to utilize Herndon Airport weather data as applicable to the project area, especially rainfall data. Therefore, in view of the potential importance of the relationship between climatological conditions and the various parameters being monitored at the demonstration site, a weather station was installed. The installed facilities include a Belford tipping bucket rain gauge with recorder and counter and a Temp-scribe temperature recorder.

Geology. Peninsular Florida is underlain mostly by fragmental and marine limestone, sandstone, and shale formations which reach a known cumulative thickness of more than 18,000 feet. Few deep well developments in Florida have penetrated crystalline rocks such as granite and hornblende diorite. Such rocks, when found, are believed to be either Pre-Cambrian or Paleozoic intrusives. The core of the Florida plateau is Pre-Cambrian.

A layer of Pleistocene sand with an estimated thickness of 25 to 35 feet is found at the demonstration site. Plio-Miocene deposits of land pebble phosphate, shark teeth, Manatee rib fragments, shell fragments, sand, and sandy clay underlay the Pleistocene sand. The thickness of the phosphatic and shell layer ranges from approximately four to eight feet. An impermeable layer of clay is found beneath the phosphatic zone. Organic or muck deposits of varying depths are also found at the demonstration site. Sinks, developed through solution process affecting the limerock, are common in much of Florida. However, sinks have not been found in the project area.

Hydrology. Rain water, when it becomes ground water, percolates downward until it reaches an impervious strata, then moves laterally toward an outlet. Sometimes the movement is in permeable rock between impermeable layers. The water bearing rock formation is known as an aquifer and the water above the impermeable cap is known as free ground water.

Florida has one of the great aquifers of the world. This aquifer discharges billions of gallons of water each day to the surface through springs and flowing wells. The recharge of ground water is so great, however, that only a very small percentage of the annual rainfall is lost through natural runoff. The piezometric water level at the project site is approximately 40 feet above MSL. Due to the relatively minor changes in elevation at the landfill site, water movement in both the horizontal and vertical directions is assumed to be non-existent. Variations in the water level are due to rainfall, evaporation and transpiration. Prior to the construction of drainage improvements at the demonstration site, the project area had a history of temporary flooding. During hurricane occurrences, or periods of extreme rainfall, flooding may be a problem. But, inundation of the project area as a whole is not expected, nor did it occur during the Hurricane Agnes passage in mid-June 1972. Procedures to alleviate cell floodings are discussed under the "Landfill Operations" section following.

The movement of the topmost ground waters is affected mostly by surface soil deposits and their geological deposition. In a layered system such as is found at the demonstration site, the lateral permeability is the governing factor in ground water movement. And for the most part, three surface soils are found throughout the entire site. The first layer, a light brown fine sand, overlying a brown fine sand locally known as "hardpan", exists throughout the entire project area but in varying thicknesses. It is found from a high elevation of 83 feet to a low elevation of 77 feet measured from MSL. The third layer, the layer immediately below the "hardpan", is a light brown fine sand with slightly more silt in its composition than found in the surface deposits. The movement of the ground water is restricted by the occurrence of the "hardpan". For while the lateral permeability of the surface soils is estimated to be between 700 to 800 feet per month, the lateral permeability of the "hardpan" is restricted (40-100 feet per month). Accordingly, it can be assumed the surface ground water movement will be within the first soil layer and not in the "hardpan".

For soils similar to these found at the demonstration site, the normal ground water hydraulic gradient is 150 feet horizontal to 1 foot vertical. This is considered to be the minimum gradient needed for water movement within the first soil layer. However, lateral movement of water at the demonstration site could be induced by the construction of drainage channels below the water table.

Surface and ground water elevations of the entire project area were determined in November 1970. These are shown in Figure 8. The maximum water elevation recorded then was 86.3 feet above MSL. Respecting the demonstration site, the ground water elevations were approximately 79 feet above MSL. Throughout most of the Project area, the naturally occurring ground water table is found within five to eight feet below the existing ground elevations.

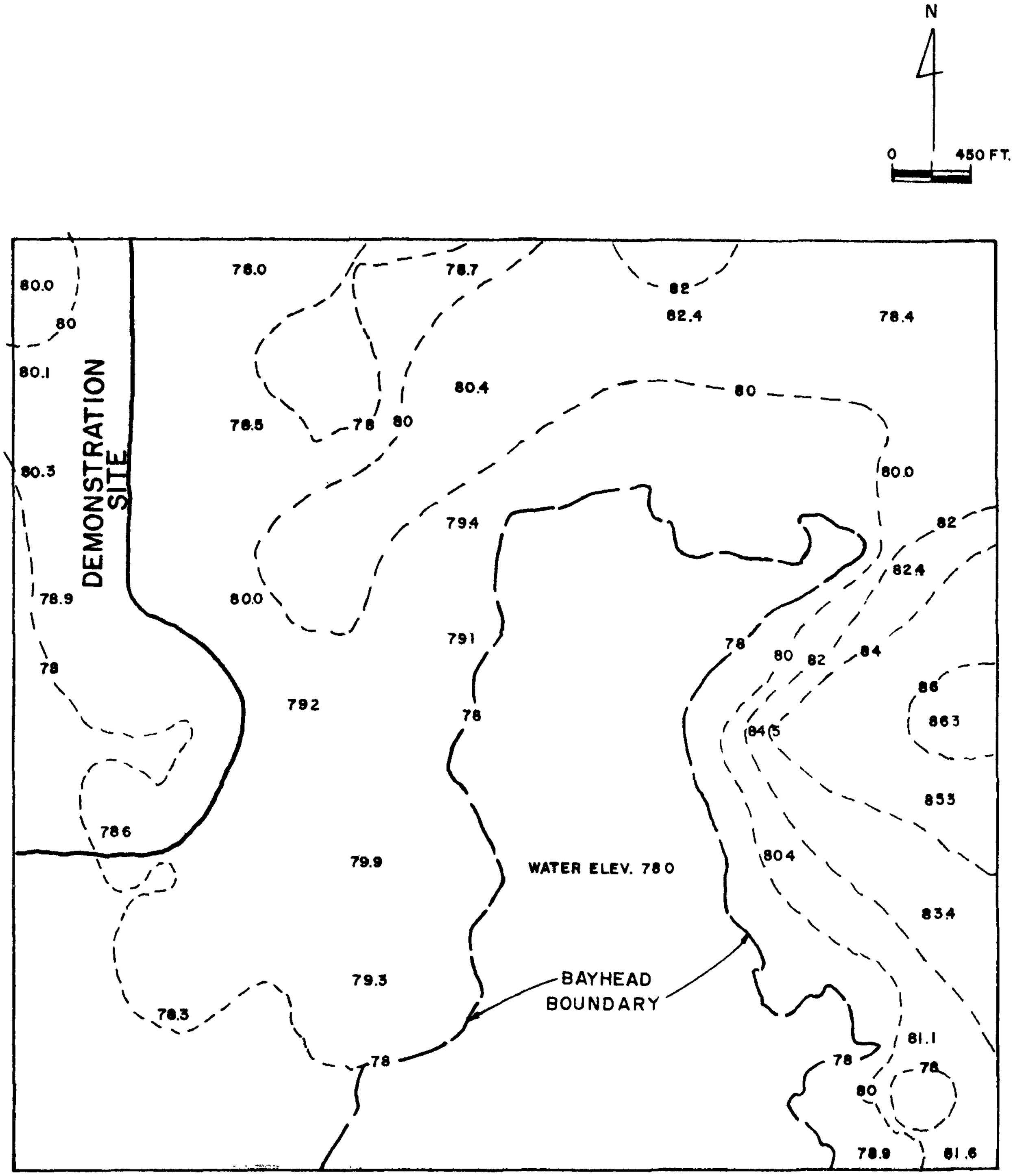

FIGURE 8 Ground Water Map of Landfill Site, Orange County, Florida.

THE SANITARY LANDFILL

The landfill operation was opened on June 7, 1971, on a limited basis, to franchised residential refuse collectors. Difficulties in obtaining equipment adequate to handle the anticipated tonnage of waste generated in Orange County prevented the start of full operations at the demonstration site at that time. The landfill has been in full operation since October 4, 1971.

Site Development

The development of landfill operations required the construction of both on-site and off-site roads and drainage improvements as well as on-site facilities. The off-site improvements discussed in the following paragraphs refer to those indispensable for operation of the landfill, i.e., the access road to the project area connecting to the closest existing improved road, and the outfall canal connecting the demonstration site to the nearest major drainage channel. The on-site improvements, in turn, refer to those made within the project boundaries.

Access Road. A 3.1-mile access road from Curry Ford Road to the project area was built as an off-site improvement (Figure 9). This facility includes two 12-foot lanes. It passes through an area of heavy organic deposits or muck. Accordingly, 200 feet of 5 to 8-feet muck deposits had to be excavated and the excavation backfilled with suitable road material. An important phase of the access road construction project was the landscaping of the entrance (Figure 10) and the erection of fences and gates (Figure 11).

Circulation Roads. Prior to Project area improvements, the alignment for a system of circulation roads servicing the 1,500 acre site was established. The system was designed to insure adequate vehicular circulation commensurate with the land use proposals established for the project area (Figure 12, Proposed Use Master Plan), and to provide access to the disposal areas during landfill operations. Since approval of the Proposed Use Master Plan, interest has been expressed in the potential utilization of the entire landfill site for recreational purposes. However, the road system will remain as planned. There will be no landfilling of disposal waste within the established road rights-of-way. Construction of appropriate roads will be similar to that established for the access road. Approximately 2,500 feet of circulation roads have been completed with a 1,500 foot extension under construction.

Outfall Canal. Drainage has been a major consideration in the construction of the various project area improvements. This consideration was in response to the high ground water table conditions found throughout the project area and the existence of a series of swamps within the landfill site. An outfall canal - about 2.7 miles long - was excavated from the landfill site to the banks of the Little Econlockhatchee River (Figure 13). This canal was designed to provide rainfall drainage sufficient to accommodate an accumulative, four-day rainfall of approximately ten inches and covering the 1,500 acre landfill site. The overall design dimensions for the canal provided a 9-foot depth, a 30-foot bottom width, and side slopes of 2 to 1. Presently, the bottom width is 15 feet since only one-half of the canal has been excavated.

FIGURE 9 Access Road Under Construction Adjacent to the Outfall Canal.

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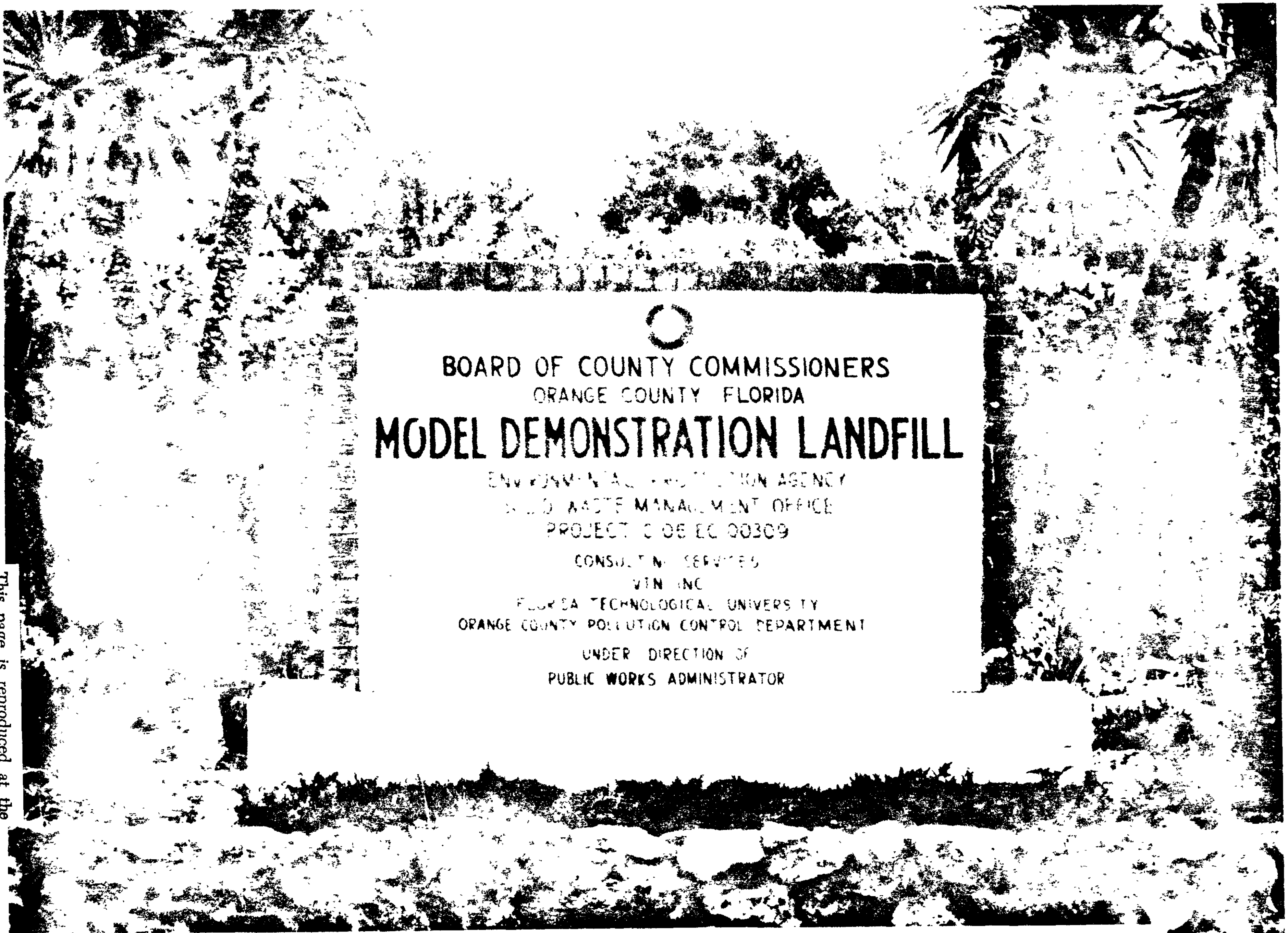

FIGURE 10 Entrance Landscaping and Sign, Orange County Sanitary Landfill.

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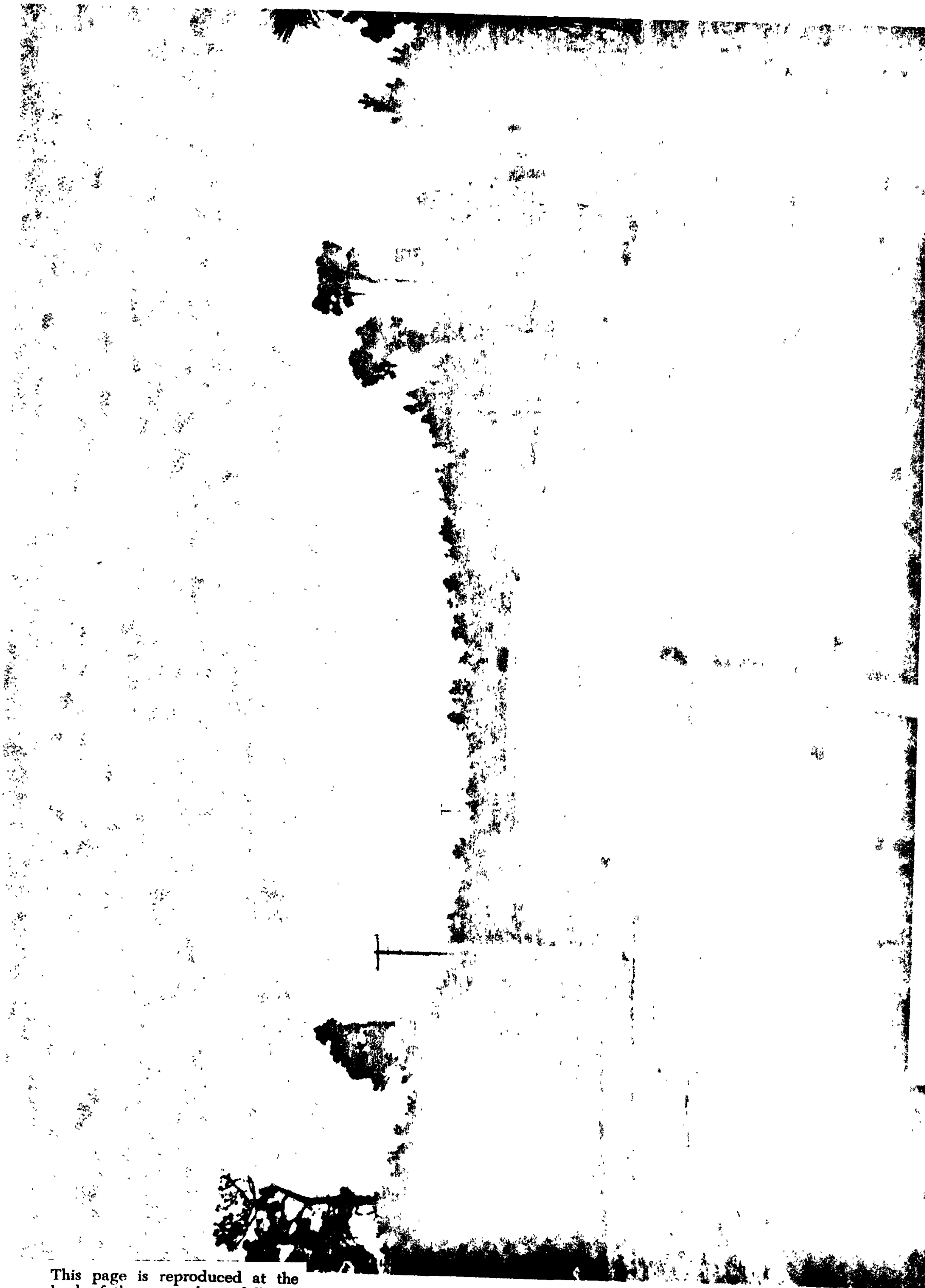

FIGURE II Entrance to the Orange County Sanitary Landfill.

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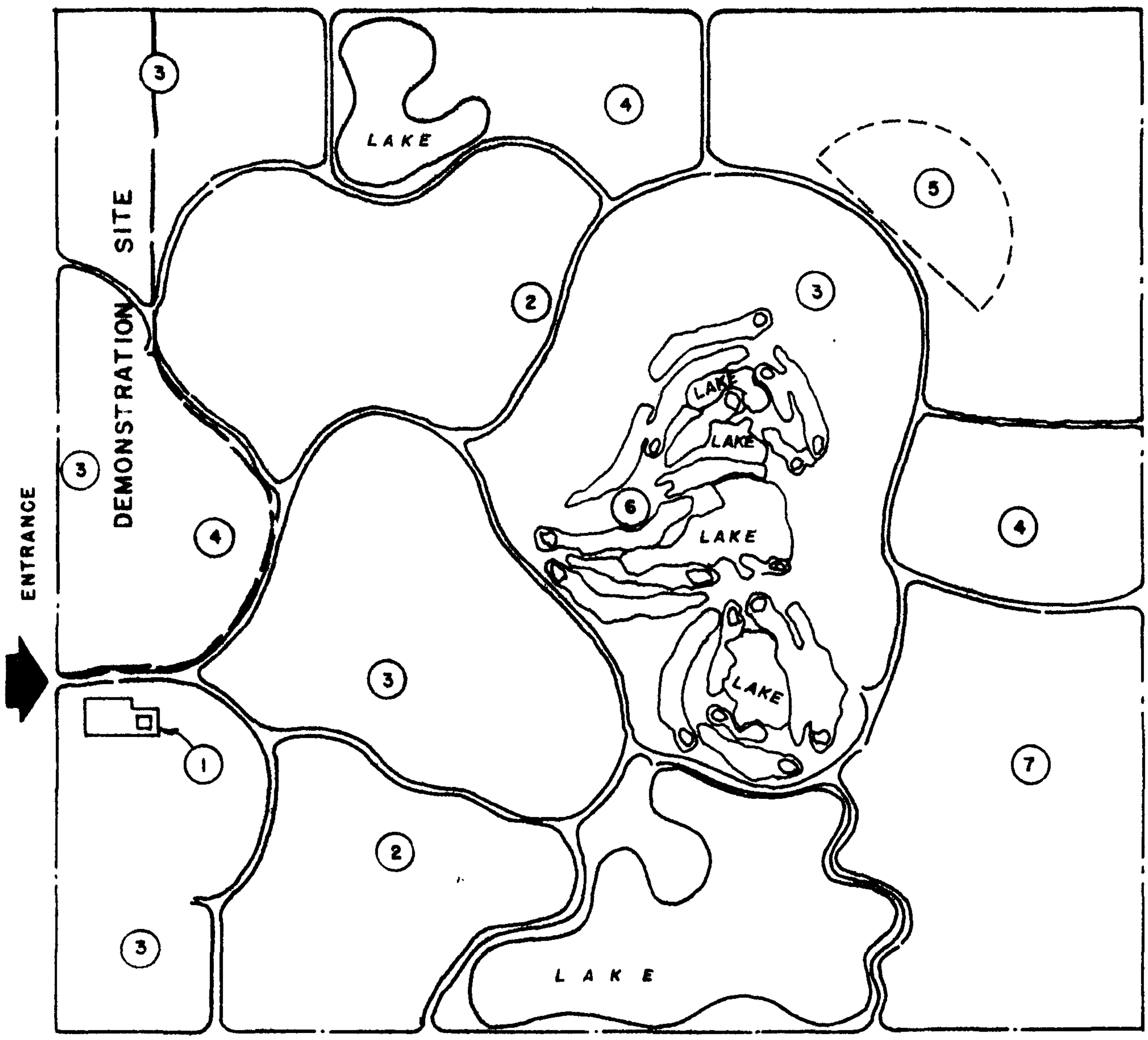

① MAINTENANCE COMPLEX
② MOBILE OR MODULAR HOMES
③ PARK
④ CAMPING
⑤ RECREATION AREA
⑥ GOLF COURSE
⑦ INDUSTRIAL PARK

FIGURE 12. Proposed Future Use Master Plan, Orange County Landfill Site

FIGURE 13 Main Channel of the Little Econlockhatchee River.

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While construction of the outfall canal was underway, it became apparent that excavation in two phases was desirable in order to provide some drainage and to permit an initial minimum lowering of the ground water table. Accordingly, only one-half of the canal was cut in its entire length. To lessen turbidity, which appeared in the Little Econlockhatchee River during construction, it was necessary to partially dam the outfall canal and to pump the water to bordering fields while excavation was underway.

The landfill site has been subjected to several occurrences of high intensity rainfall following the completion of the first half of the outfall canal. During these occurrences, no flooding of the areas served by the drainage system has been observed. Neither has the depth of water in the canal been of any significance. This would indicate the canal is adequate for preventing flooding of the demonstration site.

Drainage Channels. A network of drainage channels has been established for the demonstration site. The network includes (1) main drainage channels designed to prevent surface waters from entering the landfill and to provide a collection system for rainfall runoff, and (2) a series of minor drainage channels to be constructed in the "demonstration cell" area as a means of permanently lowering the ground water table (Figure 14). Additionally, the open cells act as natural catch basins during periods of heavy prolonged rainfall. Waters so collected move laterally into the drainage channels at a very minimal rate.

The main channels are designed for a 20-foot bottom width and 2 to 1 side slopes. The average design depth is nine feet with a maximum anticipated water depth of three feet. The cell channels are spaced at intervals of 300 feet. These cell channels are designed for a 3-foot bottom width and 2 to 1 slopes. The average design depth for these cell channels is eight feet with an anticipated maximum water depth of three feet.

As previously mentioned, there have been several occurrences of intense rainfall at the project site. Aside from some cells, there has been no flooding of areas drained by the channel system during these rainfall periods. In the drained areas, the water table has been drawn down at least five feet with no detectable rise during heavy rainfall periods.

Ponds. The construction of two ponds for the collection of surface runoff and possible leachates was planned as a necessary first phase activity. A four day detention period was used as a design base since it was anticipated that 50 percent of the rainfall would be lost by evaporation and vertical percolation. Pond "A", located near the "demonstration cells" (See Figure 15), has a surface area of seven acres. The construction of this pond was expedited by excavating a perimeter channel with a dragline as a means to lowering the water table. A self-propelled, self-loading earth mover was utilized in completing the excavation. Pond "B", originally planned for the "control cell" area, was to have a surface area of four acres. Following special ground water movement studies by the retained ground water geology consultant, it was found that construction of Pond "B" could lower the ground water level in the "control cell" area and adversely affect

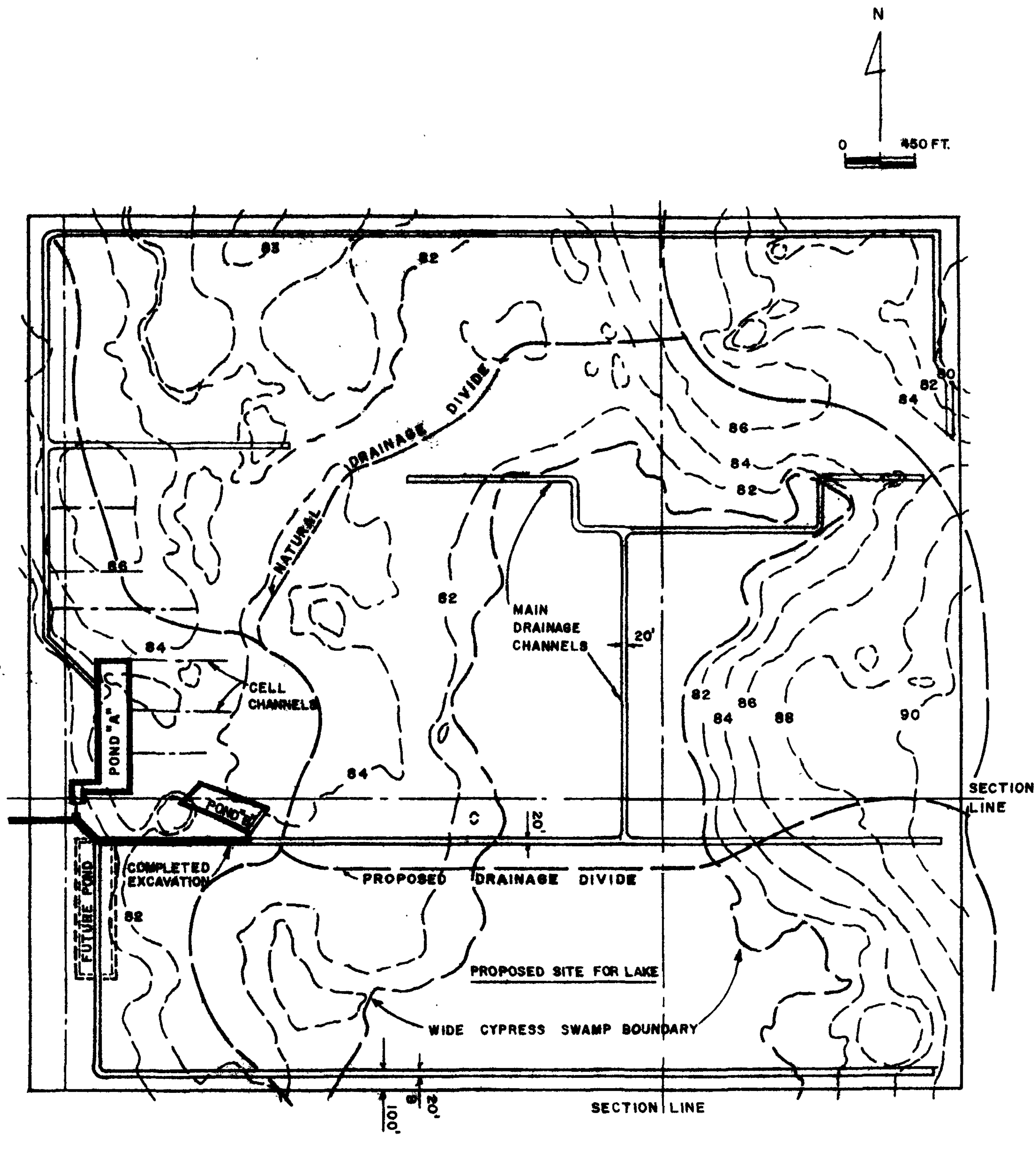

FIGURE 14. Master Drainage Plan, Orange County Landfill Site.

FIGURE 15 Drainage Pond A, Orange County Sanitary Landfill.

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the control conditions necessary to the Demonstration Project. Accordingly, the construction of Pond "B" was halted following the excavation of the perimeter channel.

Facilities. Extensive facilities have been constructed at the demonstration site (Figure 16). These provide for optimum operation and management of the project area. The completed facilities are (1) an air-conditioned concrete-block office building including a small lounge, storage room, and complete sanitary facilities (Figure 17); (2) a concrete-floored, prefabricated metal service and maintenance building including three bays for equipment service and maintenance, and equipped with a two-post lift, an air compressor, and a 20-ton overhead bridge hoist (see also Figure 17); (3) a concrete-block scale house, housing a 50-ton capacity Fairbanks-Morse scale with an automatic printing mechanism (Figure 18); (4) a pumphouse, housing chlorinator, a 1,000-gallon water tank, and pump to serve a 6-inch potable water well; (5) a washrack, including a prefabricated metal storage building, equipped with a high pressure pump for trailer washing; (6) a fuel tank storage area with pump island; and, (7) septic tanks for receiving sanitary waste and for trailer washing waste.

Landfill Operations

Initially, the hours of operation for the landfill activities were 7:00 a.m. to 6:00 p.m., Monday through Friday, and 7:00 a.m. to 12:00 noon on Saturdays. The landfill is now open from 8:00 a.m. to 5:00 p.m. Monday through Sunday, for a total open period of 63 hours each week when wastes are accepted at the demonstration site. The County restricts the personnel work week to 40 hours. However, some equipment is on 80 hours/week operation due to site pre-opening work and finishing operations following closing to the public. As such, various personnel shifts are needed for operation of the landfill.

When first opened, the landfill operation was accepting approximately 30 loads of refuse each day, or about 600 cubic yards. The estimated density of these loads was approximated at 500 pounds per cubic yard. The demonstration site, now in full operation, is accepting an average of 8,300 loads or about 12,000 tons of refuse each month. Information pertinent to operation is included in the following paragraphs.

Personnel. Personnel administration has been the responsibility of the Superintendent of Orange County's Solid Waste Disposal System, with various key members and staff assigned on a limited basis to the overall administration of the Demonstration Project.

The initial operations staff included (1) two dozer operators, responsible for all construction, compaction and daily covering; (2) one self-propelled scraper operator, assigned to cell and road construction, and to provide assistance in the daily covering operation; (3) one weighmaster; and (4) one landfill foreman assigned to the Demonstration Project on a half-time basis. As indicated earlier (see Acknowledgements) personnel from the County Pollution Control Department are assigned to Orange County solid waste disposal operations.

The operations staff has been expanded to include: (1) nine heavy equipment operators; (2) four weighmasters; (3) five maintenance men; (4) three watchmen; (5) two mechanics; and (6) two mechanics helpers. In addition, administrative positions include: (1) the Superintendent

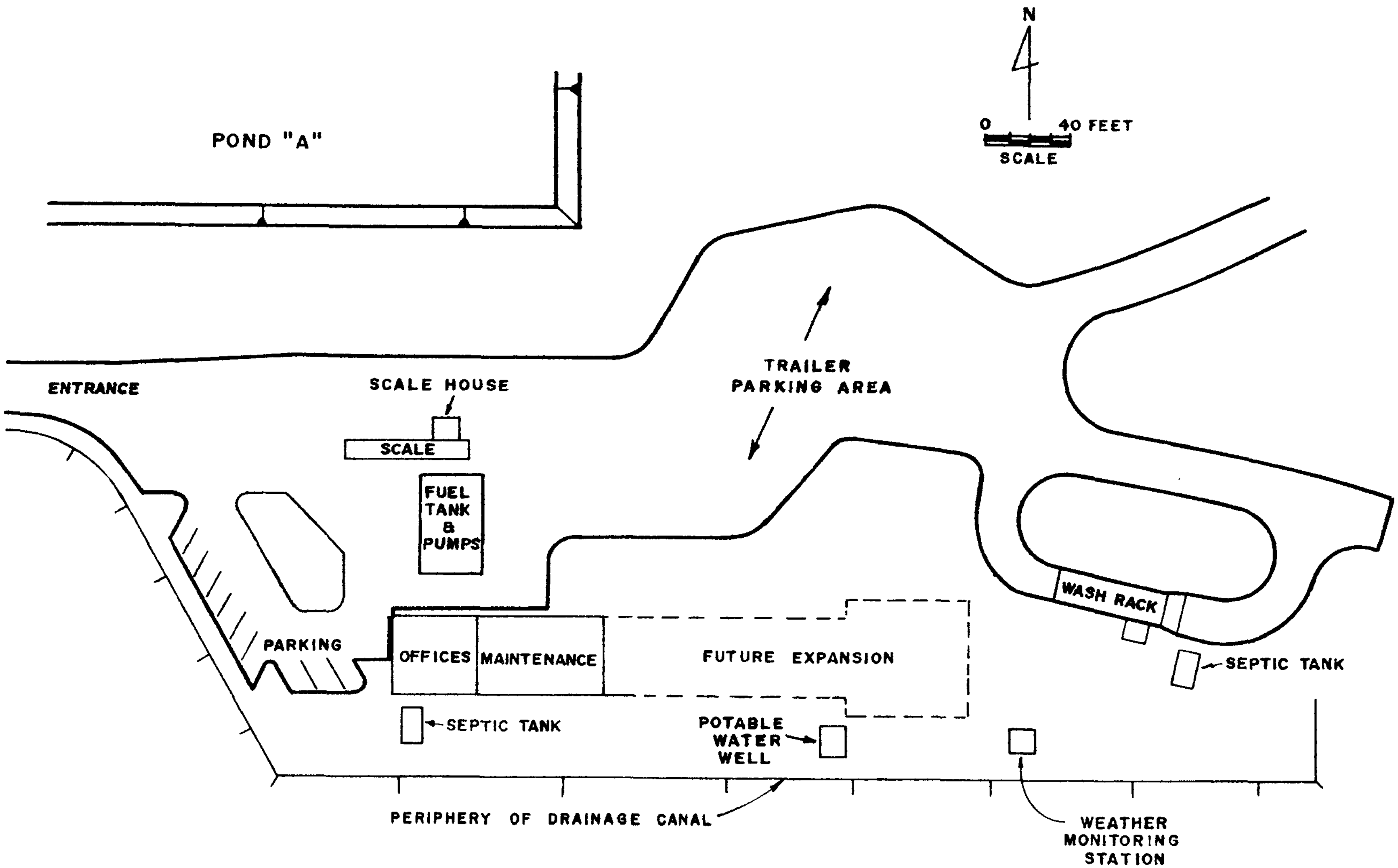

FIGURE 16. Orange County Sanitary Landfill Operation Control, Maintenance and Service Facilities.

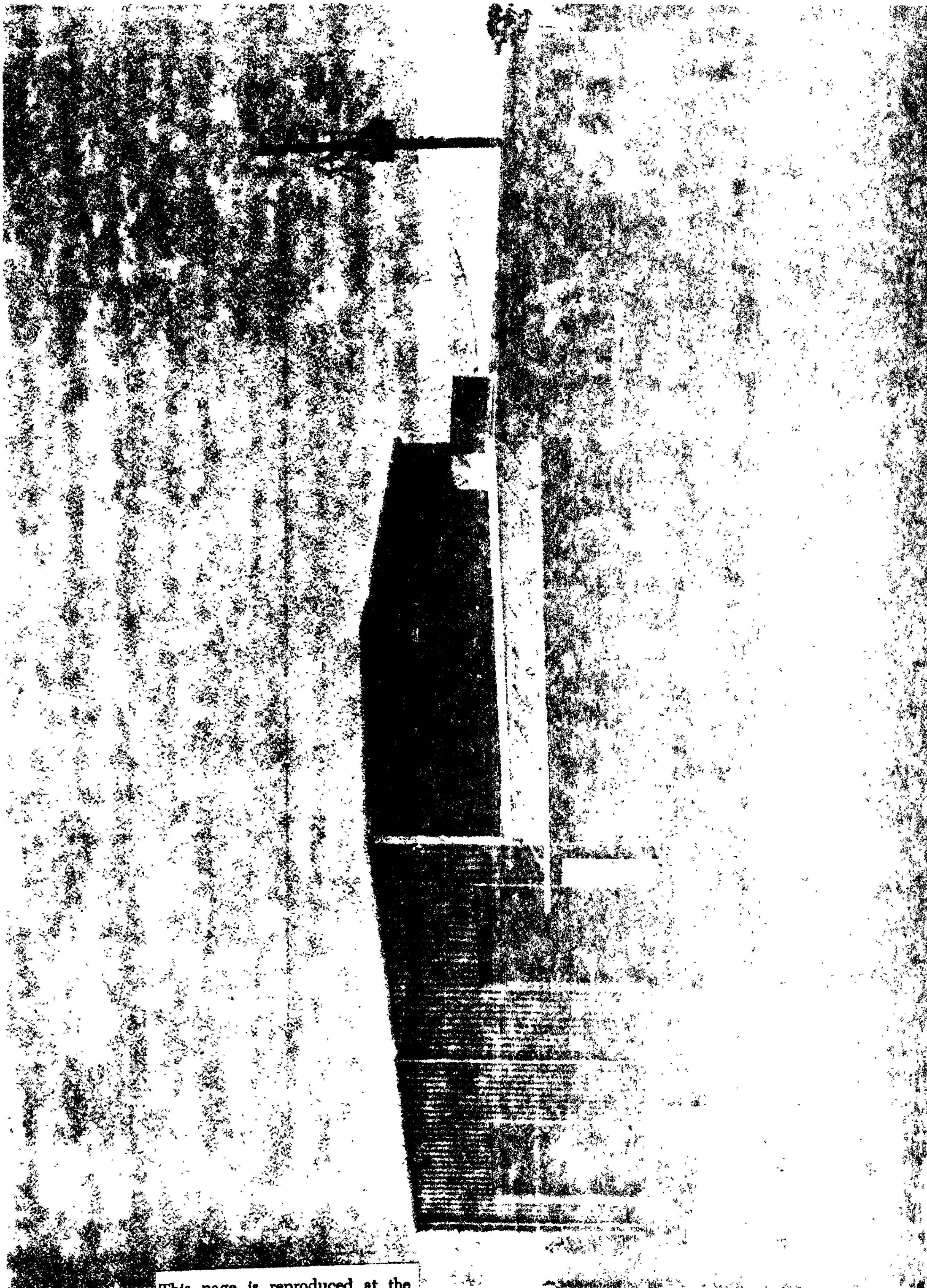

FIGURE 17. Landfill Office and Equipment Maintenance Building.

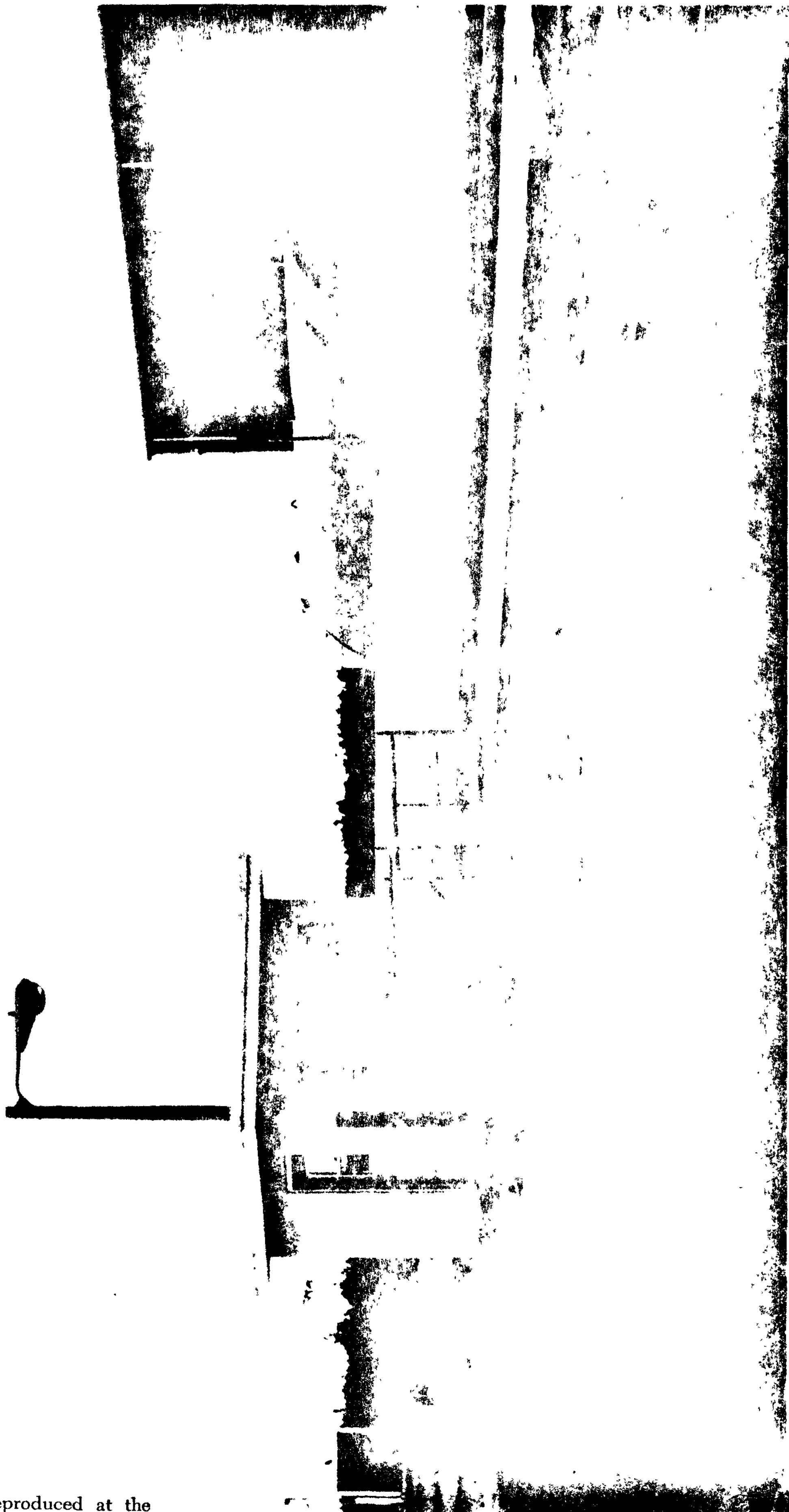

FIGURE 18. Scale House and Service Buildings, Orange County Sanitary Landfill.

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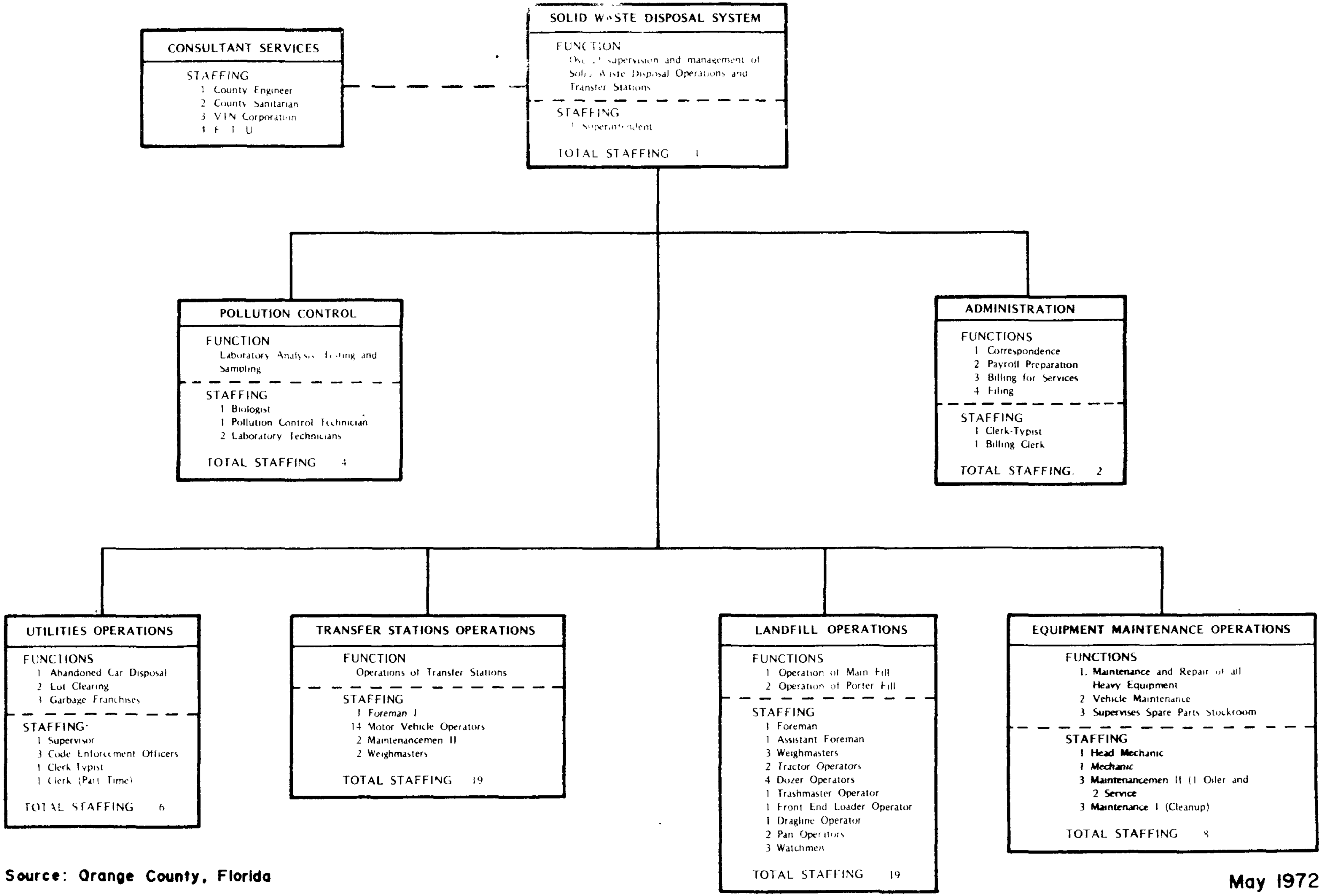
of Solid Waste Disposal Systems assigned to the Demonstration Project on a half-time basis; (2) one landfill supervisor; (3) an assistant landfill supervisor; (4) two clerks assigned on a half-time basis, and (5) four full-time and two part-time personnel from the County Pollution Control Department assigned to the waste disposal operations. The total number of personnel is determined by operating hours as established by the Board of County Commissioners, and by the policy of the Board of County Commissioners for employees to work only 40 hours/week. Accordingly, the expanded manning supports operations on a necessary two-shift basis so as to comply with the instructions of the County Commission.

The Orange County solid waste disposal organizational chart is included as Figure 19. The manpower requirements for transfer operations are shown on the chart since these operations are an integral part of the disposal program even though they operate separately from the landfill activities. Most of the position titles are self-explanatory; however, the dragline operator will have additional responsibilities covering drainage improvement construction. The self-propelled scraper operator will also be responsible for road construction.

Equipment. The equipment being used in this landfill operation is either equipment obtained for the Demonstration Project or transferred from the old landfill and dump operations. The equipment in use includes (1) one recently overhauled International Harvester TD-20 dozer (14 years old) with blade used for compaction, cell construction and cover; (2) one International Harvester EC-270 (21-cubic yard, self-propelled scraper pan) used for cell construction, clearing, road building and cover hauling; (3) one International Harvester TD-15 dozer (approximately 14 years old) with 4 in 1 bucket; (4) one Rex-Trashmaster Compactor Model 3-50 (approximately 6 years old); (5) one Northwest 95, 3-cubic yard dragline; (6) one International Harvester TD-25C dozer with blade; and, (7) the required service trucks.

Design and Construction Procedure. The primary purpose of this Demonstration Project is to develop proper landfill design and operating techniques for areas affected by high water table conditions. Accordingly, two basic approaches to landfilling were formulated. These approaches suggest (1) landfilling in non-dewatered trenches, called "control cells", and (2) landfilling in "demonstration cells", or trenches having dry bottoms due to the lowering of the water table. The two types of cells are illustrated in Figure 20.

The Control Cell. The basic design of a "control cell" is shown in Figures 21 and 22. Development of a cell requires excavation of a trench to a depth of eight feet. Filling and compaction are undertaken to the extent possible under the prevailing wet conditions. A six inch daily cover and a final two foot earth cover are part of the design. Due to the potential problem with floating material within trenches, sections of the "control cells" are separated by earthen dikes. The excavation to the water table is made with a self-loading scraper and/or dragline. Final excavation, to the area below the water table, is with the dragline. Initial plans called for filling to within two feet of the ground surface with a final two feet of cover. Experience with the first cell showed large quantities of excavated material unused and a decision was made to



Source: Orange County, Florida

May 1972

FIGURE 19 Organization Chart for Solid Waste Disposal System - Orange County, Florida

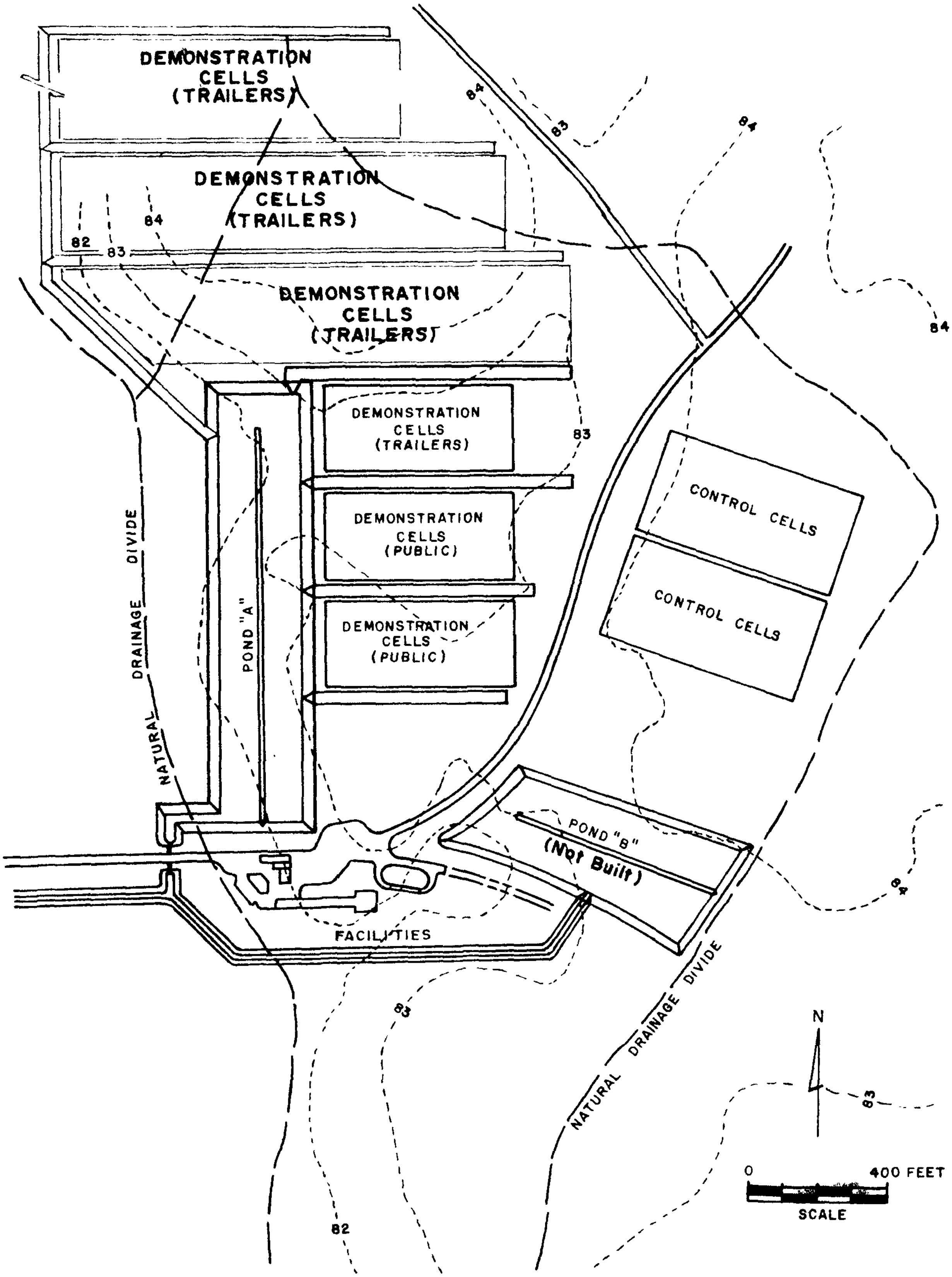


FIGURE 20 Landfill Site Plan for First Year Operations, Orange County Sanitary Landfill.

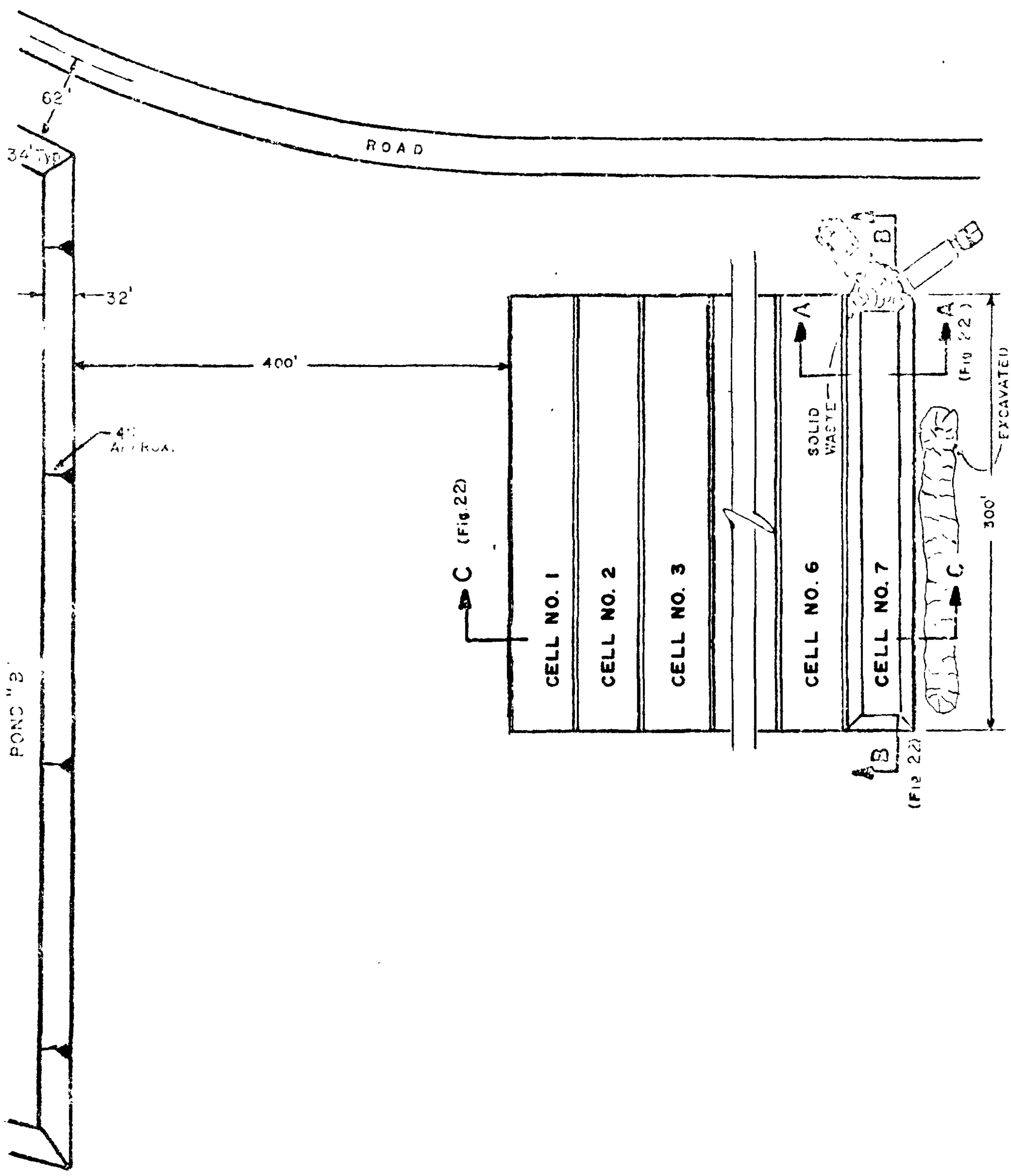
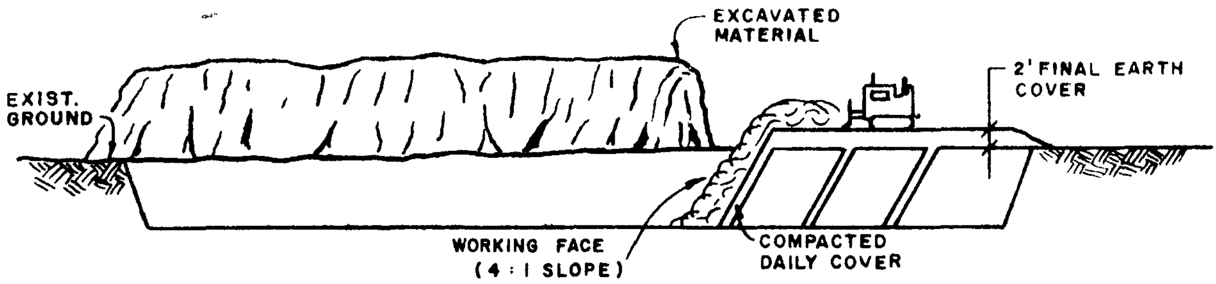
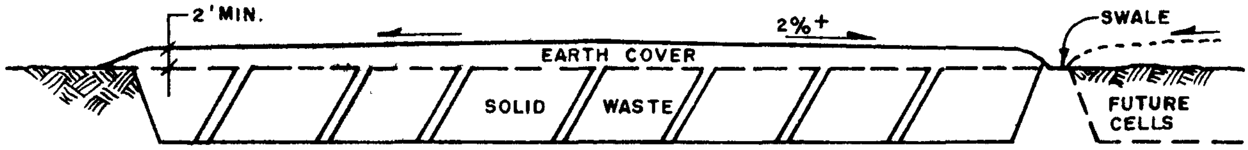


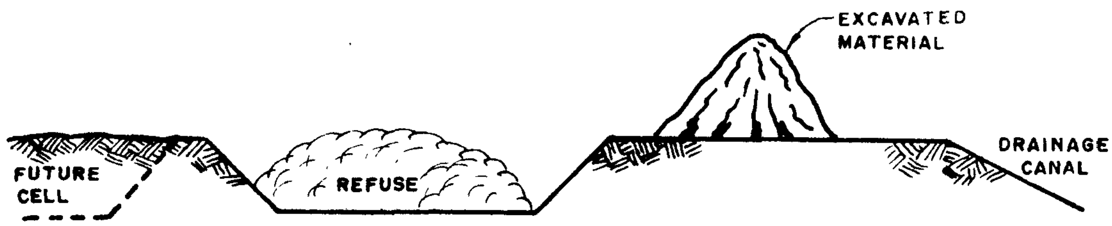
FIGURE 21 Plan View of Control Cells



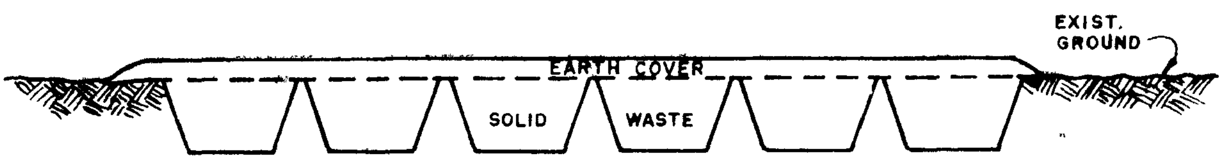
SECTION B-B
(Fig. 21)



FINAL SECTION B-B
(Fig 21)



SECTION A-A
(Fig. 21)



SECTION C-C
(Fig. 21)

FIGURE 22 Construction Sequence and Cross Sections of Control Cells.

fill to four feet above the naturally occurring ground surface. Thus the cell is approximately 12 feet of solid waste filling and two feet of final cover.

Control cells constructed to date are 100 feet wide and 500 feet long. Projected construction of control cells retains the same widths, but lengths will vary.

The Demonstration Cell. The "demonstration cells" are of two basic designs, depending on the anticipated use. These are (1) cells for use of the public and (2) cells for use of county trailers and commercial franchised collectors. Both types are built in areas permanently dewatered to a depth of at least five feet by the construction of drainage channels. The initial basic design for the public "demonstration cells" is shown in Figures 23, 24, and 25. This design was found inadequate due to the large quantities of waste handled. The public "demonstration cell" design is now of the progressive trench type. In these cells, refuse is first placed and compacted in thin daily layers separated by a six-inch layer of soil which serves as the daily cover. The overall depth of the cell is eight feet and the final cover is at least two feet. The transfer trailer "demonstration cells" (Figure 26) are being built in one eight-foot lift with a minimum of two feet of final cover. These two types of "demonstration cells" are separated to maintain a safe and orderly traffic flow and to expedite waste handling operations for trailer and commercial accounts.

Demonstration cells for public use, designated as CP1 and CP2, are each 260 feet wide and 600 and 700 feet long, respectively. Demonstration cells designated as CT are to accommodate commercial and franchised haulers, and are dimensioned as follows: CT0, 260 feet wide, 800 feet long; CT1, 260 feet wide, 1,400 feet long; CT2, 260 feet wide, 1,300 feet long; CT3, 260 feet wide, 1,000 feet long; and CT4, 260 feet wide, 800 feet long.

The surface slopes for all cells are at a grade of at least two percent to the nearest drainage ditch. These slopes are periodically regraded as required by cell consolidation and settlement.

Figure 27 shows a typical load of refuse being unloaded at the bottom of the working face of a demonstration cell.

Operational Experiences. Since June 7, 1971, solid waste disposal has been in both "demonstration" and "control" cells. Public use disposal has been confined to cells CP1 and CP2, somewhat removed from CT and CC (Control Cells) cells, to alleviate congestion and promote orderly and rapid flow of traffic. These cells have been able to accommodate, on the average, up to 36 vehicles per hour; however, some individuals persist in taking up to 30 minutes to unload. This points out the value of the spotter in attempting to reduce vehicle positioning time at the cell edge. "Demonstration Cell" CP2 was initially used for public disposal from October 4, 1971 through February 14, 1972, but was only partially filled (870 tons) to a depth of four feet, and 90 feet wide. On the latter date, cell CP1 was opened for use. Cell CP1 contains 23,229

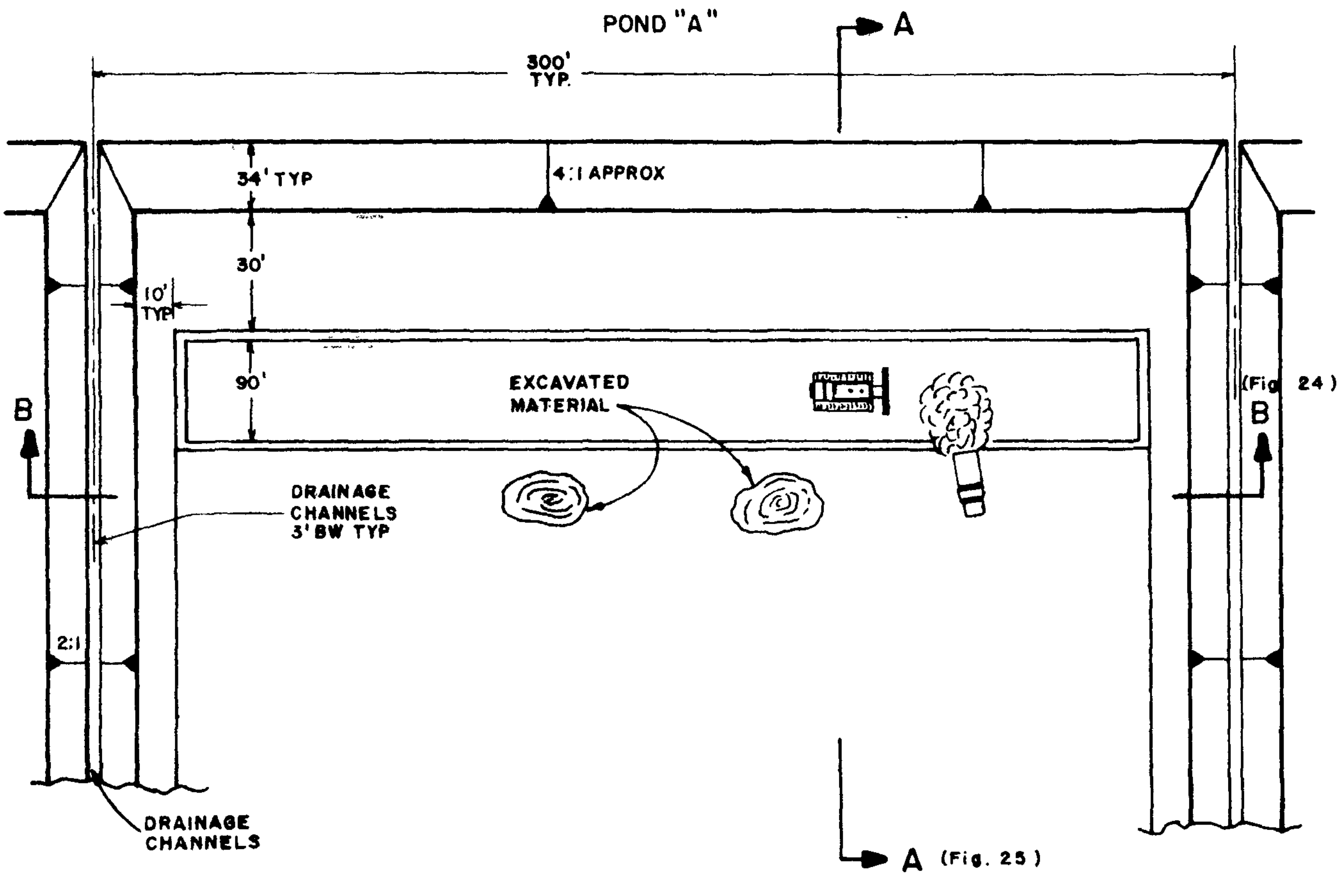
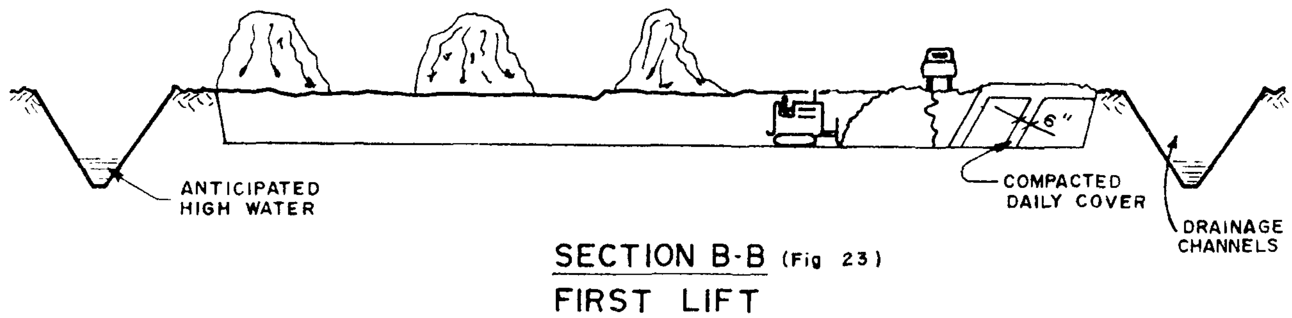


FIGURE 23 Plan View of Original Public Access Demonstration Cells



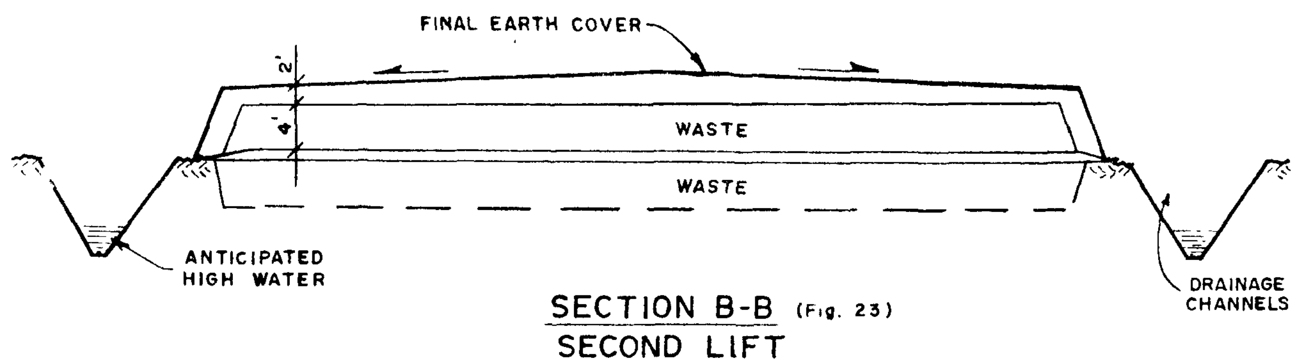


FIGURE 24 Construction Sequence and Cross Sections of Original Public Access Demonstration Cells

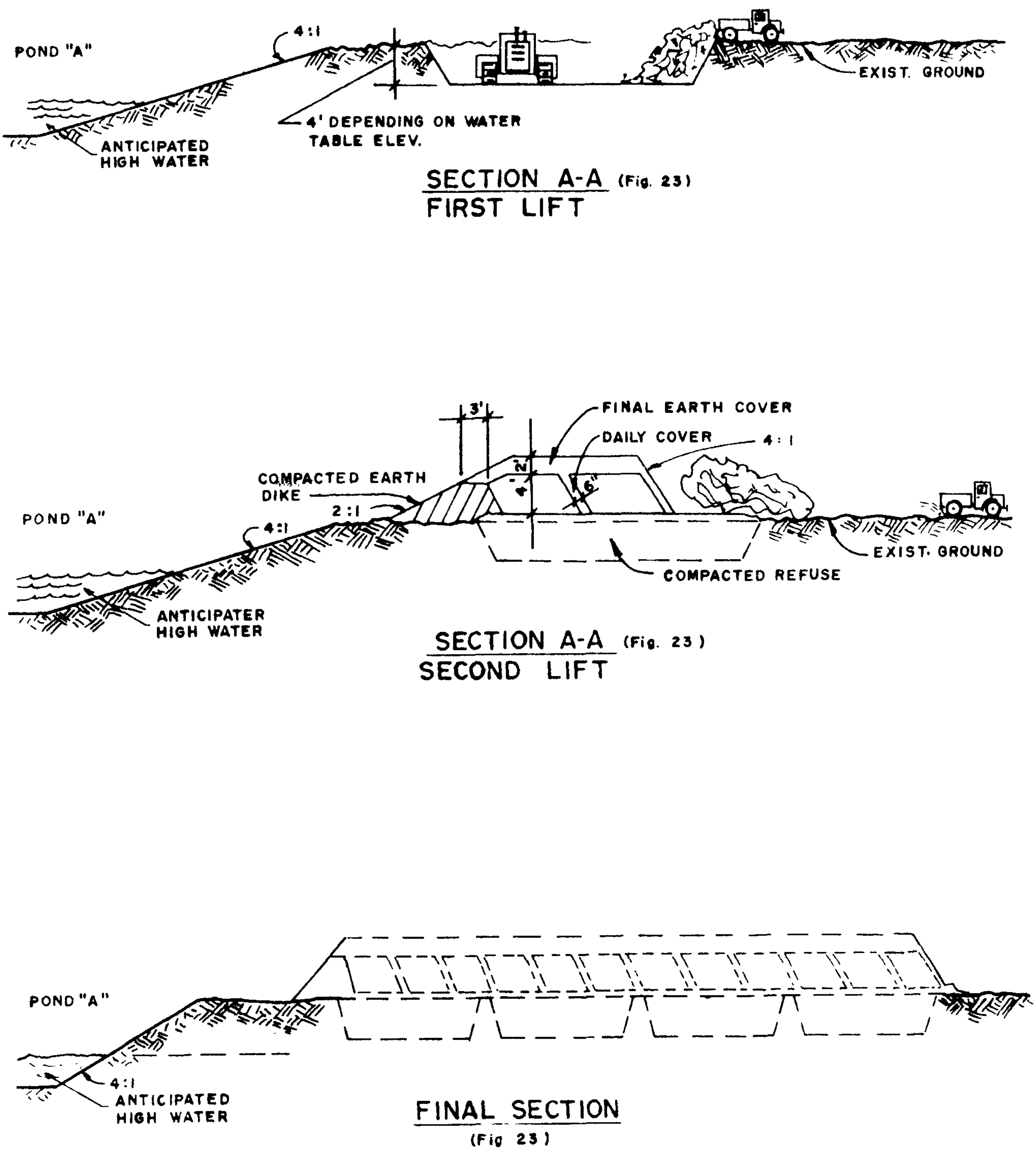


FIGURE 25 Construction Sequence and Cross Sections of Original Public Access Demonstration Cells

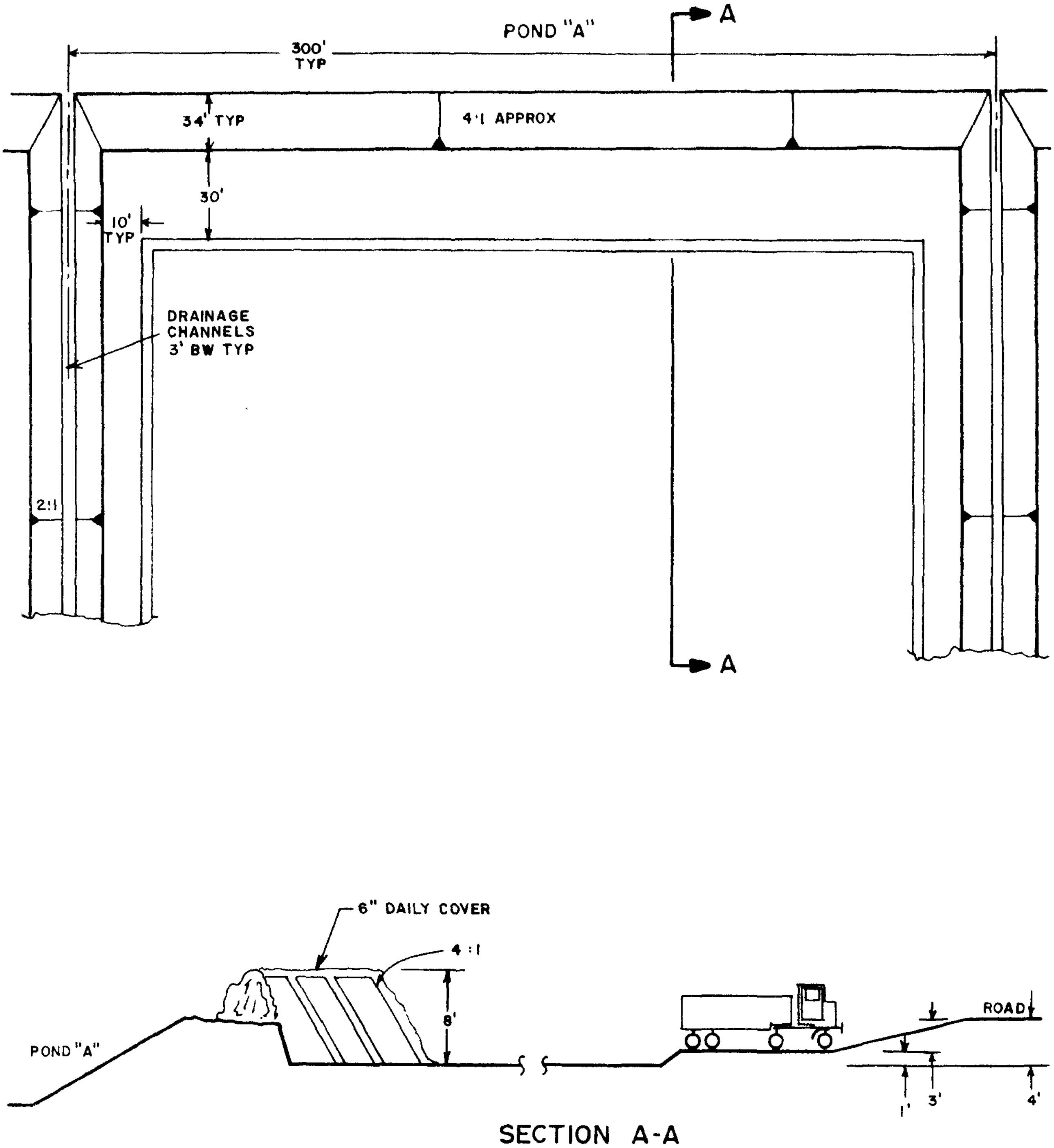


FIGURE 26 Plan View and Cross Sections of Transfer Trailer Demonstration Cells.

FIGURE 27 View of Typical Refuse Being Accepted at the Orange County Sanitary Landfill.

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tons of compacted waste to a depth of eight feet, with two feet of earth top cover, and is still in the process of filling. Cell CP2 is not presently being utilized.

Cell CT0 was first excavated to a three foot depth - the final one foot of excavation being part of the process of obtaining the daily cover for compacted refuse. Difficulty of running a loaded scraper up the open face of the cell appeared to be the only operational problem. Provision will be made in the construction of future cells for insuring better access to the cell top for the scraper. Cell CT0 was filled as of October 11, 1971, with 24,800 tons of compacted refuse, eight feet deep and two feet of earth top cover.

Filling of cell CT1, as dimensioned previously, was started on March 20, 1972, and is presently 100% filled to an eight foot depth of refuse and two foot top earth cover.

A series of "control cells", designated CC1 through CC7, is in varying stages of completion. Cell CC1 was filled with refuse to ground level (as per original plan) with eight feet of refuse and topped with two feet of earth cover. Cells CC2 through CC7 have, or will have 12 feet of refuse with two feet of earth cover. Initial cell filling begins at the cell point nearest the on-site roadway and progresses to the cell end. Filling is to an approximate six foot depth distributed across the cell width, and is being continually compacted and covered daily. Upon reversing fill direction back to the road, an additional six feet of waste is added on top of the existing layer, and is similarly compacted and covered with a final two foot top earth cover to complete the cell.

From October 12, 1971, commercial and franchised haulers were directed to the "control cells" for dumping. Cell CC1 had been filled (10,053 tons) and covered by January 12, 1972. Cell CC2 was started on February 5, 1972 and stopped on March 20, 1972 -- it is now only partially filled (5,574 tons) with four feet of refuse. Cell CC3 was filled from October 12, 1971 to February 4, 1972, with 12 feet of refuse (13,278 tons) and topped with two feet of earth cover. Cell CC4 was started on March 10, 1972 and stopped March 20, 1972. It contains 700 tons of refuse to a depth of 4.5 feet over a 150 foot length. Cell CC5 has been "panned", but not finally dug with the dragline -- filling has not begun. Cell CC6 was filled from December 12, 1971 to March 20, 1972 with 12 feet of refuse (15,825 tons) and topped with partial final earth cover. Cell CC7 has been "panned" to ground water level, but not finally dug with the dragline -- filling has not begun as of the date of this report.

As discussed previously, periods of heavy, prolonged precipitation can, and have, caused some problems with cell floodings and have created temporary muddy conditions at cell entrances. Flooded cells prohibit vehicle entry for unloading, and create undesirable operating conditions for heavy equipments on the cell floors. As a result, during such periods unloadings were diverted to cell tops, and cover operations had to be also directed from the top rather than in accordance with the progressive trench method originally proposed. Future CP type cells will be of the CT type operations and waste will be discharged from above the level of the cell floors, if necessary. Spotter personnel are instrumental in directing traffic flows away from muddied areas.

Insofar as cell inundations are concerned, experimentation with pumping appears to provide the relief necessary to maintain proper working conditions within the cells and preserves the dewatered condition required. Lateral movement of excess waters through the cell walls, as well as vertical percolation through the cell floors has been minimal. To speed this water removal, the pumping procedure will be considered for future operations as weather conditions dictate.

In order to maintain effective drainage into cell perimeter drainage ditches, the depths of ditches are maintained at a level below that of the cell floor. This requires periodic dredging of accumulated silt in the ditches. Were this type of maintenance not done, silt accumulations would defeat the purpose of the ditch system.

The problem of disposing of excess earth from "control" cell excavations was eliminated by stockpiling for future use, use in road building and increasing the solid waste disposal depth from 8 feet to 12 feet. Control Cell 1 remains as originally planned, being filled to ground level and covered with two feet of earth.

As of March 3, 1972, the landfill gave notice that it would accept such industrial waste as acids, alkalies, fungicides, pesticides and petroleum products in limited quantities. Information as to proper waste treatment required prior to disposal was given for each type waste, with the added instruction that the landfill would be advised of intended delivery as to time and quantity. Only rarely do such environmentally detrimental waste arrive unannounced. When deposited, they are done so as to be dispersed within the cell to the extent practicable, and have not been disposed of indiscriminately.

Experience has shown that equipment down-time (as well as the necessity to share equipment with another site) for maintenance and repairs is a problem that needs to be overcome. This has been partially alleviated by increasing in-shop facilities, employment of full-time heavy equipment maintenance personnel, and the decreasing dependence upon contract maintenance. The retention of qualified personnel and the adoption of an effective preventive maintenance program will go far toward reducing equipment down-time for other than servicing needs. Pride in workmanship is developing among the new staff. It has seen an existing characteristic among employees of the solid waste disposal system.

Sanitary landfill operating experience gained since June 1971 is reflected in the generally smooth functioning of the "Demonstration Project" in accordance with established procedures, and reflects credit upon supervisory personnel in their ability to adapt to situations as they arise. The capability of equipment operators to assume added functions or to "fill in" for absentees has created assurance that operations can be controlled at all times.

ENVIRONMENTAL ASSESSMENT

This section responds to one of the established project objectives -- to investigate the physical, chemical and bacteriological characteristics of the surface waters within the project site, the drainage receiving waters, and the ground waters underlying the site. More importantly, the activities undertaken to meet this objective provide valuable baseline data for the continued conduct of the Demonstration Project. The assessment activities and pertinent findings are herein documented.

Literature Review

The literature search is a continuing part of the Demonstration Project. The search to date has helped to shape the work on water quality analysis and has added to the engineering and planning activities. New data will be added since new references continually come to light and new material is being published.

The Orange County Demonstration Project involves a sanitary landfill in a high water table area. Hence, two areas of concern would be important to a literature review, i.e., those dealing with sanitary landfills generally and those concerned with the effects of contaminants in water. Since a landfill operation consists of buried materials, obvious effects would fall first on ground waters, then pass to surface waters through the sides of the drainage channels. Physical, chemical and biological effects on waters were of prime interest; however, additional review of engineering and operational features of sanitary landfills was needed.

The literature search was approached from two directions. The first activity concentrated on accumulating bibliographies, reports, papers, presentations, books and booklets on solid wastes and their ultimate disposal. The second was to search discipline literature, such as that existing for sanitary engineering, biochemistry and microbiology. In this fashion, it was possible to accumulate literature and literature sources offering a broad coverage of the subject and to provide a wide range of reference. Useful references were numerous; however, much information found was of a general nature and did not always fit the Orange County situation. That which did fit is categorized in the following paragraphs.

Environmental Effects of Landfill. Many references (of which only a select few will be noted) refer to refuse degradation in a landfill operation and the resulting effects upon water quality.[3,4,5,6,7] The rapidity of this degradation is directly dependent on the amount of water in the buried refuse. Refuse has a capacity for absorbing water; therefore, until it becomes saturated, no water drains away. Reportedly, from 1.5 to 3 inches of water per foot of depth of refuse in the landfill operation is required for this degree of saturation.[6,7,8] For an eight foot fill, this amounts to an estimated one to two feet of rain water passing through the soil. Considering then the moisture lost through evapotranspiration, the total rainfall required to allow for one foot of percolating water would be about 40 inches, or something less than an average year at the project site. Cover will be sand and sand mixtures with little vegetative cover initially. Hence, it is logical to assume high infiltration through the cover in the early stage of the project; thereafter, a rapid attainment of field capacity should be expected. Leachate could be expected within the first few months under these conditions.

As indicated by some experiences, one of the earliest contamination indicators is the occurrence of inorganic ions - particularly chlorides - in the ground water.[9,10,11] Hardness, alkalinity, and total solids all show marked changes.[12,13] Thus, inorganic loadings become very great in the leachate. These are subject to dilution in movement away from the fill; hence, downstream effects depend on the climate and hydrology of the surrounding area. As the compacted refuse decomposes, complex organic products also will appear. These are best displayed in the high BOD and COD values noted in the references. In addition to dilution, downstream effects will depend on the ion exchange capabilities of the percolating soils and the microbial action as the material passes through subsurface strata to surface water. Both inorganic and organic material will appear downstream.

The soil through which the ground water percolates to reach the drainage system may alter the microbial population by acting as a filter.[6,14] Additionally, the organic and inorganic food supplies in leachate, as well as such things as pH, may change microbial populations downstream in ground and surface water. The microbiology associated with landfills has been studied to some extent.[15,16] Both anaerobic and aerobic bacteria were found along with formation of organic acids. Coliforms and fecal streptococci were isolated. Evidence indicated bacteria in refuse belong to only a few genera. Cook, et.al.,[16] reported most bacteria as aerobic, mesophilic forms. Fungi also were reported along with algae growths in seepage. Movement and survival of organisms in soils and surface waters have also been the subject of investigation.[17,18,19,20,21] In porous soils movement can occur with the extent dependent on the nature of the material. Fine grained sand appears to be the best condition for removal. This type sand exists at the Orange County site. Survival in ponds can occur with rates of dieoff varying, but reported to be in the order of days to two weeks. The oxidation pond at the demonstration site will be protective in this respect.

A summary of leachate results by Steiner, et.al.,[22] shows concentrations of both chlorides and sodium ions reaching several thousand milligrams per liter. Metals - dissolved under acid conditions created by carbon dioxide and/or hydrogen sulfide - along with sulfate, phosphate, or more reduced ions, may range to hundreds of milligrams per liter. Hardness will rise and total solids may range to 50,000 milligrams per liter. The latter will include very high COD and BOD values and will imply some treatment prior to discharge may be needed if leachate is to be controlled. References consulted generally expressed organic contamination as COD or BOD. Other than reports on some work on nitrogen content, no detailed information was found on extensive studies which have been made concerning compounds present in leachates. Similarly, little data appeared on the microbial effects downstream from landfill operations. Quantitative estimates do exist on inorganic yield of leachate per unit of fill.

Sampling and Analysis. In order to define what is happening, sampling and analysis techniques must be adequate. Sampling procedures were mentioned in a number of references[5,10,11] These procedures were extracted and furnished to personnel involved as appropriate. Sampling for chemical and biological analyses was standardized based on the well pumping and vacuum system described elsewhere. Analyses for complex organics and microbiological contamination are described separately herein. The available literature provided little reference to these types of analyses. Instead, most reports were concerned with such parameters as pH, hardness, ionic concentrations, and gross parameters of COD and BOD.

Distribution of Leachate. The landfill area is underlain by impervious material covering the Floridan aquifer which is under pressure; therefore, leachate migration from the landfill operation is of interest. The literature consulted and referenced[2,4] indicates horizontal movement of contaminants with little vertical diffusion can be expected. Hence, vertical mixing is not expected. Therefore, contaminant distribution should be restricted to within 20 feet of the soil surface at the site. This was anticipated in the planning for the sampling wells. These wells, with the exception of those aquifer wells, are 30 feet deep, or less. Some of the later wells are in three-well clusters at varying depths. This arrangement permits a comparative determination of the water quality at various depths within a relatively small area. Additionally, percolation of leachate to the site drainage ditches was expected. Hence, surface quality monitoring will be important.

Summary. The Orange County landfill operation, located in a warm, sandy area of normally high rainfall and high water table, should be subject to rapid saturation and decomposition. The attendant leachate will include high inorganics and organics. Microbial contamination of waters possibly will occur because of the porous material at the site. The condition of surface drainage waters will be of particular interest since these are somewhat protected by the filtering action of the sand surrounding the burial cells.

Water Quality Monitoring Program

The demonstration of satisfactory solutions to problems inherent in the sanitary landfill disposal of solid waste in an area with a high water table is an overall project objective. Realizing that contamination of the surface and ground water in the general area of the landfill operation would be a particular problem, the Orange County Pollution Control Department was requested to obtain necessary background information and to conduct periodic sampling of surface and ground waters throughout the project period to ascertain if pollution problems do occur.

Related objectives for the Demonstration Project, which are concerned with water pollution control, suggest that there be means of

. . . *supplying local, state and Federal pollution control agencies with data on water pollution problems as well as solutions to water pollution problems stemming from a high water table landfill operation.*

. . . investigating and reporting changes within the "demonstration" and "control" landfill areas for variants in physical, chemical (organic and inorganic), and microbial activity in the aqueous environment.

Presently, the project team is developing a basic water quality monitoring program that will be applicable to sanitary landfills. Evaluating tests to find which ones are best suited to use as indicators of pollution are being conducted.

To accomplish these objectives, a comprehensive monitoring program was established to test changes in ground and surface water quality including bacteriological, biological and inorganic-organic chemical parameters. The study team designated to investigate these parameters included experts from the Orange County Pollution Control Department, Florida Technological University, and VTN INC. In support of these investigations, grant funds were available for hiring additional staff to analyze biological and chemical samples; to obtain chemical and bacterial samples; and to oversee construction of the shallow and deep well field.

The Orange County Pollution Control Department provided the overall direction in the field surveillance program by developing a sampling schedule for both ground and surface waters. The Pollution Control Department has a complete chemical and biological laboratory and is in the process of enlarging both of these facilities. The enlargement will provide space for handling an increasing volume of sample analysis and accommodating a new microbiology laboratory. The chemical laboratory has one chemist, one chemical laboratory technologist, and one laboratory aide. The biological laboratory employs one biologist, two technicians and one aide. In addition, the project has added one biologist, one chemical technologist, and one biological technician to the laboratory staff.

Prior to beginning landfill operations, a comprehensive ground and surface water evaluation was completed for the project area. The sampling network provided the required natural baseline data for network comparison with subsequent water quality monitoring activities. The sampling network includes

. . . surface biological sampling schedule and station locations developed to insure sampling of the solid waste disposal site, outfall canal, and the receiving stream (Little Econlockhatchee River) above and below the confluence of the outfall canal.

. . . surface chemical sampling schedule and station locations developed for the holding pond, effluent, outfall canal, and receiving stream described previously.

. . . a network of shallow wells - within and adjacent to the landfill - developed under the direction of the consulting geologist responsible for ground water management studies.

Surface Water. The study of the quality of the surface water has included the establishment of sampling locations and schedules; sampling methods; selection of pertinent physical, chemical, and biological analyses; and the interpretation of the collected data. In the following pages, these elements of the study are discussed in detail.

Sampling Locations. Surface monitoring for this study includes (1) the demonstration site's pond, (2) the 2.7-mile outfall canal leading from the Demonstration Project and (3) a 14.8-mile length of the Little Econlockhatchee River, the receiving stream. The three major factors basic to the location of sampling stations along the river were

. . . the existence of two areas of domestic waste effluent discharge.

. . . the varying morphological characteristics.

. . . the availability of chemical and phytoplankton data previously obtained by the Orange County Pollution Control Department.

With the above stated factors in mind, twelve stations were established for the initial background study (see Figure 28 and Table 1). Of these stations, nine were for chemical and biological monitoring and three for chemical monitoring only. Two stations were located in the outfall canal (Stations 1 and 2) and one station was in a tributary of the river (Station 4). The remaining were established along the entire length of the river (Stations 3 and 5 through 9).

Some alterations were made to the above during the second project year due to additional excavation of the demonstration site drainage system, canalization efforts for the tributary stream, and coordination of biological and chemical stations. These adjustments required the addition of one station each in the demonstration site's Pond A (Station PA) and its effluent (Station PE), the temporary elimination of Station 4, and the consolidation of Stations 5 and 5A, 6 a. ' 6A, and 7 and 7A.

Sampling Schedule. Samples for physical and chemical analyses were taken four times during the first month and every three months thereafter until May 1971. At that time monthly sampling began at all stations, excluding Stations 6 through 9, which continued on a quarterly basis. Samples for organic studies are taken monthly from stations PA, PE, and 1.

Biological samples are taken regularly but on a more limited overall schedule. Phytoplankton samples are obtained on a monthly schedule from all stations excluding Stations 6 through 9. These remaining four stations are sampled quarterly. Since May 1971, sampling days are in conjunction with water samples for physical and chemical analyses. Periphyton, initially sampled continuously, (through May 1971) is now on a quarterly schedule for all stations. Macroinvertebrate sampling by both qualitative and quantitative methods was on a monthly basis until May 1971 when the multi-plate method was changed to sampling on quarterly schedule

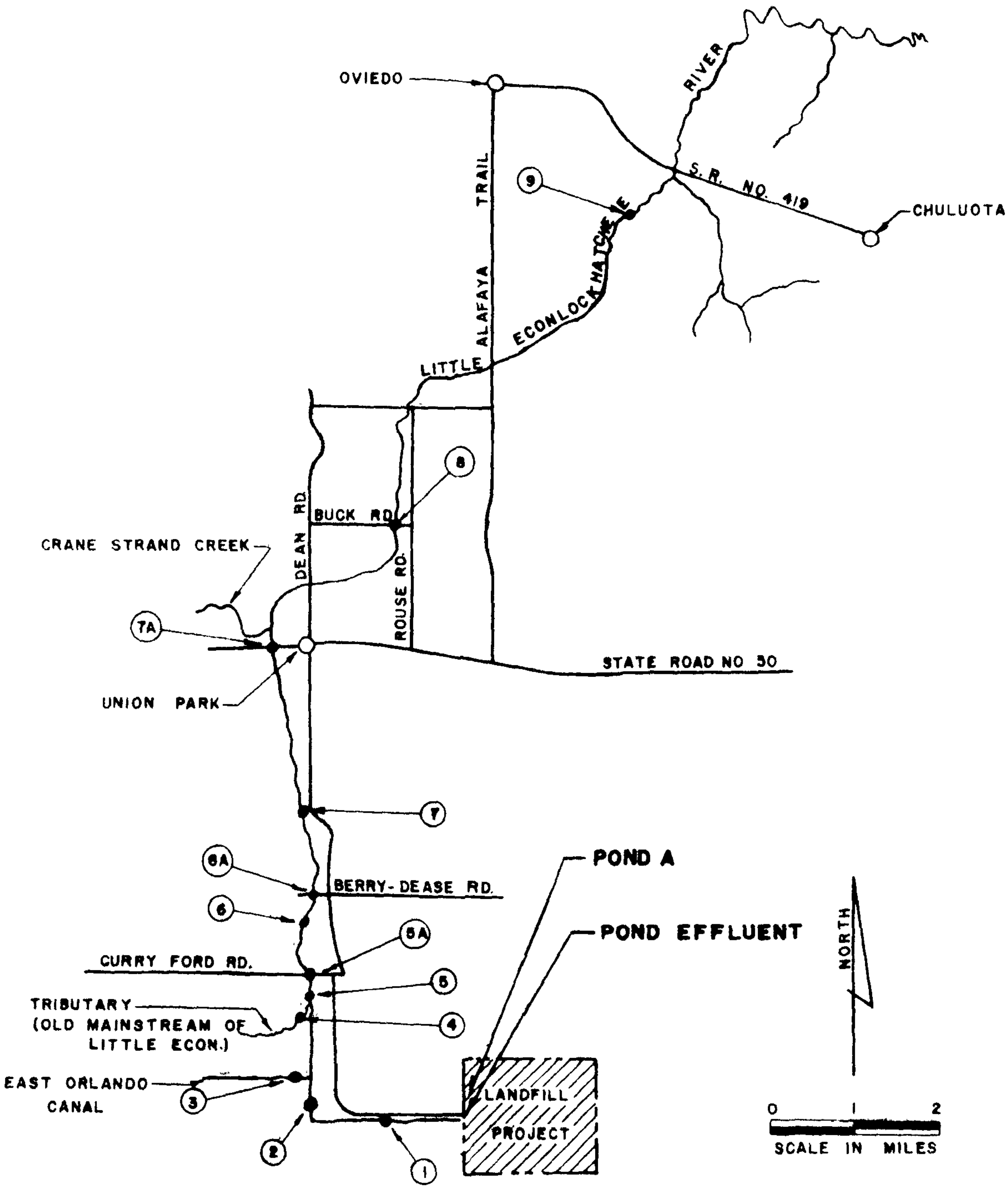

FIGURE 28 Location Of Surface Water Sampling Points, Orange County Demonstration Project.

and the qualitative method was changed to semiannual sampling. Samples for microbial studies are taken monthly from Stations PA, PE, and I.

Sampling Methods. Water samples for physical and chemical analysis were originally (through May 1971) obtained using a 24-hour battery operated composite sampler developed by the Orange County Pollution Control Department (Figures 29 and 30). Since that time, the samples have been obtained by submerging an acid washed, dark, polyethylene container six to twelve inches below the surface of the water. Samples for organic analysis are obtained in the same manner using clear, ground glass stoppered bottles. All samples are immediately placed in a cooler for transporting to the laboratory.

Dissolved oxygen measurements since May 1971, have been taken in the field using a Yellow Springs Instrument Co., Model 54 oxygen meter. Prior to that date, the determination was made in the laboratory using a BOD self-stirring probe with the same model oxygen meter.

Aquatic macroinvertebrates are collected using two methods of sampling. Qualitative samples are taken with a dip net and quantitative samples are obtained using an artificial substrate. The method employing an artificial substrate utilizes multiple-plate samplers constructed with some modifications from that of Hester and Dendy[23] (Figure 31). Each sampler consists of one-quarter inch thick Masonite plates and spacers. The eight plates are eight centimeters square and are separated by two centimeter square spacers. Each multiple-plate sampler was held together by a six inch eyebolt. At each station, two samplers are then submerged approximately one foot below the water surface and two feet apart. At the end of a four-week period, the samplers are removed, placed in separate plastic bags in a cooler and transported to the laboratory for examination.

Qualitative, macroinvertebrate samples are obtained by dragging a D-framed dip net across the bottom deposits and through aquatic vegetation. With an attempt to collect at least one of every species present, the organisms are sorted in the field using a white porcelain pan and forceps and placed in vials of 95 percent ethanol. All the various natural substrates in a station area are investigated.

Phytoplankton samples are obtained by submerging a gallon container six to twelve inches below the surface of the water. The samples are then placed in a cooler for transporting to the laboratory.

A periphyton sampler was constructed for each station following the basic design of Weber[24] (Figure 32). Each sampler contains eight, one by three inch microscope slides which are submerged three inches below the water surface. At each station after the slides have been submerged for six weeks, four slides are removed and placed in a jar containing 100 milliliters of five percent formalin solution. The remaining four slides are placed in 100 milliliters of 90 percent aqueous acetone. All jars are refrigerated in coolers for transferring to the laboratory.

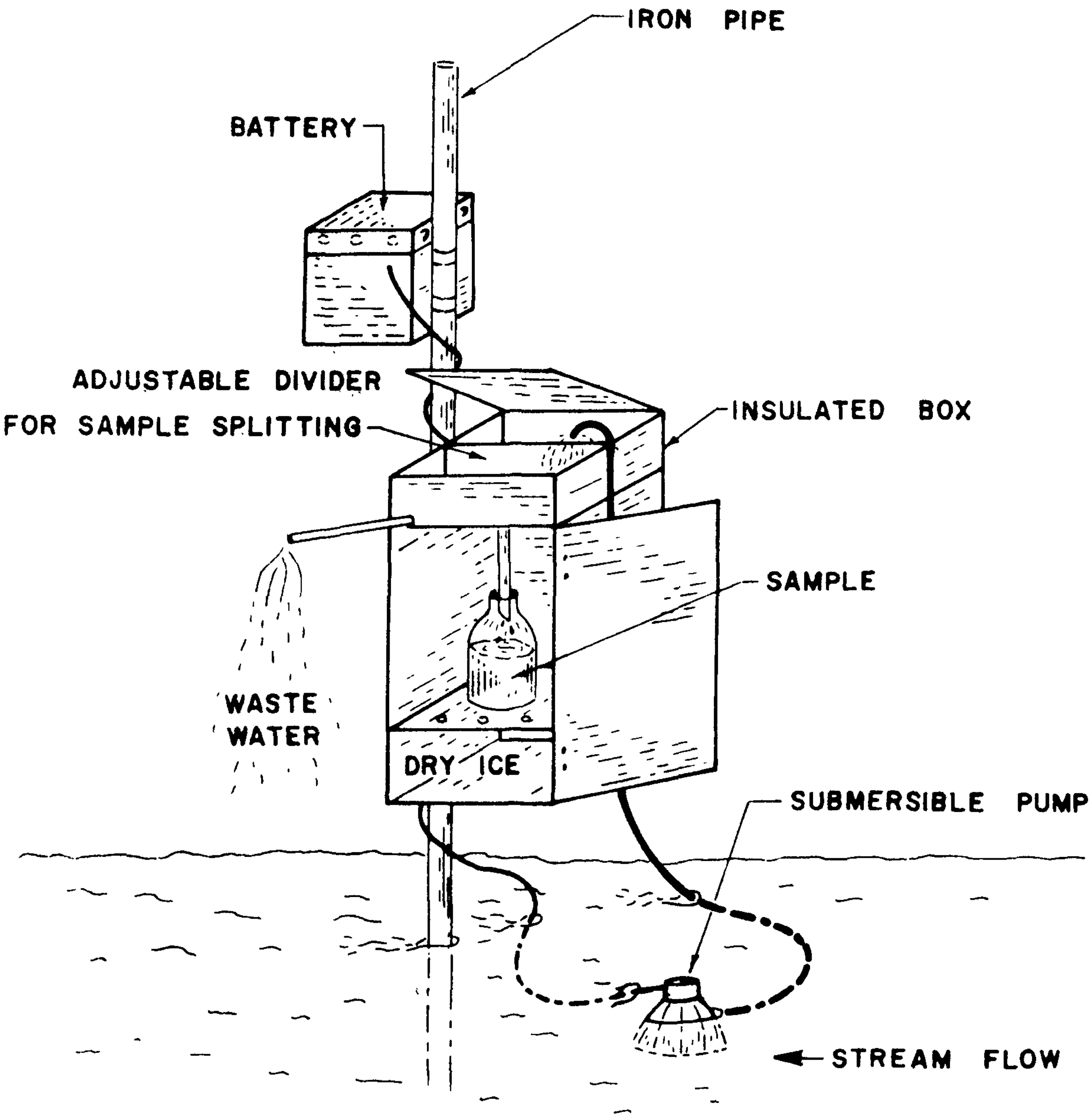

FIGURE 29. 24-Hour Composite Sampler For Surface Water Sampling

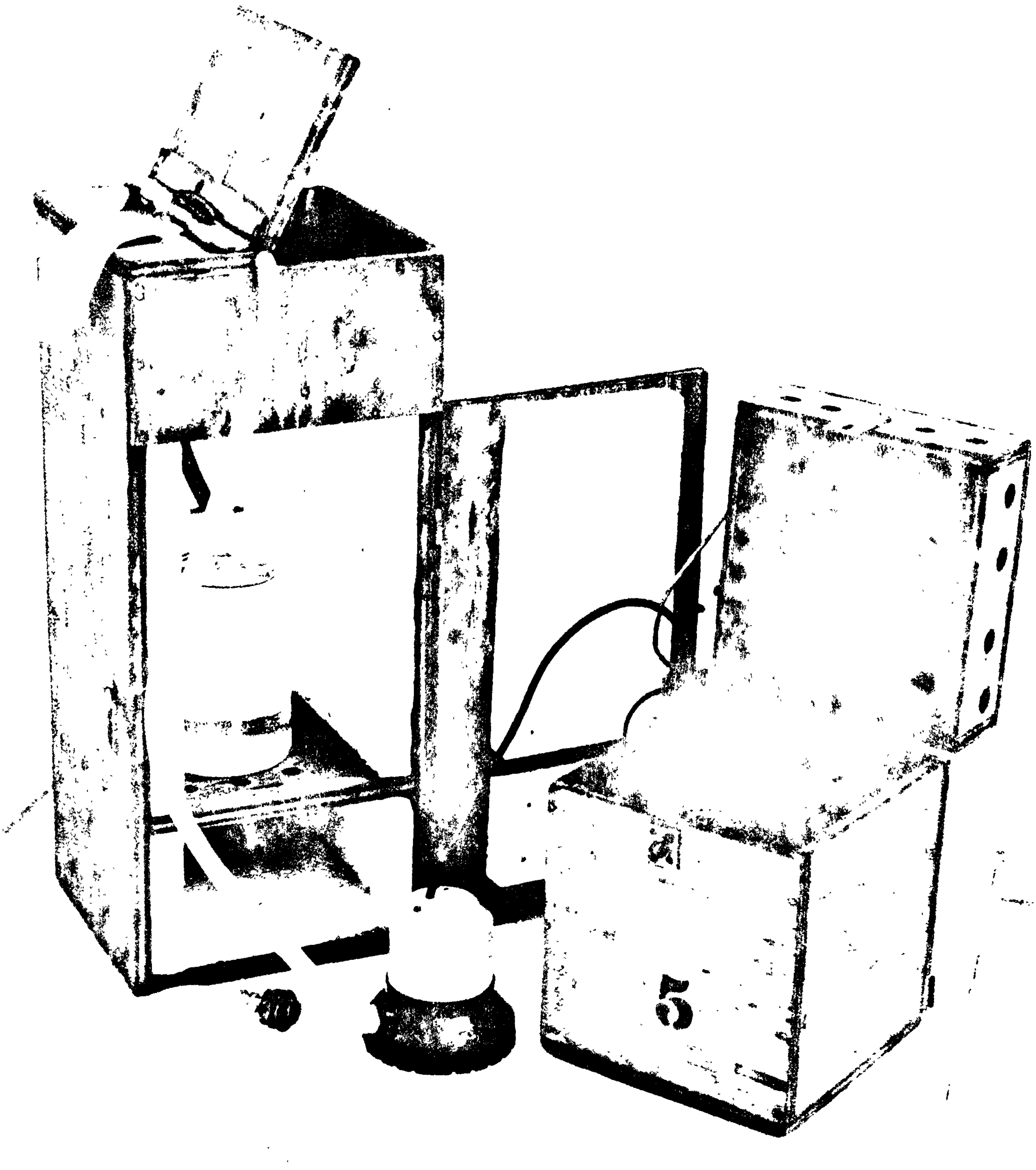

FIGURE 30 24-Hour Composite Sampler for Surface Water Sampling.

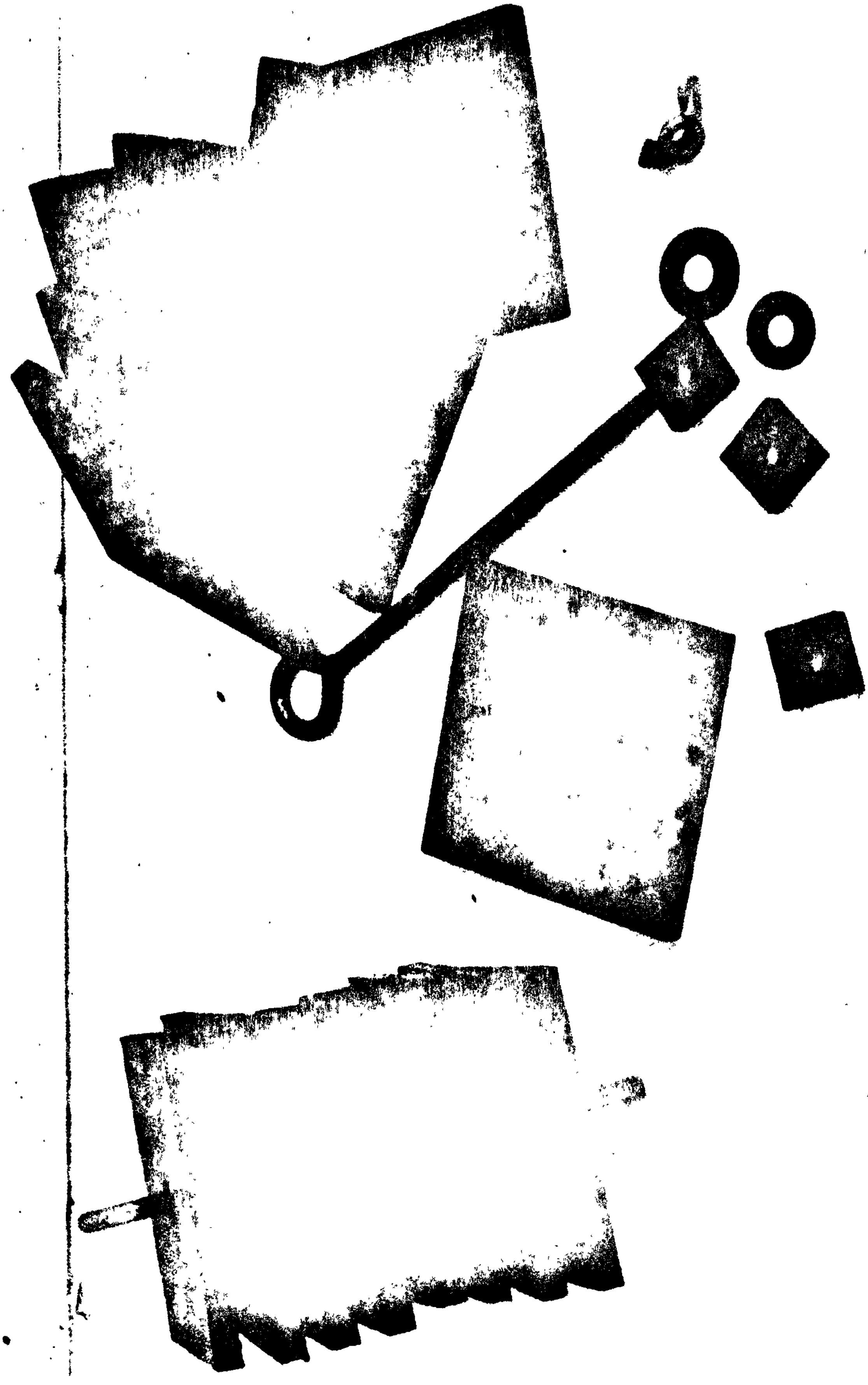

FIGURE 31 Multiple - Plate Macroinvertebrate Sampler.

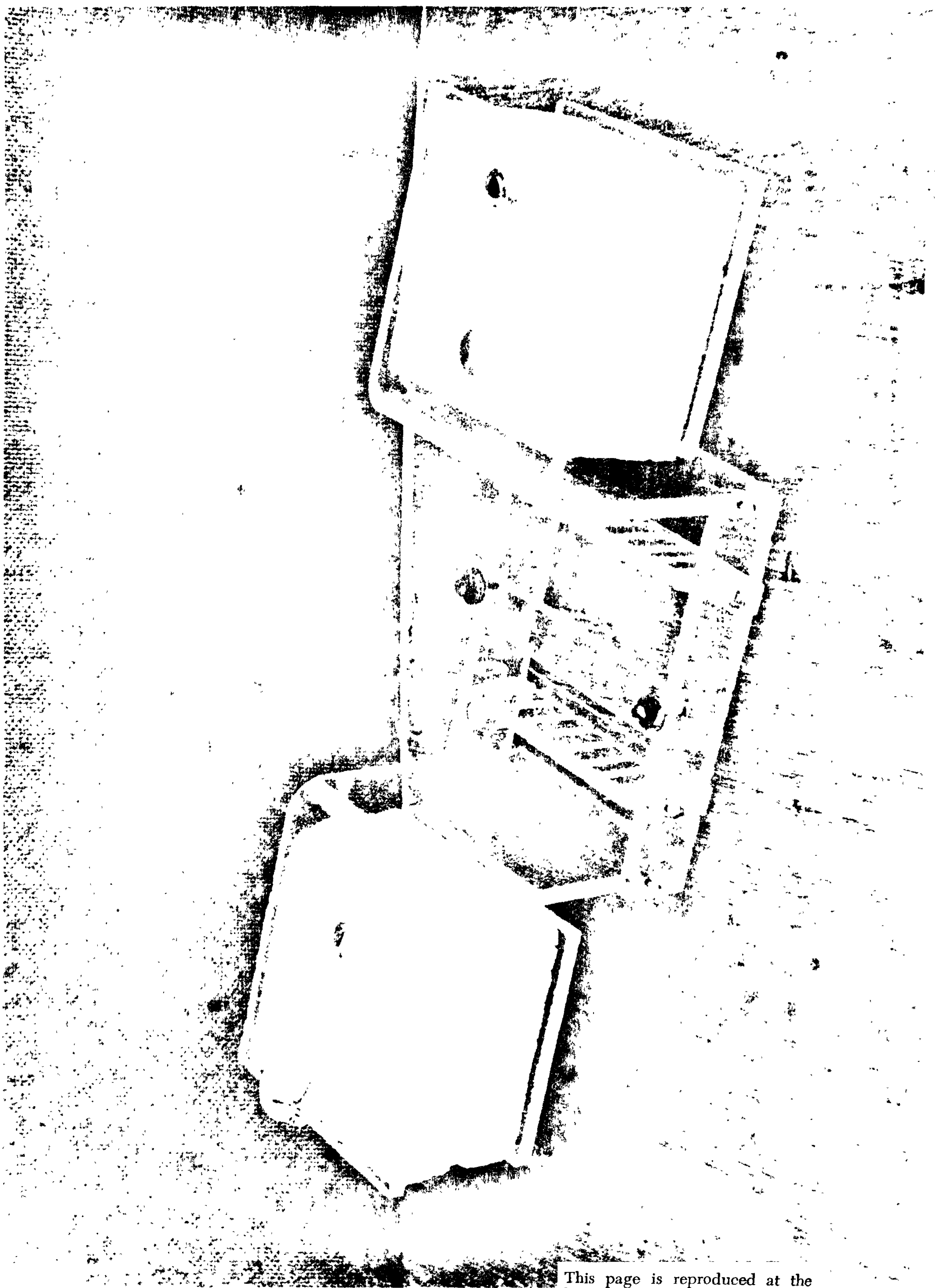

FIGURE 32 Periphyton Sampler for Surface Water Analysis.

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Physical, Chemical and Biological Analyses. The monitoring program for evaluating the surface water quality includes pH (laboratory and field), chlorides, sulfate, chemical oxygen demand, dissolved oxygen, phosphate (total and ortho), nitrogen (nitrate, nitrite, ammonia and organic), temperature, conductivity, turbidity, solids (total, suspended and dissolved), calcium, magnesium, iron, aluminum, zinc, potassium, sodium, copper and carbon (total organic and inorganic) (Tables 2 through 7). Sulfate, field pH and chemical oxygen demand analyses were not performed during the first year of the project.

Biological monitoring includes cell counts, identification, and pigment analysis of both planktonic (Tables 8 and 9) and periphytic (Tables 10 and 11) algae. The macroinvertebrate community is evaluated from identifications and numbers present (Tables 12 through 15). Bacterial studies include aerobic, anaerobic, sulfur, possible staphylococcus and filamentous fungi (Tables 16 through 21).

Physical and Chemical Properties of Site Drainage System. The landfill drainage system includes Pond A, the Pond A effluent and canal stations 1 and 2. The following discussion does not include irregularities directly caused by excavation of the pond and canal. The discussion does, however, display the general physical and chemical conditions present since October 1970.

The surface water of the landfill drainage system has acid characteristics with pH values below 7 (Table 5). The consistently lower pH at Station 1, when compared to Pond A, is a result of the drainage from Bay Branch Swamp located between the stations. Downstream from Pond A to Station 2 there is a noted increase in both hardness (5mg/l to 24mg/l, respectively) and alkalinity (7mg/l to 42mg/l, respectively). This extremely soft water condition in Pond A gives the water very little buffering capacity and accounts for the drastic pH change.

The components of hardness (calcium, magnesium, iron, aluminum and zinc) do not increase proportionally from Pond A to Station 1 (Table 6). Calcium and iron increase in greater proportions than do magnesium, aluminum, and zinc. Copper is very seldom detected and sodium concentrations are approximately one-half the chloride concentrations. Of the principle alkalies and alkaline earths, their abundance in decreasing order of concentration is sodium, calcium, magnesium and potassium.

The total dissolved solids are chiefly mineral and remain below 100 milligrams per liter throughout the landfill drainage system. They also make up the major fraction of the total solids present there. Suspended solids and turbidity are both below 10 milligrams per liter although expectantly higher values were obtained during dragline activities in the drainage system.

The chloride concentrations average 12 milligrams per liter in Pond A and its effluent with slightly higher averages (17 and 19 mg/l) downstream. The atomic ratio of sodium and chloride is almost unity and their concentration ratio almost equal to that of seawater and rainwater. The fairly high natural chloride concentrations were expected here when considering the distance from the ocean and its subsequent influence on the salt concentration of the rainwater.

The conductivity is higher at the downstream stations (143 micromhos/cm) compared to Pond A (75 micromhos/cm). Although this measurement does not indicate what ionic substances are present, it does fluctuate with regard to their concentrations and is therefore indicative of the total salt concentration.

Phosphate levels are typically below 0.1 mg/l with varying proportions of the Ortho form. Organic nitrogen is usually less than 1 mg/l in Pond A and its effluent, but it is often higher at Stations 1 and 2. Other nitrogen forms have the same trends with Pond A and its effluents having smaller concentrations than the two downstream stations. The concentrations of these nutrients are high enough to produce larger algal populations than noted to date. The ratio of nitrogen to phosphates does indicate an excess of nitrogen for optimum algal growth. The low carbon dioxide values (below 1 mg/l) and alkalinity (Table 7) found in Pond A indicate the source of carbon as a possible limiting factor in the algal populations.

The dissolved oxygen content is above 7.5 mg/l and between 78 and 105% saturation. With these high dissolved oxygen values obtained in the mornings and concomitant low available carbon dioxide for further assimilation, the biological production of oxygen appears to be sufficient to contend with any pressures that the natural chemical oxygen demand of 11 to 56 mg/l may exert.

Biological Properties of Site Drainage System. Phytoplankton data has shown low total counts (20 to 680 algae/ml) (Table 8), with a minimum of 35 genera found at the three stations (Table 9). Of these total genera, the pennales and *Dinobryon* have been the most consistently found algae. It is of interest to note that Dinobyron usually desires low nutrient concentrations.

Pigment analyses of phytoplankton from these three stations show similar seasonal trends with chlorophyll -a, -b and -c generally indicating the community composition. Chlorophyll-a, for the most part, was in its functional form with only a few occurrences of its phaopigments (non-functional chlorophyll). It was noted that when phaopigments were found there was usually a decrease in the algae counts (Table 8).

Total cell counts from periphyton samples range from 20 to 634 cells per square millimeter with all three stations having the same seasonal trends (Table 10). *Cosmarium*, *Euastrum*, *Dinobryon* and pennales are the most often found of the 35 algae found here (Table 11). Chlorophyll-a values varied between the extremes of 0.5 and 34 milligrams per square meter. These values had trends similar to that of the cell counts. Phaopigments are normally present and often in substantial proportions when total chlorophyll-a values are low.

This data of the planktonic and periphytic communities indicates the unproductive nature of the landfill drainage system as dictated by the chemical conditions discussed above. Alterations in the water chemistry by contaminated leachate will significantly alter these communities in both size and composition.

Macroinvertebrates collected during qualitative and quantitative sampling reflected a growing community in spite of some setbacks due to excavations of the drainage system (Tables 12 and 14). The Biotic Index ranges from 0 to 11. Although this is considered low for an unpolluted stream, the landfill outfall canal is relatively new and has low or at times no flow. Class I (pollution intolerant) organisms have varied from 0 to 33 percent of the species present and Class II (moderately tolerant) organisms have varied from 0 to 50 percent. Class III (pollution tolerant) organisms usually make up from 20 to 30 percent of the species present. Degradation of water quality will cause an increase in pollution tolerant forms and a subsequent decrease in intolerant organisms. Total counts range from 40 to 1,765 organisms per square meter but are predominantly below 500 per square meter. The most consistently found macroinvertebrates are the chironomids, *Anatopynia, Ablabesmyia janta, Chironomus, Procladius, Polypedilum fallax* and *Ocetis* (Tables 13 and 15).

Microbiological data is given in Tables 16 through 21. As with the well waters, there are aerobic and anaerobic populations. These have been stable and do not show evidence of changes due to the landfill burial. Sulfur oxidizing and reducing bacteria are present along with small populations of fungi and possible Staphylococcus organisms. Coliforms are being detected in surface waters in small numbers. Fecal coliforms are to be expected because of the animals, including cattle, in the general area.

Physical and Chemical Properties of the Little Econlockhatchee River. The Little Econlockhatchee River (Stations 3, and 5 through 9) and one of its tributaries (Station 4) has been monitored since October 1970. Since the landfill drainage system enters the river between Stations 3 and 5 it was important to obtain data to evaluate the river's present condition. The following is a summary of the physical and chemical properties of this receiving water.

Solids are primarily in the dissolved form with average values ranging from 146 to 243 milligrams per liter. Suspended solids and turbidity are typically below 30 and 10 milligrams per liter, respectively. Exceptions to this generally occurred during the landfill outfall canal excavation.

The river has alkaline characteristics (except for Station 4 in the unaltered tributary) typically ranging from 38 to 100 milligrams per liter and averaged pH values are from 7.1 to 7.4. Total hardness varies less between stations with averaged values of 47 to 66 milligrams per liter.

Chlorides vary greatly with extreme values of 5 and 86 milligrams per liter; however, averages for each station show a range of 19 to 48 milligrams per liter. These extremely high values are indicative of the contamination from domestic waste treatment facilities during periods of low precipitation.

Phosphate and nitrogen values are high, with average total phosphate concentrations of 0.64 to 3.66 milligrams per liter and Kjeldahl nitrogen concentrations of 0.9 to 8.3 milligrams per liter. Nitrate and nitrite nitrogen are also high with combined average concentrations of 0.23 to 0.62 milligrams per liter. This excludes the unaltered tributary (Station 4) which has less nitrate and nitrite nitrogen (0.04 mg/l).

The dissolved oxygen content is usually low (0.5 to 4.6 mg/l) at all stations, although in the canalized portions of the river (Stations 3 and 5) the dissolved oxygen content sometimes reaches a saturated condition. This saturation is accomplished by a large stand of aquatic macrophytes in these canalized areas or by large plankton populations when these stands reduce in size.

Biological Properties of the Little Econlockhatchee River. The phytoplankton data show a considerable difference in standing crop at each station (Table 8). Station 3 (upstream from the confluence of the landfill outfall canal) has total counts ranging from 52 to 24,150 algae per milliliter. Downstream the standing crop becomes less variable and decreases to a range of 10 to 250 algae per milliliter (Station 7). A rise in both size and variability occurs further downstream at Stations 8 and 9 where the total counts range from 10 to 1,860 algae per milliliter. A minimum of 48 genera of algae have been found in the river with very few having a high percentage of occurrence at each station (Table 9). Two pollution tolerant algae, *Euglena* and *Scenedesmus* are the most often found genera in the river.

Periphyton communities throughout the river were quite variable. Cell counts show location and seasonal trends similar to those of the phytoplankton. Only Stations 3, 5, and 8 have cell counts exceeding 2,000 cells per square milliliter (Table 10). Chlorophyll-a concentrations are highest at Stations 3, 5, 8, and 9, with all other stations normally remaining below 10 milligrams per square meter. Phaopigments of chlorophyll-a are quite irregular in occurrence and concentrations. Of the 36 genera found in the periphyton of the river, pennate diatoms, *Scenedesmus* and *Euglena* are the most consistently found algae (Table 11). These genera are commonly associated with organic pollution. It is interesting to note that *Dinobryon*, having the highest percentage of occurrence in the landfill outfall canal, was found only in a tributary of the river (Station 4).

Macroinvertebrates collected on multiple-plate from Stations 3, 4, and 5 are below 1,000 organisms per square meter (Table 14). Continuing downstream, Stations 6, 7, 8, and 9 have progressively higher concentrations, but usually under 3,000 organisms per square meter. The number of species present per sample also increases going downstream until Stations 8 and 9 show a definite reduction in the abundance of species. The occurrence of Class I (pollution intolerant) and Class II (moderately tolerant) organisms is limited to a single occurrence at Station 3, while 22 to 56 percent of the organisms there are in Class III (pollution tolerant). Directly downstream (Station 5) there is a slight shift in the community to more Class I (0-17%) and Class II (6-15%) organisms. At Stations 6 and 7 Class I organisms dominate with the number of species being between 21 and 55 percent of the number of species per sample and Class II organisms 5 to 20 percent of the number of species present. A reduction in Class I and Class II organisms is found at Station 8, where 0 to 27 percent are in Class I and 0 to 13 percent are in Class II. At Station 9 there is a shift to a greater percentage of Class I (22-38%) and Class II (0-27%) organisms. The macroinvertebrates collected in qualitative samples display the same pattern based on indicator organisms, but with some differences in percentage values (Table 12).

Ground Water. In order to monitor the effects of the landfill on the ground water quality, a total of 38 shallow wells was proposed (Figure 33). These shallow wells, ranging from 10 to 30 feet deep, cover 40 percent of the 1,500 acre landfill. Within this 40 percent lies the general area of filling during the first three years of operation.

Each test well is made of two inch polyvinylchloride (P.V.C.) plastic pipe. The 20 and 15 foot wells have a 10 foot well point section, and the 10 foot wells have a five foot well point. The bottom is capped to insure that water enters the casing only through a series of screen slots 0.010 inches by one inch long (Figure 34). The top end of the casing is threaded to accommodate a P.V.C. cap through which a piece of one-half inch pipe is fitted and extended to the bottom of the well. Outside the cap is an elbow connection designed to accommodate the sampling apparatus (Figure 35).

Installation of the test wells was completed by professional well drillers. A four inch steel casing was augered into the ground to the desired depth. The soil within the casing was then washed out and the two inch P.V.C. pipe and well point were placed in position. Coarse builders sand was used to backfill to a depth of ten feet. A two foot concrete seal was installed. Following this installation native soil was used to fill from the concrete seal up to ground level. The four inch steel casing was then withdrawn leaving the P.V.C. pipe and well point in place. Prior to any sampling, approximately 2,000 gallons of water were pumped continuously from each well to remove any foreign material and to thoroughly flush the layer of filter sand.

Sampling Locations. From December 1970 through May 1971, six 20-foot wells (Wells 3, 5, 6, 10, 16, and 20) were available for monitoring in relatively close proximity to the first fill areas. From May through October 1971, data was obtained from additional six 20-foot wells (Wells 4, 9, 13, 19, 23, and 24) located in more outlying areas. In October 1971 the addition of a 10 and 15 foot well clustered around each original well brought the total to 21 shallow wells in the monitoring program (excluding Well 6 which was destroyed during operations in September 1971). Two additional wells were located in the fill to the bottom of a control cell and a demonstration cell. The control cell fill well (Well 30) was also destroyed in September 1971. Additional shallow wells ranging from 10 to 30 feet deep, and two replacement wells installed in June brings the ground water monitoring program to the originally proposed 38 wells. These last wells are to be installed and located individually or in clusters of two and three.

For the purpose of monitoring fluctuations in the ground water level, additional wells were driven near each well or well cluster existing in October 1971. These wells are used only for water elevation determinations.

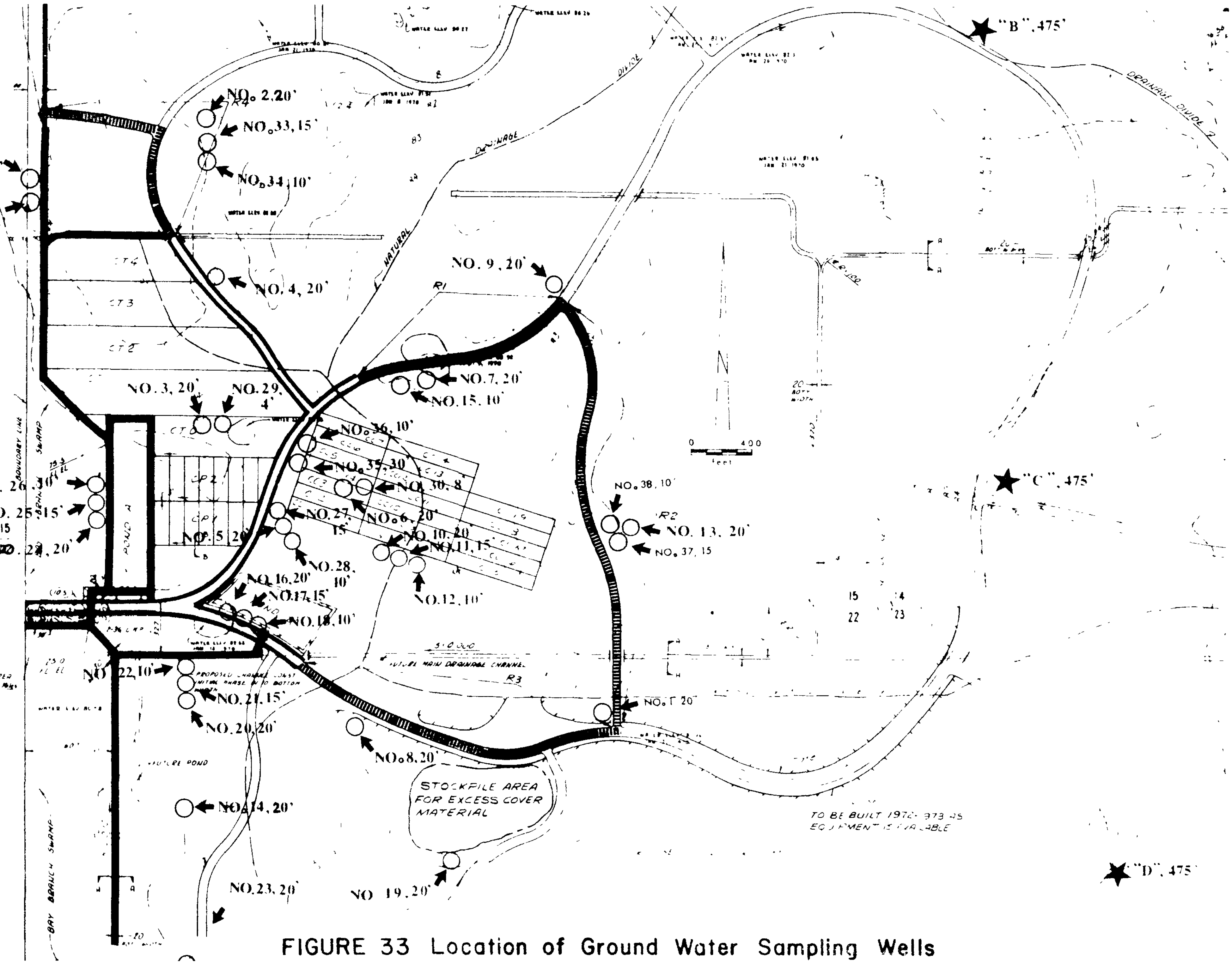

FIGURE 33 Location of Ground Water Sampling Wells

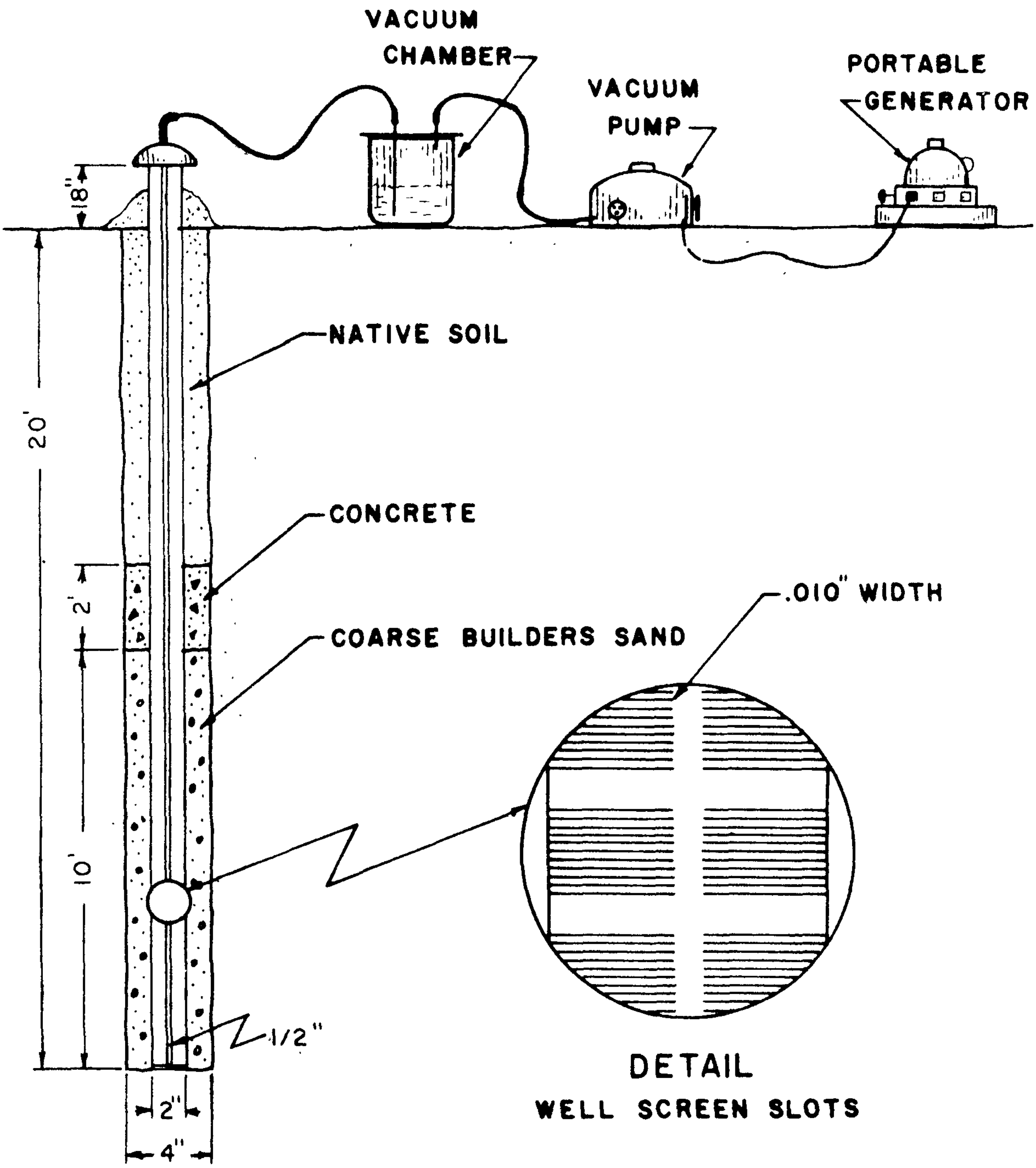

FIGURE 34. Profile Of Shallow Sampling Well.

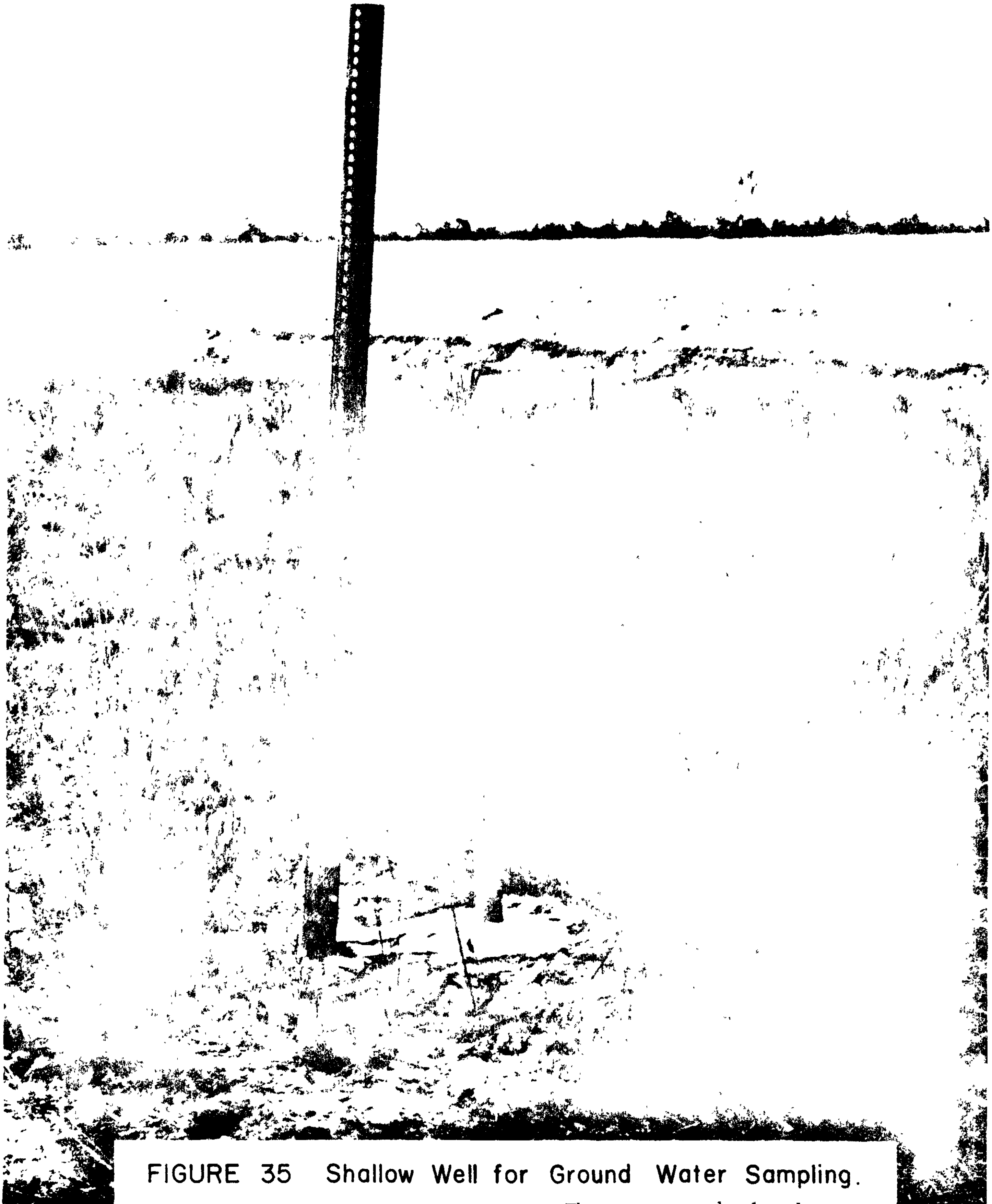

FIGURE 35 Shallow Well for Ground Water Sampling.

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Sampling Methods. Since ground water sampling requires a high standard of validity, exact procedures and compatible equipment are used. Because one of the analyses is for trace metals, no metal could be a part of any well construction material or sampling equipment.

In the process of obtaining samples from test wells, a vacuum chamber and connecting hoses, a vacuum pump, and a portable electric generator are used. The vacuum chamber, constructed of clear plastic tubing, is eight inches in diameter with a 1/8-inch wall. It is 14 inches high with a three gallon capacity. The bottom is permanently sealed and the removable top has a soft rubber gasket which allows an airtight seal when attached to the vacuum pump. Water is drawn in with vacuum maintained through the use of two 3/8 inch diameter plastic tubes permanently inserted through the top. The chamber is attached to the well and the vacuum pump by two flexible rubber hoses which slip over the ends of the 3/8-inch plastic tubes found on the chamber and attached to the well and vacuum pump with the threaded P.V.C. connectors incorporated as part of each hose. A container may be placed in the chamber and a sample drawn directly into it, or the chamber can be filled and a sample poured into a container (Figure 36). A Bell and Gosset 1/4-HP, high volume vacuum pump is being used and was chosen for efficiency, light weight, and compactness. A McCulloch 1500 watt, 115 volt portable generator has proven quite satisfactory as a power source for the vacuum pump. Again, light weight and compactness was taken into consideration in the selection of this power source.

The sampling process requires the drawing and discarding of three vacuum chambers of water as a means of insuring fresh water in the well and to flush the hose leading to the chamber. All containers for chemical analyses samples are acid washed and rinsed repeatedly with distilled water before their use. Samples are placed in capped polyethylene bottles. These bottles are marked so as to insure repetitive use of the same bottle for the same well. Bottles are filled to overflowing, capped, and stored in a refrigerated box. The samples are then taken to the laboratory for analysis. Following use, all bottles are rinsed and returned for the next sample taking. The approximate volume of each well sample is about three liters.

For microbiological analyses, separate 250 milliliter and/or one liter samples are taken aseptically. Prior to sampling, amber glass bottles are autoclaved with aluminum foil covering the bottle mouths and secured with rubber bands. At sampling time, the foil covering the sterile sample bottle is punctured with the tube of the collecting apparatus and water is pumped immediately from the well directly into the sterile bottle. Sterile bottle caps are unwrapped and placed on the filled bottle. The collected water samples are then carried in refrigerated coolers to the laboratory where analysis begins within a few hours.

Sampling Schedule. All shallow wells prior to October 1971 were sampled on a monthly basis with two sampling days per month. With the addition of more wells in October, it became necessary to adjust the scheduling. From that month through the present, sampling is done two times a month with each well sampled bimonthly.

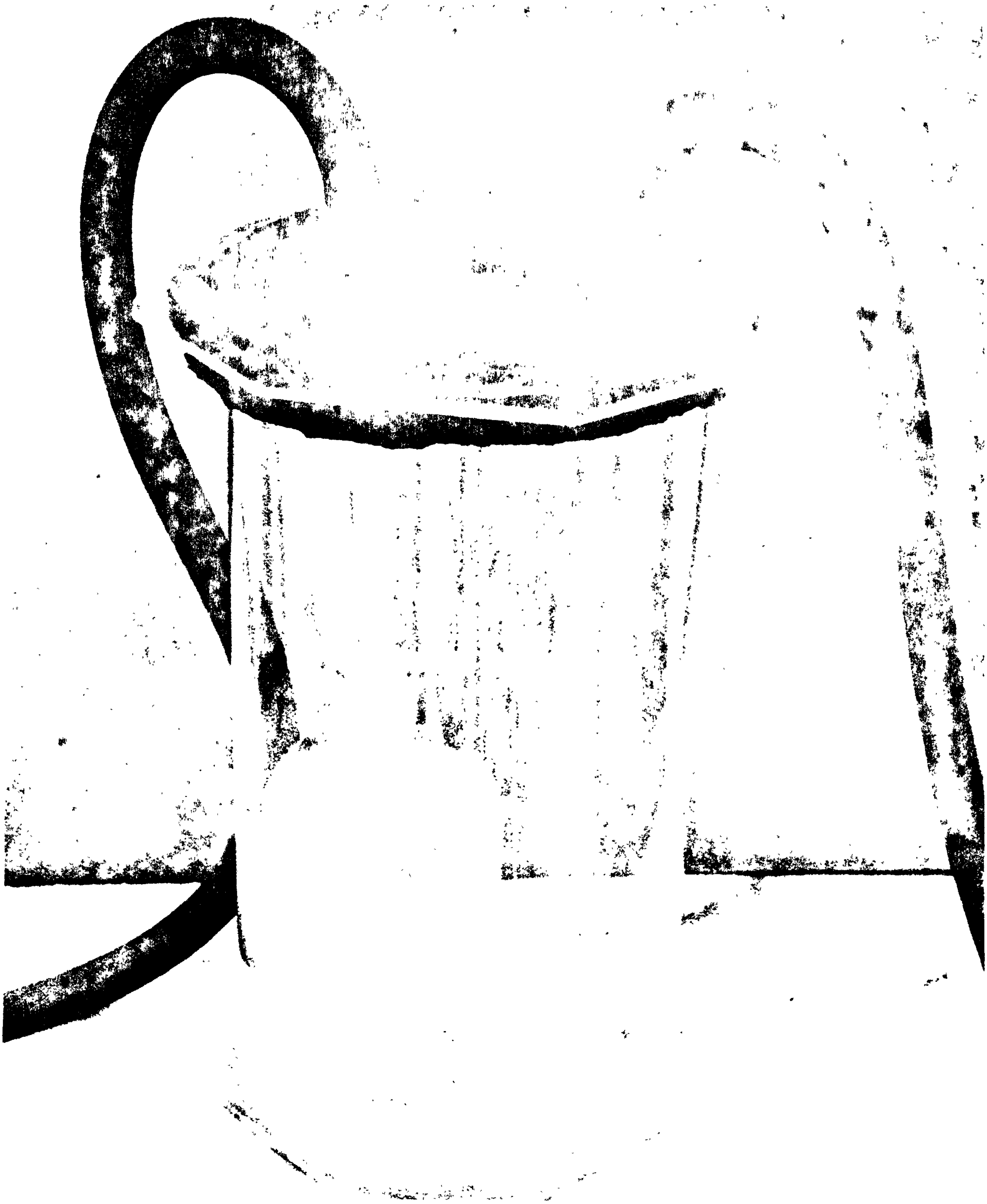

FIGURE 36 Vacuum Chamber for Shallow Well Sampling.

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Physical and Chemical Analyses - General. The monitoring program for evaluating the ground water quality includes pH (laboratory and field), chlorides, sulfate, chemical oxygen demand, phosphate (total and ortho), nitrogen (nitrate, nitrite, ammonia, and organic), temperature, conductivity, turbidity, solids (total, suspended and dissolved), calcium, magnesium, iron, aluminum, zinc, potassium, sodium, copper, and carbon analyses (Tables 22 through 29). Of the preceding parameters, sulfate, field pH and chemical oxygen demand analyses were instigated during the second year of the study.

At this time data has been collected from twenty-two wells with data from 4 to 19 samplings for each well. The number of samples obtained from each well varies as to well installation date.

Although water quality data is available and reported for each well, the following discussion is concerned with the general ground water characteristics of the demonstration site. Since December 1971, the ground water quality characteristics of Well 3 have been markedly different from that of other wells. Therefore, the generalized discussions exclude Well 3 which is discussed separately.

The temperature of the ground water has a narrow range primarily between 20 and 24 C. For a given day and equal well depth, each well water sample is of a constant temperature. A comparison of ambient and ground water temperatures showed a one to three month lag in the ground water temperature change corresponding to gross air temperature changes.

Physical analyses performed on samples from the shallow wells included total solids, suspended solids and dissolved solids (Tables 22 and 27). In early samples some minor particulates were observed in the well waters; however, they have not been observed since the wells were developed by successive pumping. Total solids are generally below 100 milligrams per liter with higher values occurring during the first few samples obtained for each well. The suspended solids and generally corresponding turbidity are below 50 milligrams per liter and 30 milligrams per liter, respectively. Both of these parameters decreased with successive samples from each well.

Evaluation of total dissolved solids was a necessary adjunct to initial examination of organic components (Table 27). Average values obtained for wells other than Well 3 ranged from 25 to 66 milligrams per liter. Values obtained for January 18 and February 8 and 15, 1971, were neglected because of the particulates noted and the fact that techniques were being refined. The total dissolved solids were low for all well waters. Similar analyses run for F.T.U. tapwater averaged 280 and for distilled water 17 milligrams per liter, respectively. Hence, five of the six initial wells showed very pure water with little soluble material. This data is comparable to low dissolved solids found in surface waters.

The pH of the wells was uniformly on the acid side ranging from about 3.1 to 5.8 when first measured in the laboratory at F.T.U. using a Sargent pH meter or Corning Model

10 with glass electrode. Wells were reasonably consistent in pH on any particular sampling date with the exception of Wells 3 and 9. Well 9 showed the highest pH values. Samples taken on several dates were subjected to aeration, initially in one case for one hour, in the second case for 40 hours. The pH rose to a range of 6.8 to 6.9 for all wells in the first case and to a range of 7.1 to 7.3 in the latter. The apparent cause was gaseous CO_2 and/or H_2S in the well water. In no case was it possible to measure the pH in the field, the values given being those after arrival at the laboratory. Some gaseous contaminants may have been lost in the handling process prior to delivery to the laboratory.

The carbon content of Pond A and its effluent is quite low (Table 7), ranging from 11 to 20 ppm -- the vast majority of this carbon being in the organic form. There appears to be very little inorganic carbon present in the surface waters at these locations. The waters of the outfall canal at Station 1 exhibit about the same characteristics as do Pond A and its effluent, except for occasionally higher values (up to about 70 ppm) usually associated with runoff from adjacent swampland rather than from the landfill site.

Concurrent with increased organic carbon following heavy rains is a drop in pH - a case in point is the heavy rainfall (2-29 inches) of October 20, 1971. When sampled on October 26, the water at Station 1 was heavily discolored due to drainage from adjacent peat bogs and its pH had dropped to 3.85, while its organic carbon content had risen to 64.2 ppm. These changes are brought about by the leaching of acidic lignified materials from adjacent swamps and not via contamination from the waste site itself.

As a general rule, the surface waters tend to be on the acidic side ranging from about 5.5 to 6.0 in Pond A and its effluent. The waters of the canal draining the site tend to be more acidic than Pond A and its effluent due to acidic drainage from adjacent areas.

The average total hardness for all wells had a range of 5.6 to 79.6 milligrams per liter, with most wells (excluding Wells 3, 4, and 9) having concentrations below 20 milligrams per liter. Chloride concentrations were variable but generally between 7 and 16 milligrams per liter. Specific conductivity, an indirect indication of mineralization, was usually between 29 and 139 micromhos per centimeter and generally corresponded to variations in total hardness.

Ortho-phosphates were below 0.04 milligrams per liter phosphorus, with total phosphate generally ranging between 0.01 and 0.35 milligrams per liter. Nitrogen determinations including four forms - nitrate, nitrite, ammonia and organic nitrogen - were generally below 0.09, 0.009, 0.30 and 1.00 milligrams per liter, respectively.

Since these analyses for sulfate and COD did not begin until April 1971, less data is available for comparison. Each of the above parameters has been fairly consistent for each well with sulphate ranging from 0 to 32 milligrams per liter and the chemical oxygen demand varying from 0 to 39 milligrams per liter.

Of the metals analyzed, the calcium concentrations varied the most from well to well. The variation had an average range of 0.2 to 29.1 milligrams per liter. This difference in values corresponds to reported variations of hardness values. Magnesium, another major contributor to hardness, was comparatively consistent with an average range of 0.50 to 1.76 milligrams per liter. Iron and aluminum values were generally between 0.25 and 1.50 milligrams per liter, while zinc was usually present in concentrations of less than 0.25 milligrams per liter. Copper has only been detected sporadically and always in concentrations less than 0.05 milligrams per liter. Sodium and potassium concentrations ranged from around 1 to 8 milligrams per liter and 0.1 to 0.8 milligrams per liter, respectively.

Hydrogen sulfide (H_2S) initially was approximated by acidifying well water to drive off the H_2S, which was then bubbled into a standard iodine solution. Residual iodine was back-titrated with standard thiosulfate solution. For the May 1971 well water samples, the maximum H_2S averaged 7.8 milligrams per liter. Values for the six wells were reasonably close, hence only the average is given. Later sulfide analyses were done by the methylene blue colorimetric procedure of *Standard Methods.*

Samples of well water were examined by ultraviolet and visible absorption to determine the organic content. Optical densities were taken on samples of February 22, March 8, April 5, and May 5 with close agreement. Dissolved organic material was estimated by the method of Armstrong and Bolach[25] using the ultraviolet absorption data. Values ranged from 1.48 milligrams per liter for Well 10 to 62.9 milligrams per liter for Well 3. Results are given in Table 28 as one example. Absorption spectra analysis has been continued to be taken as part of the analytical procedure. Correlation between organic carbon content and ultra-violet absorption at 260 millimicrons has been observed. This might be suitable as a monitoring technique in the future. Further investigation and thought is necessary.

Other Organisms. All analyses for *Salmonella* have given negative results. Some *Staphylococcus* data is given in Tables 34 and 35. These media are selective for *Staphylococcus.* Note populations are low.. Further analyses of these have shown the presence of other types of organisms, in part due to sediments and soil organisms. No pathogenic *Staphylococcus* has been detected in any samples. Isolates have shown *Bacillus* species. *Bacillus* is one of the most abundant bacteria in soils. *Shigella* was investigated for the March 1971 samples. Results were negative. The negative *Salmonella* and *Shigella* results are consistent with coliform data.

Enterococci were negative in samples in the spring of 1971.

Differentiation Tests have shown the presence of *Flavobacterium, Achromobacter,* saprophytic *Staphylococcus, Alkaligenes,* and some psendomonads whose genera have not been clarified. *Clostridia* have been formed in anaerobic samples. About 5 to 6 bacterial types have been observed with two to four isolates predominating in total aerobic populations. Aerobic isolates have been observed to grow anaerobically. Biochemically some isolates, including the predominate species, can hydrolyze lipids. Three isolates were capable of degrading starch, but none of the predominate species were so capable. None of the isolates in early tests showed degradation of cellulose in two weeks. Several degraded gelatin. Isolates also reduced nitrates.

Fungi. Table 36 presents data on filamentous fungi. Counts are small and relatively insignificant.

Sulfide analyses have been carried out on selected wells as sampling has progressed subsequent to initial pilot determinations previously cited. Results have been variable with values being very low and in some cases zero (example: Wells 4, 25, and 26 on February 7, 1972). Values for March and April 1972 sampling included 75 parts per billion sulfur for Well 3 water. Most of the rest were less than 15 ppb. Sulfide analyses for wells sampled in May 1972 failed to show positive results. The general conclusion would be that sulfides are present at very low levels.

Some work also has been done with lignin materials found to occur naturally in the ground waters. This has shown the acid soluble fraction is composed primarily of materials with molecular weights of less than 50,000, while the base soluble fraction is composed primarily of materials of molecular weights greater than 50,000, although some of the base soluble materials also have molecular weights of less than 50,000. The majority of these materials (both acid and base soluble) have molecular weights greater than 25,000 and may be separated from other organic materials by elution from a column of G-25 Sephadex. It is not planned to pursue the work on characterization of lignins any further as the organic contaminants of Well 3 rightly deserve more attention.

While there are some variations in the May 1972 data in wells other than Well 3, carbon content and other information do not yet indicate that contamination has spread to other wells.

Physical and Chemical Analyses - Well 3. As previously indicated, Well 3 has shown unique characteristics in water quality since December 1971. Well 3 is a 20 foot well located in the middle of a filled demonstration cell. Its 10-foot well point is approximately 2 feet below the bottom of the fill. Analysis of water from this well began in December 1970 and displayed only small, normal variations until December 1971. Six months after landfilling began, there was a distinct rise in the concentrations of total dissolved solids, chlorides, total hardness, Kjedahal nitrogen, calcium, magnesium, iron and sodium (Tables 22 and 26). The water from Well 3 had a distinct yellowish color as compared to the other wells which were clear. This was attributed to the fact that Well 3 is located in an area that was formerly a bog, and is therefore in highly organic soil.

One will note that Well 3 has definitely become polluted with organic matter from the landfill. The total organic carbon content of Well 3 averaged about 18 ppm during the months of July, August, September and October of 1971, and on October 4, 1971, the well contained only 28 ppm total carbon, of which 18 ppm was organic carbon. However, by December 7, 1971, Well 3 contained 102.7 ppm total carbon and 48.7 ppm organic carbon. By December

20, 1971, the carbon content had further increased to 186.0 ppm total and 95.3 organic carbon. Concurrent with this increased carbon content, an elevated CO_2 content appears to have significantly lowered the pH, although the decrease in pH may be due to other factors as well, e.g., increased H_2S production resulting from decomposition of organic matter.

Table 29 indicates the continuing contamination of Well 3 waters. By April 17, 1972, the total carbon had risen to 1,227 milligrams per liter. Most of this was in the organic form. At the same time high CO_2 values occurred along with low pH values in the range of 4.3 to 4.6. The pH remained low after one hour aeration (Table 25), indicating the possible presence of organic acids.

Total dissolved solids for Well 3, with a previous average concentration of 171 milligrams per liter, rose to 297 milligrams per liter. By June 1972 the concentration had risen to 907 milligrams per liter. Total hardness changed from 30 milligrams per liter to 166 milligrams per liter and then rose to a high of 253 milligrams per liter in June. Chlorides increased to 55 milligrams per liter from a previous concentration of 10 milligrams per liter.

Of the four forms of nitrogen, only ammonia and organic nitrogen increased in this reducing environment. Ammonia concentration went from the previous average of 0.04 milligrams per liter to a high of 13.9 milligrams per liter in April. Since that time there has been a decrease to 6.00 milligrams per liter reported in June. Organic nitrogen concentrations increased from 0.60 milligrams per liter to a high of 6.50 milligrams per liter in April. As with ammonia there was a considerable decrease in June.

The metals used in the determination of total hardness in Well 3 had concentrations in a decreasing order from Ca, Mg, Fe, Al to Zn. As of June no increase in zinc has been detected and the concentration order has changed to Ca, Mg, Al, Fe, Zn, with Ca still exhibiting the greatest concentration.

The previously undetermined chemical oxygen demand was at 1,370 milligrams per liter in January 1972 and steadily rose for six months to 4,040 in June.

It was expected that concentration of H_2S and methane would increase significantly in Well 3. Analysis in February 1972, by carbon measurement and gas chromatography, led to the conclusion that little methane was present. Sulfide analysis showed only a trace of H_2S present in the well. Gas chromatography also did not show a significant increase in fatty acids and similar metabolites and anaerobic bacteria. In these analyses the majority of the organic carbon in the well appeared to exist as polar water soluble materials (probably carbohydrates and proteins).

Work has continued on characterization of the organics of Well 3 with concentration of effort in the summer of 1972. The lipids fraction has been under investigation.

Biological Analyses - All Wells. Biological analyses of well waters were accomplished in accordance with procedures given in the Appendix.

Aerobic bacteria data is given in Table 30. These data are consistent with the chemical analyses. For Well 3 a great increase occurred in bacterial population in December 1971 just as the chemical contamination occurred. The high value of 55,000 per milliliter dropped very quickly during the next few months, perhaps due to the pH change. Data for other wells appear consistent.

Anaerobic bacteria data is given in Table 31. Counts are small, well below the aerobic case. Values for Well 3 demonstrate the contamination peak in December, 1971. The other wells appear relatively stable and consistent.

Sulfur bacteria data on sulfur reducing bacteria and sulfur oxidizing bacteria is shown in Tables 32 and 33, respectively. Populations are small in each case. The sulfur bacteria populations were affected by the ground water contamination in Well 3. As seen in Table 32, there was a reduction in sulfide producers starting in December 1971. Sulfur oxidizing bacteria went through a peak in the months after December.

Coliform Tests. An extensive analysis of coliforms has continued through the entire sampling period. No fecal coliforms have been detected in any well water samples. A few samples have shown the presence of non-fecal coliforms. These have been infrequent, and essentially the well waters are coliform free.

Weather Monitoring

A weather station was installed at the demonstration site for the continuous monitoring of the precipitation and temperature. A Belford Instrument Co., Model 595, tipping bucket with a model 592-1 recorder and counter is used for precipitation measurements. The temperature is monitored with a Bacharach Instrument Co., Temp-scribe, Model STA, seven day temperature recorder. Installation of these items was made in July 1971 and data is recorded on a daily basis (Table 37).

The two years, 1970 and 1971 had annual precipitation of 43.96 and 44.78 inches respectively (Table 38). These values were lower than the normal precipitation of 51.37 inches for the area. This year (1972), however, data has shown a general increase over 1971 for the first months.

Ground Water Level

Surface elevations at well locations varied from 84.42 to 81.24 feet above mean sea level (Table 39). The water level at these nine locations ranges from 82.35 to 75.46 feet above mean sea level. The variation per well was somewhat low (0.66 to 3.67 feet), while variations in different wells ranged from 1.00 to 5.17 feet, per day.

ECONOMIC ASSESSMENT

Capital outlay associated with the institution of the solid waste disposal system resulted primarily from three types of expenditures. These were (1) land acquisition including access road right-of-way, (2) purchase or overhaul of operating equipment and (3) site development.

Land acquisition consisted of the purchase of the following items with the total expenditure for each indicated, after which the total is given.

Landfill Site (1,500 Acres)	$531,364	
Access Road Right-of-Way	1,675	
Total for Land		$533,039

Equipment expenditures included the overhaul of units owned by the County and the purchase of new units to fill specific needs at the new site. The following equipment is already owned by the County and will be used at the landfill site:

2 International TD-20 dozers (14 years old)
(One of these was traded April 1972 on new TD-25C dozer)
1 International TD-15 dozer (14 years old)
1 Hough H90 front end loader (6 years old)

The following equipment has been overhauled and/or modified for landfill work:

1 International TD-20 dozer (14 years old)		
Overhaul cost April 1971	$ 7,000	
1 Rex Trashmaster compactor (6 years old)		
Modification cost January 1971	7,000	
		$ 14,000

The following equipment has been obtained specifically for the new landfill:

Northwest 9573 cu. yd. dragline	
(Purchased August 1971)	$127,000*
International Harvester EC-270	
Self-propelled 21 cu. yd. scraper	
(Purchased April 1970)	67,717
International TD-25C dozer	
(Purchased April 1971)	65,757

*Actual price of $114,267 included a $12,733 allowance for trade-in of a 3/4 cubic yard American dragline.

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International TD-25C dozer (Purchased April 1972)	$ 61,988		
Sub-Total for equipment		$322,462	
Total equipment costs			$336,462

Costs associated with site development include clearing, access roads, drainage, and landfill facilities. Most of these costs as itemized below have been incurred on a one-time basis and are basically those associated with making the site available for landfill operations. The operational costs, as they are accrued during the project, will be included in subsequent reports.

Clearing			
Clearing required to make site available for operations	$ 9,258		
Sub-total for clearing		$ 9,258	
Roads			
Access road (3.1 miles long) and entrance fencing and gate erection	$263,989		
On-site roads and staging area. Clearing, grubbing, filling, and road work		90,801	
Sub-total for roads			$354,790
Drainage			
(Work done by County personnel)			
Outfall canal to drain the site (2.7 miles)	$ 40,960		
On-site drainage, including Pond A	19,160		
Sub-total for drainage		$ 60,120	
Buildings and Facilities			
Concrete block office building with sanitary facilities, a small lounge, and storage room (air-conditioned and heated). Concrete floored, prefabricated metal service and maintenance building with 3 bays for equipment servicing, a 2 post lift, air compressor, and a 20-ton overhead bridge hoist. Other facilities include a scalehouse, pump house and pump, chlorinator room, metal storage building, high pressure pump (5 gpm -- 1,000 psi) for trailer washing, a washrack, and fuel storage area and pump	$134,580		

1,000 psi) for trailer washing, a washrack, and fuel storage area and pump	$134,580		
Purchase and installation of truck scales (50-ton capacity)	9,712		
A 6-inch potable water well	2,119		
Telephone lines to the site	3,600		
Sub-total for buildings and facilities		$150,011	
Total for Site Development			$574,179
Total Capital Outlay			$1,443,680

From June 1971 through July 31, 1972, the landfill site has accepted a total of 130,875 tons of solid waste, of which 45,431 tons were deposited in the "demonstration control" cells, 61,345 tons in the "demonstration trailer" cells, and 24,099 tons in the "public" cells, as shown in Table 40. While deposits were made in the public cells continually beginning in October 1971, insofar as possible, deposits were not simultaneously made in "control" cells and "trailer" cells. This was done in order to arrive at operating cost information for the separate "demonstration" cells. At this time, however, information is insufficient to evaluate cell operating costs. Refinement of reporting formats from the site, and the accumulation of additional data will permit the third year assessment to arrive at precise cost information for each type cell operation.

Table 41 reflects status of equipments in use at the demonstration site over a nine-month period. The necessity to utilize some old, reworked, or borrowed equipment has been cause for excessive downtime for repairs and has been a serious hindrance to effective operations. The past few months have seen a gradual changeover to in-house maintenance capability which is beginning to produce a greater equipment in-commission rate. The increasing caliber of qualified mechanics, coupled with their expected retention on the job, should continue to produce quality maintenance and further increase equipment availability. Again, the third year assessment report will have access to more detailed equipment maintenance data to effect a more elaborate analysis of costs relative to the landfill operation.

The measure of landfill operating effectiveness is the cost per ton of waste buried. Table 42 reflects direct operating costs only, and applies to all waste burial operations for the period of October 1971 through July 1972. Monthly fluctuations have been caused by the general equipment maintenance costs and waste tonnages delivered. Costs given are general in nature, but will be refined to assure the exclusion of costs not directly applicable to cell construction and filling so that comparative cell costs can be made. Data is presently being compiled as to costs only directly concerned with the construction and filling of control cells and demonstration cells (CC and CT). All other landfill costs which cannot be assigned directly to construction and filling of these two types of cells will be specifically excluded from computations. Accordingly, upon refining of cost data, the $1.35 average cost per ton given in the table may vary in subsequent reporting of direct costs.

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APPENDIX

LABORATORY PROCEDURES

Chemical Procedures

Reagent Preparation. Proper preparation of reagents is the foundation of meaningful and accurate analytical procedures. Maximum care must be taken in preparing reagents, especially those which are primary standards and whose strength cannot be easily checked. When required for weighing a specific quantity, reagent chemicals are dried at 103 C before weighing. Deionized water is used in the preparation of all reagents. Specific instructions for the preparation of reagents are found in the 13th edition of *Standard Methods for the Examination of Water and Wastewater.**

pH. pH is determined in the laboratory by the Glass Electrode Method as described in *Standard Methods.* A line operated Sargent Expanded Scale pH meter is used in this determination. A Sargent combination glass electrode containing a saturated solution of potassium chloride is used as the sensing element. The normal limits of accuracy reported for this method are ± 0.1 pH unit.

Alkalinity. Total alkalinity is determined in accordance with the procedure described in *Standard Methods.* End point is determined potentiometrically by titrating to a pH of 4.5. This method is free of interferences due to residual chlorine, color and turbidity. Accuracy is reported to be + 3 mg/l expressed as $CaCO_3$ using this method.

Acidity. Acidity is determined in accordance with procedure described in *Standard Methods* The analysis is carried out by titrating the alkalinity with a standard sodium hydroxide solution to a pH of 8.3 as determined potentiometrically. Selection of this method was based on the elimination of residual chlorine, color and turbidity interferences.

Suspended Solids. Total suspended solids are determined by sample filtration through a glass filter pad. The glass fiber pads used are 2.1 cm glass fiber filters, grade 934AH, manufactured by Reeve Angel, Clifton, New Jersey. During filtration, the filters are supported by Gooch crucibles. Samples are dried at 105 C avoiding the volatization of organic matter and the loss of chloride and nitrate salts. The procedure used is described in *Standard Methods.*

Ammonia Nitrogen. Ammonia nitrogen is determined according to the Nesslerization Method with the distillation at pH 7.4 into 0.02 normal H_2SO_4 as described in *Standard Methods.* A Bausch and Lomb Spectronic 20 is used unless concentrations are high. In that case, a titration determines the concentration using sulfuric acid and avoids interferences encountered when boric acid is used.

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

Total Organic Nitrogen. Kjeldahl Method and Nesslerization Measurement, in *Standard Methods*, using a Bausch and Lomb Spectronic 20 to measure color intensity. The distillation is done in 0.02 normal H_2SO_4.

Nitrate Nitrogen. Nitrates were determined in accordance with the modified brucine method as described in *FWPCA Methods for Chemical Analysis of Water and Wastes.* Method selection was based on its ability to correct for turbidity, color, salinity, and dissolved organic matter.

Nitrite Nitrogen. Nitrites are determined using the analytical procedure as described in *Standard Methods.* This method utilizes the diazotization of the nitrite ion with the color intensity being measured on a Bausch and Lomb Spectronic 20 colorimeter.

Dissolved Oxygen. Dissolved oxygen is measured in the laboratory with a Yellow Springs Instrument (Y.S.I.) D.O. Meter and the azide modification of the Winkler Method described in *Standard Methods.*

Biochemical Oxygen Demand. The 5-day biochemical oxygen demand (B.O.D.) is determined in accordance with the procedure described in *Standard Methods.* The initial and final dissolved oxygen levels are determined by the azide modification of the Winkler method described above.

Chemical Oxygen Demand (C.O.D.). The chemical oxygen demand is determined by the dichromate reflux method described in *Standard Methods.*

Metals. The metals were analyzed using a Perkin-Elmer 305 Atomic Absorption instrument utilizing the manufacturer's suggested methods. All are analyzed by atomic absorption except for calcium in which flame emission is used. Analytical wave lengths currently being used are: calcium, 4227A; magnesium, 2852A; sodium, 5890A; potassium, 7665A; iron, 2483A; copper, 3247A; zinc, 2138A; and aluminum, 3092A.

Chlorides. Chlorides are determined in accordance with the argentometric method described in *Standard Methods.* As of August 1972 (data not included in this report), the method was changed to the mercuric nitrate method due to its superior end point.

Sulfate. The turbidimetric method is used following the procedures of *Standard Methods.* This method was selected because of its ease and speed of determination over the gravimetric method.

Hardness. Total hardness is calculated using the concentrations of calcium, magnesium, iron, aluminum, and zinc as described in *Standard Methods.* This method was selected due to its accuracy and the availability of determinations by atomic absorption.

Phosphate. Ortho-phosphate concentration is determined in accordance with the stannous chloride method described in *Standard Methods*. This method provides good sensitivity. Color intensity is measured using the Bausch and Lomb Spectronic 20 at a wavelength of 690 millimicron. The samples are filtered prior to analysis, to remove turbidity. Total phosphates are determined by this method after a persulfate digestion in an autoclave. This digestion was selected in order to get good digestion with minimum time.

Total Dissolved Solids. A settled sample is filtered through a sintered glass filter. Duplicate filtered samples of 100 milliliters are pipetted into a tared weighing dish. Following evaporation to dryness at 103 C, samples are cooled in a desiccator and weighed. Total dissolved solids are also arrived at by the difference of suspended solids and total solids.

Volatile Dissolved Solids. Dried samples from the previous test are placed in a muffle furnace at a temperature of 600 C for 30 minutes. The loss in weight corresponds to the volatile dissolved solids.

Hydrogen Sulfide. Water samples were acidified with sulfuric acid, driving off H_2S which is bubbled directly into a 0.05N iodine solution. Remaining iodine is back titrated with 0.05N thiosulfate solution. H_2S is calculated by difference in iodine.

Organic Content. A Beckman DK-2A ratio recording spectrophotometer is used. The ultraviolet absorption spectrum, 190 to 360 millimicrons wave length is recorded for each water sample after suspended solids have been removed by centrifugation. The method used is that of Menzel and Vaccaro.* Conversion to estimated dissolved organic material is by the method of Armstrong and Bolach.** The visible spectrum, 360 to 800 millimicron wave length, also was taken for color analysis and to relate color to organic contamination.

Organic Compounds. A Hewlett Packard, Model 7620A, gas chromatograph with dual flame ionization detector is used. Initially, direct injection of 10 microliters of water samples was done with negative results. Subsequently, 100 ml of water from each well was extracted with $CHCl_3$, the extract dried, then taken up in 30 microliters $CHCl_3$. The microliters were injected in the gas chromatograph for analysis.

Total Organic Carbon. A Beckman, Model 915, Total Organic Carbon Analyzer is used. The procedure is under development.

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*Menzel, D. W., and R. F. Vaccaro. The measurement of dissolved organic and particulate carbon in sea water. *Limnology and Oceanography*, 9: 138-142, 1964.

**Armstrong, F.A.J., and G. B. Bolach. The ultraviolet absorption of sea water. *Journal of the Marine Biologists Association*, (United Kingdom), 41: 591-597, 1961.

Biological Procedures

Phytoplankton. Phytoplankton samples are quantified in a Sedgewick-Rafter cell using the strip counting method. The clump count is expressed as algae per milliliter. Live and dead diatoms are differentiated observing preparation of permanent diatom slide, using Hyrax mounting media (R.I. 1.65) following the procedure of Weber.* Chlorophyll-a and phaopigments (phaophytin, phaophorbide and chlorophyllide) are analyzed spectrophotometrically according to Lorensen's Method. The trichromatic method for chlorophyll analysis is also used following the method of the A.P.H.A. using appropriate modification for phytoplankton samples. All chlorophyll values are expressed in milligrams per cubic meter.

Periphyton. Periphyton analytical methods are the same as phytoplankton with the exception of a few variations in procedure. The four slides preserved in five percent formalin solution are scraped with a razor blade and the scrapings returned to the jar. Aliquots of this are used for diatom slide preparation, quantification and identification. The counts obtained are expressed in cells per square millimeter. The four slides placed in 90 percent aqueous acetone are used in chlorophyll analysis following the trichromatic method and the method for chlorophyll a in the presence of phaopigments. Both methods employed are recommended by the A.P.H A. The pigments are expressed in milligrams per square meter.

Macroinvertebrates. When the multiple-plate samplers are returned to the laboratory each sampler is disassembled and scraped with a brush into a white porcelain pan for sorting. All specimens are collected for identification and quantification. The quantification is based on organisms per square meter. All organisms collected on the multiple-plate samplers and from qualitative samples are preserved in 95 percent ethanol. For both sampling methods a pollution index developed by Beck was applied as a tool for presenting water quality from the macroinvertebrate data. The Biotic Index was calculated from:

$$2\ (\text{Class I}) + (\text{Class II}) = \text{BI}$$

where Class I organisms are pollution intolerant forms and Class II organisms are moderately tolerant.

Total Counts. Each water sample is diluted in 1 percent peptone water. Aliquots of dilutions are cultured in triplicate plates employing Tryptone Glucose Extract Agar (Difco), supplemented with Yeast Extract (Difco). Pour plate techniques are used in obtaining colony counts. For determining the count of aerobic organisms, representative pour plates are incubated at 30 C for 48 or more hours. To determine the total count of anaerobic organisms, the same

*Weber, C. I. Methods of collection and analysis of plankton and periphyton samples in water pollution surveillance system. *Water Pollution Surveillance System Application and Development*, No. 19, 1966.

medium is employed and the plates are placed in anaerobic jars. Anaerobic conditions are produced by use of a Gas Pak anaerobic generator (BBL). The anaerobic jars are incubated at 30 C for 48 or more hours. Counts are made at the end of the incubation period.

Coliform Analysis. EMB and Endo Agar (Difco) plates are inoculated with 0.1 milliliter portions of water samples. The inoculum is spread over the agar with flame-sterilized, bent-glass rods. In addition, a series of lactose broth tubes are inoculated with 1.0 or 10.0 milliliter of undiluted water samples.

Alternate to the above two methods, both total coliform counts and fecal coliform counts are obtained by Standard Methods membrane filtration technique using 100 to 200 milliliters of water for filtration. The medium used for total coliform counts is m Endo broth (Difco) and m FC broth (BBL or Difco) for fecal coliform counts. Filters plated on m Endo *broth* are incubated at 35-37C for 24 hours while those filters plated on m FC broth are incubated at 44.5C for 24 hours.

Enterococci. Predetermined volumes of water are filtered by membrane filter techniques. Filters are placed in Enterococcus agar in millipore dishes. Plates are incubated for 24 - 48 hours at 35-37C.

Salmonella. To establish the possible presence of *Salmonella*, tetrathionate broth tubes are incubated with millipore filters through which was passed 200 milliliters of a water sample. After incubation at 41 C for 48 hours, agar media of Bismuth Sulfite and SS are streaked to isolate organisms growing in the Tetrathionate broth. Isolates are subcultured to TS1 slants which are examined for biochemical characteristics of *Salmonella*. If *Salmonella* are detected they are subjected to numerous differentiation tests in order to identify the species.

Staphylococci. To detect and quantify Staphylococci, agar media of Mannitol Salt Agar, Phenylethanol Agar, Staphylococcus Medium 110, and Tellurite Glycine are inoculated with 0.1 to 2 milliliter portions of ground water samples. Alternately, water samples are filtered through membrane filters, with the filters being placed on m Staphylococcus broth. Inoculated materials are incubated at 37 C for 24 to 48 hours.

Actinomycetes and Fungi. To isolate actinomycete organisms, 0.1 milliliter of each water sample is plated on Actinomycete Isolation Agar (Difco) and spread by sterile spreader. Counts of filamentous fungi are made by adding 0.1 milliliter of each water sample onto Sabouraud Dextrose Agar (Difco) and spreading. Inoculated materials are incubated at 30 C for 2 to 5 days.

Limited Biochemical Characterization of Bacteria. Attempts are made to distinguish bacteria according to their capacity to degrade and utilize complex natural substrates. Examples of these substrates are: cellulose, starch, proteins, and lipids. 0.1 milliliter of each water sample is inoculated on agar medium containing the above substrates and spread over the surface. Counts of organisms degrading these substrates are obtained and compared to total count studies.

Differentiation of Species Isolated on Total Count Platings. All distinguishable colonies detected on total count agar plates are streaked on Tryptone Glucose Extract agar for purification. Pure cultures of each different isolate are maintained in stock culture slants employing the above medium. Each isolate will be differentiated with biochemical characteristics of each being recognized.

TABLE 1

SUMMARY OF SURFACE WATER SAMPLING STATIONS

Station Number	Type	Location
Pond A	Chemical & Biological	Located on the northeast section of Pond A.
Pond Effluent	Chemical	Located just after the Pond A water enters the canal.
1	Chemical & Biological	Midway along westerly portion of the outfall canal, approximately one mile from the landfill.
2	Chemical & Biological	Downstream from Station 1, midway along northerly portion of the outfall canal, approximately two and one half miles from the landfill.
3	Chemical & Biological	Channelized portion of the Little Econlockhatchee: One fourth mile upstream from the outfall canal within and downstream from an area of domestic waste effluent.
4	Chemical & Biological	Tributary of the Little Econlockhatchee River before channelization took place, this was the Little Econlockhatchee River proper (it enters the canalized portion of the river approximately three and one fourth miles from the landfill). Temporarily discontinued due to land clearing for canalization.
5	Chemical & Biological	Channelized portion of the river three and one half miles from the landfill and downstream from the tributary (Station 4).
5A	Chemical	Channelized area at Curry Ford Road four miles downstream from the landfill. (Presently not in use).
6	Chemical & Biological	Natural stream area with a broad natural flood plain, approximately four and three fourth miles downstream.
6A	Chemical	At USGS sampling station, five miles downstream from the landfill off Berry-Deese Road. (Presently not in use).
7	Chemical & Biological	Natural stream area with a broad natural flood plain six miles from the landfill.

TABLE 1 (CONTINUED)

SUMMARY OF SURFACE WATER SAMPLING STATIONS

Station Number	Type	Location
7A	Chemical	At Highway 50 in Union Park. Approximately eight miles from the landfill and just upstream from an area of domestic waste discharge. (Presently not in use).
8	Chemical & Biological	Located at Buck Road approximately ten and one half miles downstream from the landfill. This area has a natural broad flood plain.
9	Chemical & Biological	Natural flood plain area at Tanner Road in Seminole County, located approximately sixteen miles from the landfill and just prior to confluence with the Big Econlockhatchee River.

TABLE 2

SURFACE WATER
PHYSICAL AND CHEMICAL DATA

OCTOBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3 mg N/l	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
POND A																
7-19-71	4.6	1	11	80	--	5.7	.18	.02	.00	.004	.00	.73	31	7.0	151	71
8-10-71	6.2	10	12	66	13	---	.00	.00	---	.007	.14	.02	32	6.1	81	15
9-8-71	5.9	8	50	457	16	4.5	.09	.06	---	.005	.00	----	30	---	656	199
9-14-71	6.2	3	41	126	9	5.9	.05	.04	---	.004	.01	.37	31	26.0	142	16
10-11-71	6.6	3	37	49	17	6.0	.09	.03	---	.000	.31	.72	27	37.0	80	31
11-8-71	---	--	--	68	11	15.6	.07	---	---	.002	.00	.98	29	50.0	72	4
12-13-71	---	--	--	45	10	8.1	---	---	---	.004	.00	.19	23	3.7	47	2
1-10-72	---	--	--	62	15	5.6	.05	.04	---	.000	.35	.67	22	4.5	71	9
2-14-72	---	--	--	--	12	7.6	.02	.00	---	.004	.25	5.43	18	6.0	---	---
3-13-72	6.5	5	33	22	7	9.2	.04	.03	---	----	.00	.75	21	3.1	25	3
4-10-72	6.1	5	14	50	---	18.0	.09	.05	.05	.008	.31	.95	21	4.2	76	26
5-15-72	4.4	--	--	58	30	9.0	.01	---	---	----	.00	.53	26	6.0	61	3
6-12-72	---	--	--	--	--	54.4	---	---	---	---	---	---	---	5.7	66	24
POND EFFLUENT																
9-14-71	6.6	4	45	110	10	5.9	.06	.05	---	.002	.00	.80	31	---	117	7
10-11-71	6.8	3	28	3	11	7.5	.24	.03	---	.001	.00	.58	27	32.0	47	44
11-8-71	---	--	--	323	14	22.7	.07	.06	---	.001	.08	---	29	65.0	437	114
3-13-72	---	--	--	40	8	10.4	.03	.01	---	----	.60	.70	22	3.1	40	0
12-13-71	---	--	--	39	10	13.9	---	---	---	.007	.22	1.22	23	2.6	42	3
1-10-72	---	--	--	62	--	7.7	.71	.03	---	.000	.00	.42	22	3.1	73	11
2-14-72	---	--	--	---	--	---	.30	.00	---	.004	.20	3.07	18	5.4	---	---
5-15-72	6.0	--	--	64	21	8.0	.01	---	---	----	.00	.40	26	9.8	66	2
STATION 1																
4-5-71	6.4	10	26	477	--	---	.11	.00	.05	.005	.37	.00	23	---	653	176
7-19-71	4.1	--	31	3	--	10.8	.51	.05	.00	.017	.00	1.52	31	23.0	99	96
8-2-71	---	--	--	166	13	---	.06	.05	---	.004	.06	.08	32	8.5	188	22
9-8-71	6.4	19	130	543	22	20.3	.25	---	---	.011	.20	.73	30	35.0	586	43
9-14-71	7.6	--	43	103	12	11.1	.03	.01	---	.000	.00	.70	31	---	111	8

TABLE 2 (CONTINUED)

SURFACE WATER
PHYSICAL AND CHEMICAL DATA

OCTOBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
10-11-71	7.6	26	33	52	20	13.5	.03	.00	---	.022	.24	.50	25	30.0	52	0
11-8-71	---	--	--	302	20	52.2	.04	.02	---	.003	1.13	2.68	29	40.0	417	115
12-13-71	---	--	--	118	18	34.0	---	---	---	.004	.19	1.08	23	2.6	124	6
1-10-72	---	--	--	119	17	25.3	.31	.13	---	.000	.50	2.10	21	2.9	119	0
2-14-72	---	--	--	40	23	17.6	.03	.02	---	.006	1.50	14.15	18	3.6	62	22
3-13-72	---	--	--	63	11	16.2	.02	.01	.03	.002	.78	.70	21	3.1	63	0
4-10-72	6.4	14	14	76	---	19.8	.98	.05	.03	.004	.18	1.10	21	6.6	83	7
5-15-72	6.6	--	--	53	---	8.4	.01	---	---	----	.00	.50	26	4.5	57	4
6-12-72	---	--	--	13	---	39.6	.23	.00	.10	.003	.00	.33	26	4.5	14	1
STATION 2																
10-7-70	5.9	17	35	95	13	---	---	---	---	.005	----	---	28	60.0	137	42
10-12-70	5.9	8	22	--	--	---	.09	.02	.05	.004	.81	4.60	28	250.0	---	---
10-13-70	6.3	17	22	--	--	---	.09	.03	.05	.004	.92	4.37	20	320.0	---	---
10-28-70	6.5	44	12	54	15	---	.05	.01	.04	.007	.07	.50	27	34.0	70	16
11-9-70	6.8	28	17	140	21	---	---	---	.88	.298	.03	.45	22	60.0	186	46
4-5-71	6.7	23	17	---	38	---	00	.00	.07	.010	.34	2.24	--	700.0	---	---
5-3-71	5.9	8	8	84	--	---	2.17	2.17	.02	.009	.28	.87	26	40.0	87	3
7-19-71	7.4	65	--	---	5	---	2.00	.82	.02	.082	----	---	31	---	---	---
8-2-71	---	--	--	115	21	---	.07	.05	---	.004	.06	.07	30	11.0	115	0
9-14-71	7.5	16	--	65	16	19.0	.03	.01	---	.002	.20	.30	31	---	75	10
10-11-71	7.6	20	--	123	17	57.5	.07	.06	---	.007	1.39	1.31	25	3.7	141	18
11-8-71	---	--	--	6	21	47.7	.30	.06	---	.003	1.92	2.44	29	50.0	303	297
12-7-71	---	--	--	122	18	28.4	---	---	---	.002	.00	.44	23	4.5	122	0
1-10-72	---	--	--	180	22	59.0	.04	.16	---	.004	1.35	3.10	20	3.4	186	6
2-14-72	---	--	--	92	25	30.8	.03	.01	---	.007	.42	2.34	18	4.5	111	19
3-13-72	---	--	--	91	13	24.3	.01	.01	.01	.003	.70	1.10	18	39.0	91	0
4-10-72	6.8	13	13	96	---	28.8	.76	.01	.03	.003	.00	1.30	21	5.8	109	13
5-15-72	7.3	--	--	88	---	22.7	.01	---	---	----	.04	.40	26	7.8	91	4
6-12-72	---	--	--	43	---	24.8	[illegible]	.00	13	.002	.00	.43	28	[illegible]	45	2

TABLE 2 (CONTINUED)

SURFACE WATER
PHYSICAL AND CHEMICAL DATA

OCTOBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	C1- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NITROGEN NO_3 mg N/l	NITROGEN NO_2 mg N/l	NITROGEN NH_3 mg N/l	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
STATION 3																
10-7-70	7.2	117	22	218	37	---	5.89	5.89	---	.014	---	---	27	11.0	220	2
10-12-70	7.3	115	16	193	37	---	4.08	4.08	.04	.010	9.78	.81	26	10.0	358	165
10-13-70	7.1	90	18	233	32	---	3.95	3.32	1.15	.086	1.61	.81	26	6.0	360	127
10-28-70	6.8	71	24	192	28	---	2.04	---	.53	.002	.14	.71	24	12.0	193	1
11-19-70	7.1	78	21	---	36	---	.01	.00	.06	.004	2.22	.44	21	6.0	245	---
4-5-71	7.4	76	10	340	19	---	.00	.00	.05	.024	5.28	1.87	--	40.0	369	29
5-4-71	7.2	119	38	113	--	---	2.81	2.75	.01	.021	7.48	4.02	24	---	141	28
7-19-71	6.4	67	36	139	8	61.0	1.38	1.33	.02	.068	.71	5.89	29	40.0	159	17
8-2-71	---	---	--	97	25		.04	.02	---	.062	---	---	30	8.8	108	11
9-14-71	7.3	11	44	135	16	44.7	.31	.27	---	.028	.00	2.28	30	---	142	7
10-11-71	7.3	13	40	105	16	48.8	.04	.04	---	.004	.88	1.07	25	4.5	120	15
11-8-71	---	---	--	204	21	59.5	.06	.05	---	.004	1.19	3.43	28	40.0	268	64
12-13-71	---	---	--	139	14	37.4	---	---	---	.004	.32	.23	23	5.7	141	2
1-10-72	---	---	--	170	21	58.8	.03	---	---	.002	1.05	2.50	20	---	172	2
2-14-72	---	---	--	106	26	47.3	.03	---	---	.009	.00	1.46	19	5.1	122	16
3-13-72	---	---	--	93	16	29.3	.05	.03	.00	.001	.80	1.80		3.4	95	2
4-10-72	6.9	2	15	172	---	26.6	.16	.07	.02	.003	.00	1.2	20	5.7	118	16
5-15-72	8.1	---	--	178	---	47.3	2.19	---	---	---	.00	.40	26	2.6	181	3
6-12-72	---	---	--	---	---	10.6	2.00	1.60	.12	.004	.58	.36	25	11.5	---	---
STATION 4																
7-19-71	7.1	21	3	289	6	25.5	1.18	1.11	.03	.005	.40	---	26	6.0	302	13
8-2-71	---	---	--	182	11		.04	.03	---	.006	.16	.77	29	3.7	189	7
9-14-71	7.2	11	46	642	25	38.1	.25	.24	---	.003	.77	1.92	--	---	647	5
10-11-71	7.3	8	73	154	19	52.8	33	.21	---	.000	.47	1.30	24	2.6	154	0
11-8-71	---	---	--	192	21	50.6	.56	.44	---	.004	---	2.01	28	4.5	215	23
12-13-71	---	---	--	141	20	51.0	---	---	---	.005	.00	1.20	20	1.6	142	1
1-10-72	---	---	--	192	18	86.0	.66	.61	---	.001	.40	2.40	20	2.1	195	3
2-14-72	---	---	--	97	21	35.4	.02	.32	---	.007	.30	1.80	15	5.4	115	18
3-13-72	---	---	--	131	19	35.5	.19	.07	.03	.002	.39	2.70	15	17.0	165	34
4-10-72	6.7	9	14	338	---	42.4	1.42	97	.05	.003	.30	4.90	15	---	456	118

TABLE 2 (CONTINUED)

SURFACE WATER
PHYSICAL AND CHEMICAL DATA

OCTOBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
STATION 5																
10-28-70	6.9	45	19	---	24	---	.77	---	.19	.007	.03	1.04	22	---	100	---
11-9-70	7.0	44	15	213	24	---	.77	.56	.15	.005	.00	.32	22	10.0	260	47
2-1-71	7.5	64	23	324	28	---	2.27	2.30	.75	.039	.34	2.22	15	100.0	341	17
4-5-71	7.0	34	17	333	12	---	.00	.00	.12	.021	.00	3.31	--	80.0	371	38
5-3-71	6.3	50	37	171	28	---	1.02	.89	.01	.028	.55	2.65	25	5.0	182	9
7-19-71	7.3	57	12	109	5	62.6	1.05	.77	.03	.031	.15	1.11	28	6.0	124	15
8-2-71	7.4	43	23	150	15	---	.01	.01	---	.083	1.95	.75	30	6.1	166	16
9-14-71	7.6	11	31	129	17	45.1	.31	.16	---	.075	.00	1.57	30	---	138	9
10-11-71	6.3	8	79	88	13	32.9	.38	.04	---	.002	.00	.75	25	70.0	137	49
11-8-71	---	---	--	251	18	48.8	.25	.22	---	.004	.00	2.03	29	6.6	280	29
12-13-71	---	---	--	130	27	47.1	---	---	---	.226	.00	1.31	23	2.1	134	4
1-10-72	---	---	--	154	18	52.7	.06	.05	---	.001	.30	1.90	20	1.4	160	6
2-14-72	---	---	--	101	20	35.8	.02	---	---	.032	.50	1.60	15	7.2	118	17
3-13-72	---	---	--	103	21	28.4	.20	.16	---	----	.29	1.65	18	2.1	104	1
4-10-72	7.3	28	20	80	---	30.1	.69	.66	.05	.002	.31	1.40	19	4.9	109	29
5-15-72	7.7	---	--	138	---	39.4	1.73	---	--	----	.00	.40	26	5.1	155	17
6-12-72	---	---	---	176	---	10.8	6.14	---	.07	.002	.25	1.37	26	12.0	204	88
STATION 6																
10-7-70	7.0	51	6	138	28	---	1.30	1.30	---	.004	----	----	27	---	142	4
10-12-70	7.3	77	14	175	25	---	1.05	---	.21	.010	.81	.23	27	15.0	301	126
10-13-70	7.2	51	19	166	25	---	.55	---	.15	.007	.69	.35	27	10.0	307	141
10-28-70	7.0	50	13	174	23	---	3.45	3.20	.25	.007	.00	.78	26	24.0	192	18
11-9-70	6.9	42	10	88	21	---	.75	.50	14	.005	.26	.31	21	9.0	106	18
8-2-71	6.9	135	16	---	17	---	3.75	2.80	---	.012	.00	.74	30	4.0	---	---
11-8-71	---	---	--	---	19	46.8	.41	36	---	.005	.00	1.63	29	8.0	---	---
5-16-72	7.5	---	--	137	---	39.5	1.67	---	---	----	.00	.33	24	3.4	138	1

TABLE 2 (CONTINUED)

SURFACE WATER
PHYSICAL AND CHEMICAL DATA

OCTOBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l $(CaCO_3)$	ACID mg/l	TDS mg/l	C1- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
STATION 7																
10-7-70	6.7	72	8	125	22	---	.75	.75	---	.046	---	---	27	11.0	127	2
11-9-70	7.0	51	14	274	22	---	.90	.90	.33	.039	.00	.94	16	6.0	291	17
2-1-71	7.4	70	9	164	29	---	1.90	1.65	.50	----	.00	1.59	16	13.0	167	3
4-5-71	---	43	7	---	16	---	.00	.00	.21	.023	.09	.82	--	3.0	---	--
5-3-71	6.7	67	22	118	47	---	.95	.95	.02	.042	.91	10.04	21	10.0	125	7
8-2-71	7.5	30	18	164	37	---	1.30	1.00	---	.010	1.55	----	30	5.0	175	11
11-8-71	---	--	--	206	16	47.3	.77	---	---	.007	.00	1.95	29	4.5	228	22
5-15-72	7.5	---	--	146	---	37.7	1.44	---	---	----	.00	.60	25	3.1	151	5
STATION 8																
11-9-70	7.5	108	13	253	36	---	1.90	---	.24	.126	8.45	.75	20	5.0	279	26
2-1-71	7.5	157	75	218	44	---	3.55	2.86	.23	----	12.94	2.22	16	8.0	225	7
5-3-71	7.3	145	24	141	86	---	---	2.85	.02	.046	10.16	2.57	24	14.0	151	10
8-2-71	7.4	65	15	---	23	---	3.75	2.55	---	.270	2.46	----	30	---	---	--
11-8-71	---	--	--	178	17	47.1	4.45	---	---	.004	.00	1.60	29	1.3	205	27
5-15-72	7.2	--	--	236	---	56.9	4.64	---	---	----	8.50	.97	25	4.9	238	2
STATION 9																
11-9-70	7.3	104	18	270	33	---	1.15	---	.74	.158	4.50	8.80	19	3.0	278	8
2-1-71	7.6	124	60	---	40	---	2.96	.24	.70	----	8.85	1.77	16	6.0	230	--
5-3-71	7.3	117	19	274	86	---	2.55	2.50	.08	.112	12.94	2.76	25	7.0	280	6
8-2-71	7.4	57	18	200	22	---	2.80	2.70	---	.097	1.99	1.39	30	3.0	210	10
11-8-71	---	---	--	---	26	65.7	3.10	2.55	---	.080	3.58	2.29	29	5.1	---	--
5-15-72	7.6	---	--	227	---	57.0	4.12	---	---	----	6.10	.90	25	15.1	235	8

TABLE 3

SURFACE WATER
TOTAL DISSOLVED SOLIDS
MILLIGRAMS PER LITER

JULY 1971 THROUGH OCTOBER 1971

Date	Pond A	Pond Effluent	Station 1
July 9, 1971	151.0	162.0	176.0
Aug 10	50.0	64.5	51.5
Sept 16	75.5	---	---
Sept 20	---	56.0	35.0
Oct 26	187.0	58.0	51.0

Note: Sample analysis at FTU Laboratory

TABLE 4

SURFACE WATER
PHYSICAL AND CHEMICAL DATA
(Additional)

OCTOBER 1970 THROUGH JUNE 1972

DATE	pH (field)	CONDUCTIVITY (micromhos/cm)	SO_4	DO	D.O. (%Sat.)	COD
POND A						
1-10-72	---	55	----	---	---	---
3-13-72	---	---	2.4	7.7	84	13
4-10-72	6.3	120	18.8	9.5	105	20
5-15-72	---	50	6.6	---	---	--
6-12-72	6.6	74	13.3	7.6	93	35
POND EFFLUENT						
1-10-72	---	51	----	---	---	---
3-13-72	---	---	2.5	7.7	87	11
5-15-72	---	---	5.4	---	--	25
STATION 1						
1-10-72	---	70	----	---	--	---
3-13-72	---	---	7.6	7.8	86	42
4-10-72	5.4	100	13.1	9.4	104	37
5-15-72	---	---	5.4	---	---	21
6-12-72	4.7	64	5.6	6.5	78	20
STATION 2						
10-7-70	---	---	----	5.8	66	---
10-28-70	---	88	----	4.6	56	---
11-9-70	---	166	----	0.5	48	---
4-5-71	---	---	----	---	---	---
5-3-71	---	732	----	---	---	---
1-10-72	---	209	----	---	---	---
3-13-72	---	---	11.0	7.5	78	56
4-10-72	6.1	135	14.3	9.4	103	44
5-15-72	---	---	7.6	---	---	18
6-12-72	6.0	115	5.3	6.6	83	36
STATION 3						
10-7-70	---	405	----	.5	5	---
10-12-70	---	378	----	---	---	---
10-13-70	---	310	----	---	---	---
10-28-70	---	264	----	.7	8	---
11-9-70	---	366	----	1.8	19	---
5-4-71	---	415	----	---	---	---
1-10-72	---	209	----	---	---	---
3-13-72	---	---	14.1	7.5	---	44
4-10-72	---	145	14.0	9.8	107	40
5-15-72	---	---	19.5	---	---	11
6-12-72	6.3	190	7.2	5.0	59	41

TABLE 4 (CONTINUED)

SURFACE WATER
PHYSICAL AND CHEMICAL DATA
(Additional)

OCTOBER 1970 THROUGH JUNE 1972

DATE	pH (field)	CONDUCTIVITY (micromhos/cm)	SO_4	DO	D.O. (%Sat.)	COD
STATION 4						
1-10-72	---	200	----	---	---	---
3-13-72	---	---	100	6.6	64	117
4-10-72	6.7	195	128	9.7	99	136
STATION 5						
10-28-70	---	196	----	1.3	14	---
11-9-70	---	198	----	4.0	44	---
2-1-71	---	286	----	2.3	22	---
5-3-71	---	259	----	8.5	102	---
8-2-71	---	---	----	0.7	8	---
1-10-72	---	181	----	---	---	---
3-13-72	---	---	12.0	7.3	66	29
4-10-72	6.8	200	21.4	9.5	100	32
5-15-72	---	---	17.0	---	---	20
6-12-72	6.2	315	14.4	---	---	49
STATION 6						
10-7-70	---	221	----	4.7	58	---
10-12-70	---	231	---	---	---	---
10-13-70	---	210	----	---	---	---
10-28-70	---	186	----	3.2	38	---
11-9-70	---	210	----	4.6	50	--
5-16-72	---	204	15.8	---	---	17
STATION 7						
10-7-70	---	214	----	3.9	48	---
11-9-70	---	233	----	2.5	24	---
2-1-70	---	299	----	3.5	35	---
5-3-71	---	250	----	1.3	14	---
8-2-71	---	---	----	4.1	53	---
5-15-72	---	---	14.1	---	---	19
STATION 8						
11-9-70	---	399	----	2.0	21	---
2-1-71	---	540	----	2.2	22	---
5-3-71	---	531	----	1.3	15	---
8-2-71	---	---	----	1.2	15	---
5-15-72	---	---	22.9	---	---	30
STATION 9						
11-9-70	---	355	----	2.4	25	---
2-1-71	---	507	----	2.4	24	---
5-3-71	---	484	----	8.5	100	---
8-2-71	---	---	----	.7	8	---
5-15-72	---	---	22.4	---	---	24

TABLE 5

SURFACE WATER
pH MEASUREMENTS

JULY 1971 THROUGH MAY 1972

Date	Pond A	Pond Effluent	Station I
July 9, 1971	5.80	5.90	5.60
Aug 10	6.65	7.10	6.40
Sept 16	6.10	---	---
Sept 20	---	6.15	5.50
Oct 26	6.40	5.65	3.85
Nov 19	6.35	6.05	4.70
Dec 14	6.35	---	5.80
Jan 11, 1972	6.23	6.05	5.24
Feb 14	6.20	6.13	4.90
Mar 13	6.55	5.97	4.95
Apr 10	6.94	---	4.96
May 15	6.60	5.20	5.74

Note: Sample analysis at FTU Laboratory

TABLE 6

SURFACE WATER
METAL ANALYSIS

JULY 1971 THROUGH JUNE 1972

DATE	Ca	Mg	Fe	Al	Zn	K	Na	Cu
POND A								
7-19-71	.70	95	.00	--	01	20	5.8	.00
9-8-71	75	.55	.20	-	01	.25	7.2	00
9-14-71	1.05	.70	20	--	.02	.25	4.9	.00
10-11-71	1.20	.70	.06	.0	.01	.25	4.5	.00
11-8-71	2.30	.90	.32	1.0	.01	.30	4.8	.00
12-7-71	1.60	.95	.10	.0	.01	.10	5.4	.00
1-10-72	1.20	.60	.06	.0	00	.05	6.7	00
2-14-72	.80	70	.25	.4	.01	.15	6.1	.00
3-13-72	.80	.85	.20	.6	.01	.20	6.8	.01
4-10-72	.80	.80	.25	2.2	.02	.45	6.0	.02
5-15-72	1.20	.90	.05	.4	.01	.35	7.2	.00
6-12-72	11.20	5.10	3.05	.0	.00	7.10	32.0	.00
POND EFFLUENT								
9-14-71	1.20	.70	.20	--	.01	.23	4.5	.00
10-11-71	1.10	.80	.02	.3	.01	.20	4.7	.00
11-8-71	2.70	1.00	.40	2.0	.03	45	5.2	.00
12-13-71	1.65	.95	.14	1.0	.01	.10	5.8	.00
1-10-72	1.20	1.10	.08	0	.00	.10	6.7	.00
3-13-72	.80	.85	.25	8	.02	.20	6.8	.00
5-15-72	1.20	.90	.10	.2	.01	.30	7.5	.00
STATION 1								
7-19-71	2.45	1.10	.08	--	.05	.25	5.9	.02
9-8-71	6.10	1.20	.10	--	.01	.45	5.4	.00
9-14-71	2.60	1.00	.30	--	.01	.15	5.7	.00
10-11-71	3.00	1.05	16	.3	.01	.23	5.5	.00
11-8-71	9.20	3.20	1.15	2.5	.08	.75	10.6	.00
12-13-71	5.70	2.20	1.30	1.5	.01	.23	8.8	.00
1-10-72	2.70	3.25	58	.8	.00	.05	7.8	.00
2-14-72	2.60	1.35	.60	.8	.02	.50	7.7	.05
3-13-72	2.00	1.15	.50	1.0	.01	.15	6.4	.00
4-10-72	3.20	1.20	.70	1.0	.04	.30	7.1	.01
5-15-72	1.60	.85	.50	.0	.00	.20	6.9	.00
6-12-72	8.80	2.80	.90	.8	.00	2.25	1.8	.00
STATION 2								
9-14-71	4.65	1.50	.70	--	.01	.20	7.4	.00
10-11-71	17.60	3.30	.00	.0	.01	2.45	13.4	.00
11-8-71	7.40	3.20	1.20	2.5	.01	.80	10.6	.02
12-13-71	5.70	2.20	1.30	.5	.01	.20	8.7	.00
1-10-72	17.80	3.05	.32	.3	.00	3.05	19.0	.00
2-14-72	5.40	1.95	1.20	1.0	1.00	.30	9.6	.00
3-13-72	4.20	1.60	.90	1.0	.01	.35	8.9	.03
4-10-72	5.20	1.65	1.30	1.2	.02	.25	8.5	.02

TABLE 6 (CONTINUED)

SURFACE WATER
METAL ANALYSIS

JULY 1971 THROUGH JUNE 1972

DATE	Ca	Mg	Fe	Al	Zn	K	Na	Cu
STATION 2 (Cont.)								
5-15-72	5.60	1.45	.90	.2	.01	.15	8.5	.00
6-12-72	6.00	1.55	.70	.4	.01	.10	7.9	.00
STATION 3								
7-19-71	18.40	3.65	.00	--	.01	5.80	19.2	.00
9-14-71	12.50	2.90	.50	--	.41	3.98	8.9	.00
10-11-71	14.20	2.85	.15	.3	.01	1.60	12.0	00
11-8-71	11.00	3.20	1.20	3.0	.03	.85	10.6	.00
12-13-71	7.00	2.25	1.25	1.5	.01	.30	8.9	.00
1-10-72	16.40	3.20	.30	.8	.00	2.90	18.8	.00
2-14-72	4.80	2.20	1.10	1.2	.01	.65	10.3	.03
3-13-72	5.00	2.10	.85	1.2	.01	.70	9.6	.02
4-10-72	5.20	1.70	1.20	.8	.02	.45	13.0	.01
5-15-72	12.00	4.20	.00	.0	.00	3.45	33.0	.00
6-12-72	1.20	.90	.30	.6	.00	.15	5.9	.00
STATION 4								
7-19-71	6.05	2.45	.20	--	.01	3.00	16.8	.00
9-14-71	10.40	2 75	.45	--	.01	3.40	6 9	00
10-11-71	16.00	2.60	.40	.3	.03	2.25	9.1	.02
11-8-71	14.80	3.10	.50	.0	.03	3.40	12.4	.00
12-13-71	14.80	2.90	.42	.3	.01	3.65	14.8	.00
1-10-72	28.50	3.20	.14	.3	.00	2.25	14.6	.00
2-14-72	8.60	3.00	.25	.2	.02	3.85	16.0	.01
3-13-72	7.40	2.65	.30	1.0	.03	2.95	18.0	.02
4-10-72	5.20	2.50	.70	3.2	.03	4.05	16.0	.02
STATION 5								
7-19-71	19.20	3.50	.10	--	.03	3.30	13.0	.02
9-14-71	11.90	3.50	.55	--	.01	2.55	9.8	.00
10-11-71	3:70	1.20	.74	3.0	.01	.25	5.5	.00
11-8-71	12.40	3.25	.74	.5	.24	1.93	12.0	.02
12-13-71	12.40	2.90	.80	.5	.00	3.10	13.0	.00
1-10-72	15.80	2.85	.10	.3	.00	2.43	17.0	.00
2-14-72	7.00	3.05	.70	.8	.02	2.85	15.0	.02
3-13-72	5.40	2.90	.40	.4	.00	1.05	19.0	.00
4-10-72	8.00	2.80	.60	.8	.04	2.10	16.0	.04
5-15-72	10.60	3.10	.10	.0	.00	1.80	24.0	.00
6-12-72	1.40	.95	.05	.6	.00	.40	8.5	.00
STATION 6								
11-8-71	12.80	3.05	.48	.3	.04	2.93	12.2	.02
5-16-72	10.80	2.95	.20	.0	.01	1.30	22.0	.00

TABLE 6 (CONTINUED)

SURFACE WATER
METAL ANALYSIS

JULY 1971 THROUGH JUNE 1972

DATE	Ca	Mg	Fe	Al	Zn	K	Na	Cu
STATION 7								
11-8-71	13.00	3.00	.58	.3	.02	2.60	11.2	.00
5-15-72	10.20	2.85	.30	.0	.01	2.90	21.0	.00
STATION 8								
11-8-71	13.00	2.90	.72	.3	.01	2.45	10.6	.00
5-15-72	14.20	5.15	.10	.0	.05	6.10	33.0	.00
STATION 9								
11-8-71	19.40	4.00	.30	.0	---	4.20	19.2	.02
5-15-72	14.00	5.30	.05	.0	.04	6.20	35.0	.00

TABLE 7

SURFACE WATER
CARBON ANALYSES

JULY 1971 THROUGH MAY 1972

Date	Total Carbon	Total Inorganic Carbon	Total Organic Carbon	CO_2 Carbon	Carbonate Carbon
POND A					
July 9, 1971	11.0	8.0	3.0	5.0	3.0
Aug 10	---	1.0	---	0.0	1.0
Sept 16	16.5	1.8	14.7	0.8	1.0
Oct 26	14.3	3.0	11.3	0.0	5.0
Nov 19	12.7	2.5	10.2	0.0	2.5
Dec 14	17.0	2.0	15.0	0.0	2.0
Jan 11, 1972	14.8	1.4	13.4	0.4	1.0
Feb 14	15.0	3.0	12.0	1.0	2.0
Mar 13	14.5	2.3	12.2	0.6	1.7
Apr 10	19.0	2.0	17.0	0.0	2.0
May 15	13.3	1.0	12.3	0.0	1.0
POND EFFLUENT					
July 9, 1971	11.5	8.5	3.0	5.5	3.0
Aug 10	11.5	1.0	10.5	0.0	1.0
Sept 20	16.0	1.5	14.5	0.5	1.0
Oct 26	20.7	3.1	17.6	2.1	1.0
Nov 19	15.0	1.5	13.5	0.0	1.5
Jan 11, 1972	13.3	2.5	10.8	1.1	1.4
Feb 14	14.7	2.5	12.2	1.0	1.5
Mar 13	14.3	2.7	11.6	1.7	1.0
May 15	13.0	3.0	10.0	0.0	3.0
STATION 1					
July 9, 1971	25.5	22.0	3.5	18.0	4.0
Aug 10	21.0	9.0	12.0	6.5	2.5
Sept 20	20.0	7.0	13.0	4.5	2.5
Oct 26	71.2	7.0	64.2	4.5	2.5
Nov 19	53.7	1.5	52.5	0.0	1.5
Dec 14	19.3	2.0	17.3	0.5	1.5
Jan 11, 1972	35.8	11.3	24.5	10.3	1.0
Feb 14	49.0	9.5	39.5	8.0	1.5
Mar 13	40.3	7.2	33.1	6.7	0.5
Apr 10	39.0	7.3	31.7	6.3	1.0
May 15	20.0	6.0	14.0	4.5	1.3

Note: Average milligrams per liter for triplicate samples.

TABLE 8

PHYTOPLANKTON STANDING CROP DECEMBER 1970 THROUGH MAY 1972

(ORGANISMS PER MILLILITER AND MILLIGRAMS PER CUBIC METER)

Date	Chlorophyll-a Funct.	Chlorophyll-a Non-Funct.	Chlorophyll- a	Chlorophyll- b	Chlorophyll- c	Total Count
POND A						
11-9-71	12.03	.00	6.25	.00	.00	100
12-13-71	1.15	.00	.88	1.22	.56	660
1-13-72	1.23	2.65	2.15	9.62	4.64	40
2-14-72	3.21	.00	2.08	1.68	.20	137
3-13-72	4.46	.00	3.50	1.25	.00	---
4-11-72	1.60	.00	1.38	.00	.00	140
5-15-72	.67	3.07	2.53	.00	.00	570
STATION 1						
3-3-71	----	----	------	-----	-----	40
5-5-71	2.47	.00	2.47*	-----	-----	360
8-2-71	1.00	.00	1.00*	-----	-----	40
11-9-71	20.05	.00	10.60	.20	2.50	680
12-13-71	2.01	1.15	2.48	2.93	8.31	195
1-13-72	1.23	2.65	2.15	9.62	4.64	60
2-14-72	.60	.20	.68	.00	.30	40
3-13-72	2.41	.00	1.28	3.30	1.73	90
4-11-72	2.01	.00	1.95	.00	0.24	90
5-15-72	.00	7.35	1.75	.00	2.05	330
STATION 2						
12-1-70	.95	.00	.95*	-----	-----	370
12-29-70	4.76	.00	4.76*	-----	-----	260
1-25-71	5.68	.00	5.68*	-----	-----	100
2-26-71	----	----	----	-----	-----	20
3-3-71	----	----	----	-----	-----	100
4-12-71	2.01	.00	2.01*	-----	-----	200
5-5-71	.80	3.69	4.49*	-----	-----	440
8-2-71	8.02	.00	8.02*	-----	-----	280
11-9-71	9.36	.00	4.65	.00	.90	320
12-13-71	2.41	.00	1.50	6.33	12.12	70
1-13-72	5.73	.00	5.23	.00	.00	80
2-14-72	2.01	.00	1.01	.30	.00	21
3-13-72	2.01	.00	.76	.89	2.55	180
4-11-72	5.61	.00	2.91	1.68	.00	120
5-15-72	2.14	.12	2.04	.00	27.28	336
STATION 3						
12-1-70	-----	----	------	-----	-----	490
12-29-70	-----	----	------	-----	-----	700
1-25-71	2.21	.00	2.21*	-----	-----	270
2-26-71	145.68	1.13	146.81*	-----	-----	20,910
4-12-71	32.88	8.66	41.54*	-----	-----	2,940
5-5-71	10.83	11.35	22.18*	-----	-----	1,120
8-2-71	210.50	23.86	234.36*	-----	-----	24,150

TABLE 8 (CONTINUED)

PHYTOPLANKTON STANDING CROP
DECEMBER 1970 THROUGH MAY 1972

(ORGANISMS PER MILLILITER AND
MILLIGRAMS PER CUBIC METER)

Date	Chlorophyll-a Funct.	Chlorophyll-a Non-Funct.	Chlorophyll- a	Chlorophyll- b	Chlorophyll- c	Total Count
11-9-71	14.03	.00	6.68	.00	19.50	140
12-13-71	4.01	.00	2.31	.00	7.95	90
1-13-72	3.01	1.55	3.62	4.50	9.04	230
2-14-72	.80	1.60	1.77	1.19	.82	52
3-13-72	7.22	.00	3.48	.00	.27	160
4-11-72	4.81	.00	2.99	1.19	.00	100
5-15-72	2.56	.00	2.45	.72	2.57	130
STATION 4						
1-25-71	1.78	.00	1.78*	-----	-----	150
2-26-71	2.19	1.30	3.49*	-----	-----	350
4-12-71	2.14	.00	2.14*	-----	-----	280
8-2-71	1.60	1.20	2.80*	-----	-----	40
11-9-71	2.01	.00	1.88	1.80	3.32	240
12-13-71	1.00	.00	.64	.26	2.41	130
1-13-72	.40	1.70	1.43	.00	5.93	100
2-14-72	1.00	.00	.57	.39	.00	8
3-13-72	3.21	1.29	3.96	1.38	5.28	470
4-11-72	36.09	.00	33.00	.00	0.00	290
STATION 5						
1-25-71	2.01	.33	2.34*	-----	-----	440
2-26-71	23.26	1.29	24.55*	-----	-----	240
5-5-71	12.03	10.89	22.92*	-----	-----	690
8-2-71	20.48	18.12	38.60*	-----	-----	740
11-9-71	6.01	.00	2.60	.00	.00	140
12-13-71	1.34	1.84	2.32	2.17	1.16	125
1-13-72	1.87	2.43	3.34	.33	2.48	130
2-14-72	2.01	.00	1.55	3.77	4.98	100
3-13-72	1.20	1.04	1.68	1.97	5.63	600
4-11-72	20.05	13.63	30.00	.00	.00	1460
5-15-72	.31	1.85	1.33	1.34	.89	132
STATION 6						
1-25-71	1.25	.00	1.25*	-----	-----	110
2-26-71	.00	1.73	1.73*	-----	-----	40
4-2-71	.23	2.58	2.81*	-----	-----	220
5-5-71	1.00	.96	1.96*	-----	-----	160
8-2-71	5.61	.00	5.61*	-----	-----	160
11-9-71	.00	.00	.00	.00	.00	40
5-15-72	.00	1.40	.72	1.39	3.72	40

TABLE 8 (CONTINUED)

PHYTOPLANKTON STANDING CROP
DECEMBER 1970 THROUGH MAY 1972

(ORGANISMS PER MILLILITER AND MILLIGRAMS PER CUBIC METER)

Date	Chlorophyll-a Funct.	Chlorophyll-a Non-Funct.	Chlorophyll- a	Chlorophyll- b	Chlorophyll- c	Total Count
STATION 7						
2-26-71	.19	1.68	1.87*	-----	-----	250
4-1-71	.00	1.44	1.44*	-----	-----	60
5-5-71	.00	1.38	1.38*	-----	-----	90
8-2-71	.40	1.56	1.96*	-----	-----	120
8-2-71	1.00	.00	1.00	-----	-----	---
11-9-71	.00	.00	.00	.00	.00	20
5-15-72	.40	.44	.66	.04	1.42	10
STATION 8						
3-4-71	18.95	11.15	30.11*	-----	-----	1,290
4-1-71	11.36	10.39	21.75*	-----	-----	500
5-5-71	45.71	35.97	81.67*	-----	-----	1,540
8-2-71	26.73	.00	26.73*	-----	-----	980
11-9-71	.00	.00	.00	.00	.00	10
5-15-72	43.30	34.16	62.70	27.12	34.26	1,575
STATION 9						
12-1-70	-----	-----	------	-----	-----	1,860
12-29-70	-----	-----	------	-----	-----	640
3-4-71	2.41	.40	2.81*	-----	-----	280
4-2-71	3.32	3.90	7.22*	-----	-----	660
5-5-71	36.09	39.98	76.06*	-----	-----	1,600
8-2-71	3.61	16.04	19.65*	-----	-----	1,470
11-9-71	2.41	.96	3.08	.00	.00	120
5-15-72	14.84	12.39	21.87	10.04	6.80	990

*SUM OF FUNCTIONAL AND NON-FUNCTIONAL CHLOROPHYLL-a

TABLE 9

PERCENT OCCURRENCE ALGAE FOUND IN PLANKTON SAMPLES

NOVEMBER 1970 THROUGH MAY 1972

ORGANISM GROUP and GENUS	PA	PERCENT OCCURRENCE BY STATION 1	2	3	4	5	6	7	8	9
CYANOPHYTA										
Chroococcales										
Agmenellum		10	7	21		24	14	17	17	38
Anacystis	28	10		14					33	13
Homogonales										
Anabaena	71	30	20	21			14		17	
Arthrospira	14	10		7						
Lyngbya	14	10	7	14	20	8	42			38
Oscillatoria				21	10	16		17	33	13
Schizothrix	14	10								
Unidentified										13
CHLOROPHYTA										
Volvocales										
Carteria	14	40	27	36	20	33		17	17	
Chlamydomonas	14	20	13	7		8			17	13
Eudorina		10				8				
Pandorina			7	7		16			17	25
Spondylomorum									17	13
Tetrasporales										
Sphaerocystis	14			7						13
Ulotrichales										
Binuclearia				7						
Geminella		10	7							
Chlorococcales										
Actinastrum				21					17	13
Ankistrodesmus	43	30	20	21	10	16	14	17	67	63
Chlorella			7		10	8	14	33	17	50
Closteriopsis	29	20	7	7				17	17	13
Coelastrum	28		7	29	20	24	14		50	75
Crucigenia				14					17	25
Dictyosphaerium			7						17	13
Kirchneriella			7						17	25
Micractinium				7		8			17	38
Nephrocytium	14			7						
Oocystis				7					17	
Pediastrum									17	13
Scenedesmus	29	20	20	92	10	67	57	50	100	87
Schroederia				7					17	13
Selenastrum				7	10				17	25
Tetraedron				7						13

TABLE 9 (CONTINUED)

PERCENT OCCURRENCE ALGAE FOUND IN PLANKTON SAMPLES

NOVEMBER 1970 THROUGH MAY 1972

ORGANISM GROUP and GENUS	PERCENT OCCURRENCE BY STATION									
	PA	1	2	3	4	5	6	7	8	9
Zygnematales										
Closterium			7	14	30	16		17	67	13
Cosmarium			7	7		16		17	17	38
Luastrum			27							
Micrasterias	43	30		7						
Mougeotia			7			8				
Penium		10		7	10					
Spirogyra						16				
Spondylosium				7						
Staurastrum				7						
Tetmemorus				7						
PYRRHOPHYTA										
Dinokonatae										
Glenodinium	14	20								
Peridinium	14	20	7							
CHRYSOPHYTA										
Heterococcales										
Tetragoniella				7	10			17	17	
Chrysomonales	14									
Dinobryon	100	70	40	28	10	8	14			13
Centrales	29	10	20	93	90	75	28	33	50	50
Pennales	86	70	93	86	90	100	57	83	83	88
EUGLENOPHYTA										
Euglenales										
Euglena		70	34	86	40	58	28	67	84	87
Lepocinelis						8			17	13
Phacus		10	7	28	20	24	14	17	17	38
Trachelomonas				7	10				17	13
NUMBER OF SAMPLES	7	10	15	14	10	12	7	6	6	8

TABLE 10

PERIPHYTON STANDING CROP
NOVEMBER 1970 THROUGH MAY 1972

MILLIGRAMS PER SQUARE MILLIMETER
CELLS PER SQUARE MILLIMETER

Inclusive Dates	Chlorophyll-a Funct.	Chlorophyll-a Non-Funct.	Chlorphyll a	Chlorphyll b	Chlorphyll c	Total Count
POND A						
12-15-71 - 1-26-71	-----	-----	.54	.46	.54	121
4-18-72 - 5-31-72	5.12	5.15	7.85	5.08	15.01	634
STATION 1						
2-22-71 - 3-23-71	.00	.00	.00*	-----	-----	20
6-16-71 - 7-28-71	.68	6.00	6.68*	-----	-----	67
9-17-71 - 10-28-71	17.73	2.32	19.15	6.02	.00	244
12-15-71 - 1-26-72	8.18	6.61	11.95	5.51	2.60	-----
4-18 72 - 5-31-72	1.02	.05	1.05	.24	.69	399
STATION 2						
11-2-70 - 12-1-70	-----	-----	------	-----	-----	133
12-1-70 - 12-29-70	2.39	2.80	5.19*	-----	-----	40
2-22-71 - 3-23-71	10.36	1.09	11.45	-----	-----	---
3-23-71 - 5-5-71	1.23	3.07	4.30*	-----	-----	45
9-17-71 - 10-28-71	30.00	6.75	33.98	11.13	.54	472
12-15-71 - 1-26-72	5.80	.31	2.39	1.04	.00	223
STATION 3						
12-1-70 - 12-29-70	72.62	99.62	172.24*	-----	-----	2,214
2-15-71 - 2-12-71	36.34	11.46	48.00*	-----	-----	2,702
2-22-71 - 3-23-71	5.93	6.96	12.89*	-----	-----	707
9-17-71 - 10-28-71	.00	.00	.00	.00	.00	41
12-15-71 - 1-26-72	6.14	4.36	8.70	2.96	.00	300
STATION 4						
11-2-70 - 12-1-70	-----	-----	------	-----	-----	66
12-1-70 - 12-29-70	1.98	.00	1.98*	-----	-----	59
1-15-71 - 2-12-71	2.59	3.41	6.00*	-----	-----	584
2-22-71 - 3-23-71	8.18	1.02	9.20*	-----	-----	645
9-17-71 - 10-28-71	2.05	.00	1.11	.50	.10	17
12-15-71 - 1-26-72	.00	9.89	5.31	3.92	2.11	418
STATION 5						
11-2-70 - 12-1-70	-----	-----	------	-----	-----	3,106
12-1-70 - 12-29-70	18.21	.00	18.21*	-----	-----	-----
1-15-71 - 2-12-71	2.05	2.86	4.91*	-----	-----	131
2-22-71 - 3-23-71	18.41	8.12	16.53*	-----	-----	619
3-23-71 - 5-5-71	13.64	.00	13.64*	-----	-----	463
12-15-71 - 1-26-72	7.16	5.49	10.26	5.02	2.24	184

TABLE 10 (CONTINUED)

PERIPHYTON STANDING CROP
NOVEMBER 1970 THROUGH MAY 1972

MILLIGRAMS PER SQUARE MILLIMETER
CELLS PER SQUARE MILLIMETER

Inclusive Dates			Chlorophyll-a Funct.	Chlorophyll-a Non-Funct.	Chlorphyll a	Chlorphyll b	Chlorphyll c	Total Count
STATION 6								
12-1-70	-	12-29-70	.00	8.93	8.93*	----	-----	305
2-22-71	-	3-23-71	7.71	.00	7.71*	-----	---	246
9-17-71	-	10-28-71	5.46	.00	3.81	.00	.00	98
12-15-71	-	1-26-72	55.23	.14	27.70	8.10	4.26	714
4-18-72	-	5-31-72	6.14	.00	6.09	1.85	2.95	91
STATION 7								
12-1-70	-	12-29-70	11.80	.00	11.80	-----	-----	116
1-15-71	-	2-12-71	36.21	7.77	43.98*	-----	-----	883
2-22-71	-	3-23-71	7.02	.00	7.02*	-----	-----	191
3-23-71	-	5-5-71	6.07	2.18	8.25*	-----	-----	362
6-16-71	-	7-28-71	3.42	1.36	4.78*	-----	-----	18
9-17-71	-	10-28-71	1.16	.00	.97	1.35	.41	16
4-18-72	-	5-31-72	2.73	.00	2.10	.38	4.07	20
STATION 8								
11-2-70	-	12-1-70	-----	-----	------	-----	-----	351
12-1-70	-	12-29-70	11.73	3.82	15.55*	-----	-----	141
1-15-71	-	2-14-71	88.65	40.23	128.88*	-----	-----	3,510
2-22-71	-	3-23-71	41.97	20.87	62.84*	-----	-----	2,697
3-23-71	-	5-5-71	28.16	58.98	87.14*	-----	-----	781
6-16-71	-	7-28-71	.68	2.66	3.34*	-----	-----	35
9-17-71	-	10-28-71	1.36	.00	.92	.00	.00	4
12-15-71	-	1-26-72	64.10	17.05	73.95	24.21	23.93	2,186
STATION 9								
11-2-70	-	12-1-70	-----	-----	------	-----	-----	135
12-1-70	-	12-29-70	4.64	3.48	8.12*	-----	-----	192
2-22-71	-	3-23-71	10.91	.47	11.38*	-----	-----	650
3-23-71	-	5-5-71	12.62	14.12	26.74*	-----	-----	300
6-16-71	-	7-28-71	12.95	.89	13.83*	-----	-----	185
9-17-71	-	10-28-71	25.23	.00	22.50	2.23	1.71	557
4-18-72	-	5-31-72	26.42	4.48	28.97	9.44	12.36	271

*SUM OF FUNCTIONAL AND NON-FUNCTIONAL CHLOROPHYLL-a .

TABLE 11

PERCENT OCCURRENCE OF ALGAE FOUND IN PERIPHYTON SAMPLES

NOVEMBER 1970 THROUGH MAY 1972

ORGANISM GROUP and GENUS	Percent Occurrence By Station									
	PA	1	2	3	4	5	6	7	8	9
CYANOPHYTA										
Chroococcales										
Agmenellum		25	17		17	20				13
Anacystis			17	20	17	20			13	25
Coelosphaerium			17							
Homogonales										
Anabaena	100	25	17	20	33				13	
Lyngbya					17					25
Oscillatoria			17				20	14	25	
Phormidium			17							
Spirulina							20			13
Unidentified			17		17			14	13	13
CHLOROPHYTA										
Volvocales										
Pandorina						20				
Ulotrichales										
Geminella							40		25	
Stichoccus	50				17					
Stigeoclonium			17	60	67	80		14	25	38
Cladophorales										
Rhizoclonium										13
Oedogoniales										
Oedogonium						20				
Chlorococcales										
Actinastrum					17					
Ankistrodesmus					17				13	25
Chlorella	50		17	80	50	20			38	25
Closteriopsis		50								
Coelastrum				20		20				13
Crucigenia									13	
Nephrocytium				20					13	
Oocystis			17	20						
Pediastrum	50				17					
Scenedesmus		25	17	100	33	80		43	63	50
Schroederia										13
Tetraedron	50	25							13	13
Zygnematales										
Closterium		50	67	20	67	20	29		63	50
Cosmarium	100	50	83	100	33		14		13	

TABLE 11 (CONTINUED)

PERCENT OCCURRENCE OF ALGAE FOUND IN PERIPHYTON SAMPLES

NOVEMBER 1970 THROUGH MAY 1972

ORGANISM GROUP and GENUS	Percent Occurrence By Station PA	1	2	3	4	5	6	7	8	9
Euastrum	100	50	83	20	17					
Micrasterias		50	33							
Mougeotia	50	25	17	20						
Perium		75	17			20				
Spirogyra			17		20					
Tetmemorus		25								
PYRRHOPHYTA										
Dinokonatae										
Peridinium	100	25								
CHRYSOPHYTA										
Heterococcales										
Centritractus			17							
Chrysomonadales										
Dinobryon	100	25	50		33					
Centrales	50	50	33	100	67	80	40	71	75	63
Pennales	100	100	100	100	100	100	100	100	100	100
EUGLENOPHYTA										
Euglenales										
Euglena	50	75	50	40	50	20		43	38	13
Phacus				60	17	20			13	
NUMBER OF SAMPLES	2	4	6	5	6	5	5	7	8	8

TABLE 12

MACROINVERTEBRATE SUMMARY FROM QUALITATIVE SAMPLING

NOVEMBER 1970 THROUGH NOVEMBER 1971

Date	Biotic Index (BI)	Total Species (S)	Species Per Sample Class I	Species Per Sample Class II	Species Per Sample Class III	Percentage Class I	Percentage Class II	Percentage Class III
STATION 1								
1-26-71	0	2	0	0	2	0	0	50
5-4-71	2	8	0	2	2	0	25	25
11-15-71	9	20	3	3	5	15	15	25
STATION 2								
12-18-70	2	4	0	2	0	0	50	0
1-26-71	0	6	0	0	1	0	0	17
5-4-71	4	13	1	2	4	8	15	31
11-15-71	4	15	1	2	4	7	13	27
STATION 3								
11-24-70	1	12	0	1	5	0	8	42
12-28-70	2	14	0	2	3	0	14	21
1-25-71	2	16	1	0	3	6	0	19
2-26-71	0	11	0	0	5	0	0	45
4-12-71	0	11	0	0	2	0	0	18
5-4-71	0	14	0	0	7	0	0	50
11-15-71	1	12	0	1	3	0	8	25
STATION 4								
11-24-70	1	21	0	1	6	0	5	29
12-28-70	2	18	0	2	6	0	11	33
1-25-71	4	16	1	2	1	6	13	6
2-26-71	5	24	2	1	7	8	4	29
4-12-71	0	11	0	0	4	0	0	36
11-19-71	9	20	4	1	5	20	5	25
STATION 5								
11-24-70	4	19	0	4	7	0	21	39
12-28-70	3	17	0	3	6	0	18	35
1-26-71	4	27	1	2	6	4	7	22
2-25-71	4	25	1	2	8	4	8	32
4-4-71	5	24	1	3	6	4	13	25
11-17-71	10	33	3	4	10	9	12	30
STATION 6								
11-24-70	19	31	7	5	5	23	16	16
12-28-70	22	31	10	2	3	32	6	10
1-28-71	19	30	8	3	6	27	10	20
2-25-71	12	22	5	2	6	23	9	27
4-2-71	10	23	4	2	7	17	9	30
11-16-71	22	29	8	6	5	36	27	23

TABLE 12 (CONTINUED)

MACROINVERTEBRATE SUMMARY
FROM QUALITATIVE SAMPLING

NOVEMBER 1970 THROUGH NOVEMBER 1971

Date	Biotic Index (BI)	Total Species (S)	Species Per Sample Class I	Species Per Sample Class II	Species Per Sample Class III	Percentage Class I	Percentage Class II	Percentage Class III
STATION 7								
12-28-70	23	31	10	3	4	32	10	13
2-27-71	10	23	4	2	6	17	9	26
4-1-71	22	35	9	4	6	26	11	17
6-21-71	20	29	7	6	5	24	21	17
11-16-71	18	25	7	4	4	28	16	16
STATION 8								
11-24-70	5	16	1	3	4	6	19	25
12-28-70	4	25	1	2	9	4	8	36
3-1-71	4	17	1	2	6	6	12	35
4-1-71	3	17	1	1	4	6	6	24
6-21-71	2	7	0	2	3	0	29	43
11-23-71	9	30	4	1	8	13	3	27
STATION 9								
11-24-70	15	28	5	5	7	18	28	25
12-28-70	22	31	9	4	6	29	13	19
3-1-71	15	22	6	3	4	27	14	18
4-2-71	14	26	5	4	4	19	15	15
11-23-71	10	18	4	2	5	22	11	27

TABLE 13

PERCENT OCCURRENCE OF MACROINVERTEBRATES COLLECTED IN QUALITATIVE SAMPLES

NOVEMBER 1970 THROUGH FEBRUARY 1972

ORGANISM GROUP and GENUS	Percent Occurrence By Station								
	1	2	3	4	5	6	7	8	9
Planariidae				17	33	17		20	20
Oligochaeta	33	25	100	83	83	67	100	80	80
Hirudinea		25	86	50	100		50	80	60
Asellus sp.							25	100	100
Hyalella azteca				33	100			100	100
Progambarus sp.			14	33	17		25	40	60
Palaemonetes paludosus					83	33	25	20	20
Baetis spiethi				33	17	100	50		
Caenis diminutus	33	25	71	33	100	50	100	100	80
Callibaetis floridana			29	17	67				
Ephemerella sp.						67	50		
Stenonema spp				33	17	83	100	20	100
Anax spp			28		17			20	
Aphylla williamsoni			43	17	50				
Boyeria vinosus							25		
Dromogomphus spinosus						17	25		
Erythemis simplicicollis	33								
Gomphus sp.		25	14	17		100	100		40
Libellula spp		25		67	17				
Macromia spp			14	17		100	100		80
Miathyia marcella					17				
Nasiaeschna pentacantha					33	17			
Neocordulia sp.						33	25		
Pachydiplax longipennis		25	86		50			60	
Perithemis seminole		50	43		17	17	25	40	20
Tetragoneuria sp.					17				
Argia spp					50	100	100		20
Calopteryx maculata						50	25		
Enallagma spp	33	25	57		67	50	100	60	80
Heterina titia						33	25		
Ischnura spp		25	57	33	83			100	40
Unident. Zygoptera					33	17			
Corixidae			14		17				
Pelocoris sp.			14						
Ranatra sp.									20
Corydalus cornutus						50	75		40

TABLE 13 (CONTINUED)

PERCENT OCCURRENCE OF MACROINVERTEBRATES COLLECTED IN QUALITATIVE SAMPLES

NOVEMBER 1970 THROUGH FEBRUARY 1972

ORGANISM GROUP and GENUS	Percent Occurrence By Station 1	2	3	4	5	6	7	8	9
Sialis sp	33			17					
Elmidae			14	100	67	83	100		100
Dytiscidae			43						
Gyrinidae			14			50			
Haliplidae					17				
Hydrophilidae			57		17			20	
Lepidoptera	33			33					
Cheumatospyche sp.					33	83	75	20	100
Leptocella sp							25		
Nyctiophylax sp						17			
Oecetis sp	67	50		17	17	50	25		40
Oxyethira sp.	33								
Polycentropus sp.	33					33			
Ceratopogonidae	33	25	14	57	33	67	50		20
Simuliidae				17		50		20	
Blepharocera sp.									20
Tubifera sp.			29						
Ablabesmyia janta	33	50					25		40
A. spp		25	14	33		83	50		
Anatopynia sp.	67	50		17					
Chironomus spp	67	50	14	33		33		60	
Cladotanytarsus sp.						60	60	20	
Clinotanypus spp			43	50	67	33	75	20	40
Corynoneura taris							25		
Cryptotendipes casuarius	33	25							
Cryptochironomus fulvus	33	75		17	67	83	100	40	60
Cricotopus spp		25	43		50	17	25	40	60
Dicrotendipes spp		50		50		17		80	20
Einfeldia sp.	33	25						40	
Endochironomus sp.						17			
Glyptotendipes sp.								80	20
Goeldichironomus holoprasinus	33	25	29		17			20	
Harnischia spp	33							80	60
Labrundinia floridana						17	25		80
Orthocladius sp.	33								
Parachironomus spp.	33				17			100	

TABLE 13 (CONTINUED)

PERCENT OCCURRENCE OF MACROINVERTEBRATES COLLECTED IN QUALITATIVE SAMPLES

NOVEMBER 1970 THROUGH FEBRUARY 1972

ORGANISM GROUP and GENUS	Percent Occurrence By Station 1	2	3	4	5	6	7	8	9
Paralauterborniella nigrohalterale		25		17	50	17			40
Pedionomus beckae								20	
Pentaneura inculta						67		20	60
Polypedilum fallax							25		
P. spp.		25	29	83	50	100	75	20	80
Procladius spp	67	50							40
Psectrocladius sp.						17	25		20
Rheotanytarsus spp				17	17	50	25	40	100
Stenochironomus sp.						33	50		
Tanypus spp	33								
Tanytarsus spp	67	25	29	50	17	83	100	20	
Thienemanniella xena						17			80
Tribelos sp							25		
Ferrissia sp.			29	67	100	67	50	60	100
Gyraulus sp.			14	17	17	50	25		
Helisoma sp.			57	33	83		50	40	
Physa sp.			57	67	100	100	75		80
Promenetus sp.				83	17		25		20
Pseudosuccinae sp.			14		17				
Viviparus sp.				83	100				
unident. Gastropoda			43	50	33		25	40	
Uniondae					33	67	75		40
Sphaeriidae			71	83	100	67	100	80	80
NUMBER OF SAMPLES	3	4	7	6	6	6	4	5	5

TABLE 14

MACROINVERTEBRATE SUMMARY FROM MULTIPLE-PLATE SAMPLERS
NOVEMBER 1971 THROUGH FEBRUARY 1972

ORGANISMS PER SQUARE METER

INCLUSIVE DATES			Total Count (N)	Total Species (S)	Biotic Index (BI)	Number of Species Class I	Number of Species Class II	Number of Species Class III	Number of Individuals Class I	Number of Individuals Class II	Number of Individuals Class III
POND A											
1-26-72	-	2-23-72	130	13	11	4(31)*	3(23)	1(8)	65	25	5
STATION 1											
6-20-71	-	7-20-71	65	4	1	0(0)	1(25)	0(0)	0	40	0
10-28-71	-	11-23-71	1,765	17	6	2(12)	2(12)	5(29)	15	50	1,145
1-26-72	-	2-23-72	390	14	6	2(14)	1(14)	3(21)	10	55	240
STATION 2											
11-2-70	-	12-1-70	180	10	2	0(0)	2(20)	2(20)	0	30	100
12-1-70	-	12-29-70	50	7	2	1(14)	0(0)	2(29)	10	0	10
1-15-71	-	2-12-71	40	3	2	1(33)	0(0)	1(33)	30	0	5
6-20-71	-	7-20-71	200	14	6	2(14)	2(14)	3(21)	45	10	15
10-28-71	-	11-23-71	775	22	3	0(0)	3(14)	4(14)	0	85	295
1-26-72	-	2-23-72	130	10	3	0(0)	3(30)	3(30)	0	45	35
STATION 3											
11-2-70	-	12-1-70	760	9	0	0(0)	0(0)	4(44)	0	0	640
12-1-70	-	12-29-70	440	9	2	1(11)	0(0)	2(22)	5	0	75
1-15-71	-	2-12-71	50	6	0	0(0)	0(0)	2(33)	0	0	15
3-15-71	-	4-12-71	320	12	0	0(0)	0(0)	4(33)	0	0	130
10-28-71	-	11-23-71	90	6	0	0(0)	0(0)	3(50)	0	0	55
1-26-72	-	2-23-72	260	9	0	0(0)	0(0)	5(56)	0	0	195
STATION 4											
11-2-70	-	12-1-70	140	12	6	3(25)	0(0)	1(8)	65	0	20
12-1-70	-	12-29-70	65	5	0	0(0)	0(0)	4(80)	0	0	55
1-15-71	-	2-12-71	410	15	9	4(27)	1(7)	4(27)	35	5	60
3-15-71	-	4-12-71	243	11	5	2(18)	1(9)	4(36)	6	3	118
10-28-71	-	11-23-71	580	17	13	6(35)	1(6)	3(18)	280	35	15
1-26-72	-	2-23-72	430	7	5	2(29)	1(14)	1(14)	250	70	60

TABLE 14 (CONTINUED)

MACROINVERTEBRATE SUMMARY FROM MULTIPLE–PLATE SAMPLERS
NOVEMBER 1971 THROUGH FEBRUARY 1972

ORGANISMS PER SQUARE METER

INCLUSIVE DATES	Total Count (N)	Species (S)	Biotic Index (BI)	Number of Species Class I	Number of Species Class II	Number of Species Class III	Number of Individuals Class I	Number of Individuals Class II	Number of Individuals Class III
STATION 5									
11-2-70 - 12-1-70	195	13	2	0(0)	2(15)	6(46)	0	65	90
12-29-70 - 12-29-70	300	18	7	3(17)	1(6)	3(17)	30	30	15
1-15-71 - 2-12-71	455	12	1	0(0)	1(8)	6(50)	0	20	270
3-15-71 - 4-4-71	1,586	25	10	4(16)	2(8)	7(28)	16	36	1,311
1-26-71 - 2-23-72	395	10	3	1(10)	1(10)	2(20)	5	90	170
STATION 6									
11-2-70 - 12-1-70	315	13	12	5(38)	2(15)	1(8)	230	15	10
12-1-70 - 12-19-71	885	13	14	6(46)	2(15)	0(0)	180	100	0
1-15-71 - 2-12-71	760	13	14	6(46)	2(15)	0(0)	75	455	0
3-15-71 - 4-4-71	1,411	16	17	8(50)	1(6)	2(13)	151	554	10
10-28-71 - 11-23-71	505	11	13	6(55)	1(9)	0(0)	270	80	0
1-26-72 - 2-23-72	1,450	12	14	6(50)	2(17)	1(8)	500	890	5
STATION 7									
11-2-70 - 12-1-70	1,715	29	14	6(21)	2(7)	3(10)	495	20	95
12-1-70 - 12-29-70	1,975	17	19	8(47)	3(18)	1(6)	755	185	35
1-15-71 - 2-12-71	615	14	13	6(43)	1(7)	1(7)	165	55	5
3-15-71 - 4-1-71	2,389	21	23	11(52)	1(5)	2(10)	405	977	13
6-20-71 - 7-20-71	1,065	24	20	9(38)	2(8)	3(13)	205	235	15
10-28-71 - 11-23-71	1,010	14	13	6(43)	1(7)	2(14)	450	355	10
1-26-72 - 2-23-72	450	10	12	5(50)	2(20)	0(0)	135	290	0
STATION 8									
11-2-70 - 12-1-70	1,620	6	2	1(17)	0(0)	3(50)	50	0	220
12-1-70 - 12-29-70	4,040	11	6	3(27)	0(0)	2(18)	50	0	260
3-15-71 - 4-1-71	16,530	17	9	4(24)	1(6)	7(41)	240	260	11,700
6-20-71 - 7-20-71	1,880	4	0	0(0)	1(0)	1(25)	0	0	2,860
10-28-71 - 11-23-71	1,615	16	4	1(6)	2(13)	5(31)	45	35	70
1-26-72 - 2-23-72	1,065	13	5	2(15)	1(8)	4(31)	35	15	465

TABLE 14 (CONTINUED)

MACROINVERTEBRATE SUMMARY FROM MULTIPLE-PLATE SAMPLERS
NOVEMBER 1971 THROUGH FEBRUARY 1972

ORGANISMS PER SQUARE METER

INCLUSIVE DATES	Total Count (N)	Total Species (S)	Biotic Index (BI)	Number of Species* Class I	Number of Species* Class II	Number of Species* Class III	Number of Individuals Class I	Number of Individuals Class II	Number of Individuals Class III
STATION 9									
11-2-70 - 12-1-70	5,960	11	8	3(27)	2(18)	1(9)	4,210	520	455
12-1-70 - 12-29-70	700	6	5	2(33)	1(17)	0(0)	140	40	0
1-15-71 - 2-14-71	1,815	11	11	4(36)	3(27)	0(0)	255	1,280	0
3-15-71 - 4-1-71	3,295	15	12	5(33)	2(13)	0(0)	245	125	0
6-20-71 - 7-20-71	1,585	9	4	2(22)	0(0)	1(11)	10	0	20
10-28-71 - 11-23-71	1,920	12	11	4(33)	3(25)	0(0)	640	360	0
1-26-71 - 2-23-72	550	8	8	3(38)	2(25)	1(13)	120	250	50

*( ), PERCENTAGE OF TOTAL SPECIES PER SAMPLE

TABLE 15

PERCENT OCCURRENCE OF MACROINVERTEBRATES COLLECTED ON MULTIPLE-PLATE SAMPLERS

NOVEMBER 1970 THROUGH FEBRUARY 1972

ORGANISM GROUP and GENUS	Percent Occurrence By Station									
	PA	1	2	3	4	5	6	7	8	9
Planariidae					17			29		
Oligochaeta		67	33	50	50	80		43	50	
Hirudinea			17	67	50	80		43		
Asellus sp.									33	29
Hyalella azteca			17					14	50	71
Palaemonetus paludosus										
Cambarinae			17		17				17	
Baetis spiethi					17		100	43		
Caenis diminutus	100					80		14	67	
Callibaetis floridanus			17	33	50	40				
Stenonema spp					67	20	100			
Anax sp.						20				
Boyeria vinosa								14		
Erythemis simplicicollis						20				
Miathyia marcella						20				
Pachydiplex longipennis						60				
Tetragoneura cynosura			17		17	20				
Argia spp					17	20	33	57		
Enallagma spp		33	33	17		60				
Heterina titia							17			
Ischneura spp	100	67	67	17	17	40				14
Dytiscidae					17	20				
Elmidae					17	20	17	29		14
Gyrinidae	100		33			20	17	29		
Hydrophylidae				33						
Veliidae				17						
Corydalus cornutus							33	14		14
Sialis sp.							17			
Ceratopogonidae			17			60		14		
Culicidae		33		17						
Psychomiidae									17	
Simuliidae					17		83	71		14
Cheumatopsyche sp.		33			17		100	86		57
Oecetis sp.	100		67				50	57		14
Oxyethira sp.	100	33								

TABLE 15 (CONTINUED)

PERCENT OCCURRENCE OF
MACROINVERTEBRATES COLLECTED
ON MULTIPLE-PLATE SAMPLERS

NOVEMBER 1970 THROUGH FEBRUARY 1972

ORGANISM GROUP and GENUS	Percent Occurrence By Station									
	PA	1	2	3	4	5	6	7	8	9
Polycentropus sp.			33				17	29		14
Ablabesmyia janta	100	100	50		33	40	17	29		
A. spp	100	67	50					43		
Anatopynia sp.	100		17							
Chironomus spp		33	83	33	33	40			83	
Cladotanytarsus sp.										14
Clinotanypus spp						20	17			
Corynoneura taris				17	33	20	67	57	17	
Cricotopus spp		67	17		17	40		43	50	57
Cryptochironomus fulvus		33	17			20				
Cryptotendipes casuaris		33	33							
Dicrotendipes spp			50			20		14	100	57
Einfeldia sp.		33			17				50	14
Glyptotendipes sp.	100		17						83	
Goeldichironomus holoprasinus		33	17	33	17				50	
Harnischia spp		33	33							
Labrundinia spp	100		33		67	20	17	43	33	
Nilotanypus americanus					17					
Orthocladius sp.		67						14		
Parachironomus spp		67	50	17	17	17	17	14	50	
Paralauterborniella nigrohalterale						20		14		14
Pedionomus beckae			17						50	
Pentaneura inculta		67			17	20	50	100	17	43
Polypedilum fallax	100	67	50	17	17		17	29		
P. spp					50	40	100	100	17	100
Procladius spp			50							
Psectrocladius sp.						20	17	43	50	
Rheocricotopus robacki								29		57
Rheotanytarsus spp				33	17	20	100	100	67	100
Stenochironomus sp.								14		
Tanypus sp.						20				
Tanytarsus spp		33	50	33	83	40	50	71		
Thienemanniella xena					17	20	83	57	17	100
Tribelos sp.								29		
Chironominae	100	67		17						

TABLE 15 (CONTINUED)

PERCENT OCCURRENCE OF MACROINVERTEBRATES COLLECTED ON MULTIPLE-PLATE SAMPLERS

NOVEMBER 1970 THROUGH FEBRUARY 1972

ORGANISM GROUP and GENUS	Percent Occurrence By Station PA	1	2	3	4	5	6	7	8	9
Tanypodinae										
Ferrissia sp.			17	50	67	80	33	57	50	14
Helisoma sp.				33		40	33	14		
Physa sp.				33	33	60		29		
Promenetus sp.					17	40				
Pseudosuccinae sp.				17						
Viviparus sp.					33	40		14		
Gastropoda				50	17	60		29		
Unionidae								14		
Sphaeriidae				33	17	20	17	14		
NUMBER OF SAMPLES	1	3	6	6	6	5	6	7	6	7

TABLE 16

SURFACE WATER
AEROBIC BACTERIA
VIABLE ORGANISMS PER MILLILITER

JULY 1971 THROUGH MAY 1972

Date	Pond A	Pond Effluent	Station 1
July 10, 1971	---	2,000	4,100
Aug 16	1,875	1,950	3,200
Sept 20	3,900	3,900	10,300
Oct 23	5,000	10,400	8,340
Nov 30	3,900	2,000	4,100
Dec 13	5,000	---	3,300
Jan 10, 1972	3,000	2,300	10,500
Feb 14	3,600	3,200	5,000
Mar 14	9,700	5,400	13,200
Apr 10	11,900	---	12,400
May 15	9,800	4,300	10,300

TABLE 17

SURFACE WATER
ANAEROBIC (FAULTATIVE) BACTERIA
VIABLE ORGANISMS PER MILLILITER

OCTOBER 1971 THROUGH MAY 1972

Date	Pond A	Pond Effluent	Station 1
Oct 23, 1971	320	400	610
Nov 30	780	560	1,950
Dec 13	625	---	765
Jan 10, 1972	310	400	1,620
Feb 14	130	320	750
Mar 14	180	265	810
Apr 10	360	---	1,200
May 15	200	780	1,050

TABLE 18

SURFACE WATER
SULFUR OXIDIZING BACTERIA
VIABLE ORGANISMS PER MILLILITER

JULY 1971 THROUGH MAY 1972

Date	Pond A	Pond Effluent	Station 1
July 10, 1971	No counts were made.		
Aug 16	161	305	422
Sept 20	78	547	660
Oct 23	32	40	75
Nov 30	50	60	120
Dec 13	42	---	87
Feb 14, 1972	70	36	125
Mar 14	73	85	900
Apr 10	84	---	280
May 15	125	200	710

TABLE 19

SURFACE WATER
SULFUR REDUCING BACTERIA
VIABLE ORGANISMS PER MILLILITER

OCTOBER 1971 THROUGH MAY 1972

Date	Pond A	Pond Effluent	Station 1
Oct 23, 1971	23	0	56
Nov 30	5	10	38
Dec 13	5	--	25
Jan 10, 1972	Bacteria not observed at any location		
Feb 14	Bacteria not observed at any location		
Mar 10	10	10	20
Apr 10	10	--	40
May 15	8	8	32

TABLE 20

SURFACE WATER
POSSIBLE STAPHYLOCOCCUS
VIABLE ORGANISMS PER MILLILITER

JULY 1971 THROUGH MAY 1972

Date	Pond A Phenylethanol Agar	Pond A Mannitol Salt Agar	Pond Effluent Phenylethanol Agar	Pond Effluent Mannitol Salt Agar	Station 1 Phenylethanol Agar	Station 1 Mannitol Salt Agar
July 10, 1971	10	8	12	4	40	4
Aug 16	20	10	23	8	127	10
Sept 20	(Staphylococcus and pathogenic species not evident as confirmed on Mannitol Salt Agar)					
Oct 23	"	"	"	"	"	" " "
Nov 30	15	--	26	--	100	--
Dec 13	45	--	--		27	--
Jan 10, 1972	10	--	10	--	10	--
Feb 14	10	--	80	--	47	--
Mar 14	15	--	51	--	72	--
Apr 10	48	--	--	--	118	--
May 15	31	--	130	--	163	--

TABLE 21

SURFACE WATER
FILAMENTOUS FUNGI
MOLD COLONIES PER MILLILITER

JULY 1971 THROUGH DECEMBER 1971

Date	Pond A	Pond Effluent	Station 1
July 10, 1971	24	23	14
Aug 16	20	12	12
Sept 20	14	18	8
Oct 23	18	19	10
Nov 30	12	5	9
Dec 13	7	--	8

TABLE 22

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l (CaCO$_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS CaCO$_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO$_3$	NITROGEN NO$_2$ mg N/l	NITROGEN NH$_3$ mg N/l	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
WELL 3																
12-15-70	---	--	---	---	---	-----	.01	.01	---	.004	.00	.46	20	---	---	--
1-4-71	6.5	40	61	---	13.0	35.6	.06	.01	---	.004	.03	.01	22	---	---	--
1-6-71	7.0	45	38	---	14.0	39.3	.04	.01	.01	.003	.03	2.59	22	---	---	--
1-11-71	6.5	42	131	---	14.0	30.3	.25	.00	.00	.005	.00	.55	22	---	---	--
1-18-71	6.2	31	153	---	12.0	35.1	.01	.00	.04	.007	.08	.63	22	---	—	--
1-25-71	6.7	39	124	80	11.0	29.4	.01	.00	.01	.002	.00	.86	22	4.0	101	21
2-16-71	6.4	27	29	193	13.0	29.8	.14	.01	.00	.000	.00	.34	22	---	217	24
2-22-71	5.9	28	142	510	13.0	-----	.03	.01	.01	.004	.00	.00	22	---	526	16
3-1-71	6.5	30	57	113	14.0	-----	.02	.01	.01	.004	.00	.60	22	2.1	149	36
4-5-71	6.4	43	91	133	6.0	36.1	.02	.01	.03	.005	.01	.51	22	20.0	159	26
5-10-71	5.5	29	157	157	9.0	-----	.26	.01	.02	.003	---	----	22	4.8	167	10
7-21-71	6.4	14	44	122	4.0	-----	.03	.00	.00	.003	.00	.41	23	7.7	136	14
10-4-71	7.4	8	33	59	10.0	30.1	.05	.01	---	----	.37	.60	23	---	66	7
12-7-71	---	--	---	297	55.0	166.0	.08	.01	---	.006	.94	1.27	23	5.3	229	2
12-20-71	---	--	---	372	59.0	184.0	---	---	---	.004	1.36	1.96	24	5.7	397	25
1-18-72	---	--	---	553	26.0	216.0	.01	.01	---	.003	5.20	2.21	21	35.0	570	17
2-7-72	---	--	---	526	55.0	164.0	.01	.00	---	.004	8.80	3.60	21	9.8	545	19
4-3-72	4.4	--	>425	---	---	252.0		.01	.03	.003	13.90	6.50	27	---	---	---
6-5-72	4.4	--	---	907	8(---	253.0	.26	---	---	----	6.00	.53	24	9.2	930	23
WELL 4																
5-17-71	6.4	55	79	504	---	51.2	.04	.03	.01	.005	.37	.90	22	18.0	511	7
7-21-71	6.2	31	51	117	3.0	-----	.00	.00		.004	.20	1.04	23	11.0	131	14
8-10-71	6.8	46	87	113	5.0	-----	.01	.00	---	.004	.15	.00	23	6.3	128	15
9-20-71	7.1	22	112	---	6.0	46.6	---	---	---	----	.00	1.08	23	---	---	--
10-19-71	7.0	36	204	81	8.0	53.5	.12	.01	.07	.006	.26	.42	24	6.9	83	2
12-7-71	---	--	---	82	6.0	53.1	.13	.01	---	.007	.42	.73	23	1.4	86	4
12-20-71	---	--	---	67	6.0	20.4	---	---	---	.005	.00	.75	24	3.7	67	0

TABLE 22 (CONTINUED)

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l $(CaCO_3)$	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NITROGEN NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	NITROGEN ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
2-7-72	---	--	---	28	13.0	21.1	.01	.01	---	.008	.00	.30	21	5.4	52	24
4-3-72	6.4	14	24	45	---	19.8	---	.00	.01	.000	1.50	16.9	21	6.9	52	7
6-5-72	5.8	--	---	62	---	15.8	.26	---	---	---	.00	.45	21	4.8	74	12
WELL 5																
12-15-70	---	--	---	---	---	-----	.01	.01	---	.004	.00	.15	20	----	---	--
1-4-71	6.7	20	112	---	8.0	7.8	.02	.00	.01	.004	.00	.00	22	----	---	
1-6-71	6.8	42	114	---	10.0	17.8	.02	.00	.02	.004	.00	4.44	22	----	--	--
1-11-71	5.8	21	213	---	9.0	14.0	.02	.00	---	.007	.00	.28	22	----	---	--
1-18-71	6.5	15	80	31	10.0	8.9	.01	.00	.03	.006	.00	.20	22	9.0	54	21
1-25-71	6.0	13	155	48	9.0	7.7	.03	.00	.01	.002	.86	.67	22	5.0	70	22
2-16-71	6.5	7	---	24	8.0	5.4	.01	.00	.02	.000	.01	.07	22	----	93	69
2-22-71	5.2	8	151	39	9.0	5.1	.10	.01	.00	.003	.00	.20	22	----	46	7
3-1-71	5.6	7	71	46	10.0	----	.05	.01	.05	.004	.02	.20	23	2.1	57	11
4-5-71	5.3	7	125	18	6.0	----	.01	.00	.05	.001	.13	.61	22	11.0	62	18
5-10-71	4.9	5	183	66	6.0	-----	.01	.00	.00	.001	---	---	22	4.5	71	5
7-21-71	4.9	2	54	---	2.0	3.5	.76	.02	.00	.002	.00	.23	23	----	---	-
8-26-71	5.6	5	43	66	---	----	.01	.00	.00	.001	.16	---	23	6.9	72	6
9-8-71	5.8	14	152	64	8.0	17.9	.01	.00	---	.003	.06	.12	23	1.8	67	3
10-4-71	7.2	6	24	26	8.0	8.0	.56	.06	---	----	.00	.47	23	----	29	3
11-1-71	6.0	12	418	56	10.0	35.0	.16	.00	---	.003	.32	.68	24	6.8	63	7
1-3-72	---	--	---	126	15.0	6.5	---	---	---	.004	.30	.25	23	1.4	130	4
3-6-72	6.0	12	111	23	12.0	7.9	.06	.02	---	.002	.23	.60	21	1.9	29	6
5-8-72	5.2	--	---	23	12.0	8.1	.01	---	---	----	.00	.03	21	4.5	31	8
WELL 27																
11-1-72	7.2	53	164	123	10.0	-----	.06	.00	---	.002	.21	.78	24	75.0	179	56
1-3-72	---	--	---	117	11.0	31.8	---	---	---	.002	.40	.35	23	6.6	128	11
3-6-72	7.0	36	45	59	11.0	15.2	.04	.00	---	.002	.38	1.10	21	6.9	87	28
5-8-72	5.4	--	---	48	15.0	7.4	.01	---	---	----	.00	.04	21	35.0	69	21

TABLE 22 (CONTINUED)

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
WELL 28																
11-1-71	5.6	5	165	107	12.0	30.0	.07	.04	---	.002	.10	.46	24	50.0	189	82
1-3-72	---	--	---	127	5.0	13.9	---	---	---	.002	.40	.95	23	6.9	132	5
3-6-72	6.3	7	56	---	14.0	13.4	.04	.02	---	.003	.75	.75	21	7.9	93	--
5-8-72	5.1	--	---	73	---	12.2	.01	---	---	----	.00	.16	21	11.0	75	2
WELL 6																
12-15-70	---	--	---	---	---	-----	.21	.06	.17	.004	.00	.05	20	---	---	--
1-4-71	6.2	27	100	---	9.0	-----	.04	.00	.01	.002	.08	.00	22	---	---	--
1-6-71	5.7	15	136	---	8.0	8.4	.05	.01	.01	.004	.00	.10	22	---	---	--
1-18-71	6.2	12	214	30	9.0	6.0	.02	.00	.05	.007	.00	.29	22	26.0	65	35
1-25-71	6.0	12	266	37	12.0	6.5	.01	.00	.01	.002	.00	.48	22	12.0	64	27
2-16-71	5.2	6	39	17	8.0	4.9	.02	.00	.02	.000	.03	.10	22	---	43	26
2-22-71	5.5	9	70	34	9.0	4.9	.02	.01	.01	.004	.00	.00	22	---	37	3
3-1-71	5.5	7	76	123	9.0	-----	.02	.01	.00	.004	.00	.52	23	3.9	145	22
4-5-71	5.5	8	122	92	5.0	-----	.01	.00	.05	.003	.00	.44	22	35.0	96	4
5-10-71	5.3	8	93	42	7.0	5.8	.42	.01	.00	.003	.00	.00	22	6.6	45	3
7-21-71	---	4	47	---	2.0	4.6	.00	.00	.00	.001	.00	.37	23	---	---	--
8-26-71	5.7	7	54	48	---	-----	.22	.07	.01	.003	.11	.00	23	6.6	64	16
9-8-71	7.0	8	194	43	7.0	4.9	.03	.01	---	.003	.00	.02	23	2.0	50	7
WELL 9																
5-17-71	6.5	50	83	261	6.0	158.3	1.05	.02	.02	.005	.39	.94	22	26.0	383	122
7-21-71	7.2	138	22	281	2.0	-----	.37	.00	.00	.005	.10	.33	23	9.8	293	12
8-10-71	7.1	96	54	233	6.0	-----	.01	.01	---	.005	.27	.00	23	4.8	246	13
9-20-71	8.0	38	42	168	---	109.0	---	---	---	----	.00	.30	23	---	173	5
10-19-71	5.9	5	149	139	8.0	84.8	.09	.01	.03	.011	.10	.47	24	5.3	159	20
12-7-71	---	--	---	107	5.0	54.9	.09	.01	---	.007	.37	1.16	23	3.7	113	6

TABLE 22 (CONTINUED)

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NITROGEN NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
2-21-72	---	--	---	58	8.0	34.6	.08	.01	---	.004	.30	1.41	22	6.0	78	20
4-17-72	5.8	24	64	41	17.0	35.9	.08	.01	.03	.007	.34	1.36	21	3.9	58	17
WELL 10																
12-15-70	---	--	---	---	---		.04	.02	---	----	.00	.01	20	---	---	--
1-4-71	6.0	--	---	---	10.0	8.0	.02	.00	.01	.004	.00	4.46	22	---	---	--
1-6-71	6.0	11	44	---	10.0	6.3	.02	.00	.02	.004	.00	4.27	22	---	---	--
1-11-71	6.2	10	149	---	10.0	6.9	.07	.00	.01	.007	.00	.29	22	---	---	--
1-18-71	5.0	3	65	49	10.0	6.0	.04	.00	.03	.004	.09	.33	22	15.0	70	21
1-25-71	6.0	12	210	41	6.0	5.7	.01	.00	.01	.001	.00	.67	22	7.0	61	20
2-16-71	6.0	7	13	9	9.0	4.9	.04	.01	.00	.000	.04	.02	22	---	40	31
2-22-71	5.3	5	74	8	9.0	4.7	.04	.01	.01	.004	.12	.00	22	---	16	8
3-1-71	5.8	6	40	54	8.0		.05	.01	.02	.004	.00	.27	23	0.7	77	23
4-5-71	5.3	6	73	137	14.0		.01	.00	.04	.001	.00	.34	22	7.5	142	5
5-10-71	5.0	4	121	2	8.0	4.8	.10	.00	.00	.001	1.82	.00	22	2.6	8	6
7-21-71	5.7	5	24	---	2.0	3.9	3.85	.00	---	.001	.00	.00	23	---	---	--
8-26-71	5.6	6	49	37	---		.19	.02	.04	.010	.11	.00	23	9.5	52	15
9-8-71	5.3	7	164	36	7.0	5.0	.06	.00	---	.003	.00	.02	23	1.4	36	0
10-4-71	6.9	4	49	29	7.0	7.2	.04	.00	---	----	.00	.39	23	5.4	42	13
11-1-71	5.3	6	229	---	7.0	5.1	.02	.01	---	.004	.30	1.27	24	9.8	---	-
1-3-72	---	--	---	80	11.0	3.5	---	---	---	.004	.50	.35	23	2.6	84	4
3-6-72	6.2	7	58	16	11.0	6.4	.14	.02	---	.003	.22	.30	21	1.9	16	0
5-8-72	6.3	--	---	13	---	5.3	.00	---	---	----	.00	.00	20	16.0	16	3
WELL 11																
11-1-71	5.6	6	158	4	8.0	7.6	.03	.03	---	.003	.11	2.63	24	14.0	35	31
1-3-72	---	--	---	106	13.0	9.0	---	---	---	.004	.27	.35	23	4.5	120	14
3-6-72	5.6	6	48	30	10.0	13.4	.18	.02			.20	.50	21	7.9	50	20
5-8-72	5.9	--	---	---	---	6.2	.01	---	---	.001	.00	.04	20	12.0	---	-

TABLE 22 (CONTINUED)

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
WELL 12																
11-1-71	5.5	5	26	--	10.0	8.2	.01	.03	---	.003	.00	.68	24	16.0	561	-
1-3-72	---	--	---	97	10.0	6.3	--	---	---	.003	.15	.25	23	2.1	102	5
3-6-72	5.7	6	28	--	10.0	9.6	.08	.02	---	.001	.19	.40	21	12.0	---	--
5-8-72	5.3	--	---	73	--	5.7	.00	---	---	----	.00	.25	20	8.2	76	3
WELL 13																
5-17-71	6.7	55	71	213	15.0	9.8	.05	.01	---	.004	.28	.70	22	22.0	372	159
7-21-71	5.9	12	37	180	4.0	---	.01	.00	.00	.004	.00	.03	23	53.0	211	31
8-10-71	7.2	94	50	128	11.0	---	.01	.01	---	.006	.79	.53	23	6.3	171	43
9-20-71	7.3	6	25	55	--	13.0	---	---	---	----	.72	.42	23	---	63	8
10-19-71	5.7	4	98	48	14.0	7.5	.11	.00	.03	.004	.01	.75	24	17.0	88	40
12-7-71	---	--	---	43	14.0	9.8	.09	.01	---	.005	.28	4.18	22	8.8	87	44
2-21-72	---	--	---	--	12.0	7.5	.24	.00	---	.003	.22	.83	22	11.0	---	--
4-17-72	5.0	1	64	--	--	10.9	3.35	.28	.03	.007	.00	.19	21	8.5	---	--
WELL 16																
12-15-70	---	--	---	--	---	---	.03	.02	.25	.007	.00	.78	20	---	---	---
1-4-71	5.8	7	127	--	11.0	11.1	.11	.00	.01	.003	.00	4.66	22	---	---	---
1-6-71	5.5	6	132	--	12.0	6.7	.06	.00	.02	.004	.00	.30	22	---	---	---
1-11-71	5.5	4	150	--	10.0	6.6	.05	.00	.01	.007	.00	.19	22	---	---	---
1-18-71	5.7	10	311	38	8.0	6.2	.00	.00	.05	.010	.00	.47	22	23.0	93	55
1-25-71	6.1	11	148	49	11.0	5.4	.04	.00	.01	.002	.00	.57	22	9.0	76	27
2-16-71	5.9	9	23	--	10.0	5.2	.01	.01	.02	.000	.00	.08	22	---	32	---
2-22-71	5.4	13	92	29	10.0	---	.05	.01	---	.004	.00	.00	22	---	33	4
3-1-71	5.8	8	51	55	12.0	---	.02	.01	.03	.005	.00	.22	23	4.5	68	13
4-5-71	4.5	--	160	163	7.0	---	.01	.00	.02	.004	.00	.35	22	20.0	169	6
5-10-71	5.2	11	133	112	6.0	4.9	.02	.00	.02	.001	.00	.00	22	---	270	158

TABLE 22 (CONTINUED)

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSI mg/
7-21-71	6.3	15	36	21	2.0	2.9	.16	.02	.11	.013	.00	.96	23	45.0	65	44
8-26-71	6.3	13	25	79	6.0	2.7	.61	.02	.34	.007	.12	---	23	30.0	123	44
9-8-71	5.7	8	132	72	4.0	3.5	.08	.01	---	.006	.00	.31	24	34.0	118	46
10-4-71	7.0	9	38	50	6.0	10.3	.04	.01	---	----	.00	.29	23	11.0	71	21
11-1-71	5.5	3	35	16	1.0	10.3	.05	.00	---	.004	.14	.91	24	13.0	45	29
1-18-72	---	--	---	64	---	10.1	.64	.01	---	.000	.82	.80	21	9.8	71	7
3-20-72	6.4	7	12	8	6.0	5.9	.04	.01	.07	.006	.20	.65	21	4.5	11	3
5-22-72	5.4	--	---	--	10.0	6.0	.00	---	---	----	.00	.33	22	4.2	---	--
WELL 17																
11-1-71	5.5	3	30	42	3.0	4.3	.01	.01	---	.005	.26	1.01	24	7.9	42	0
1-18-72	---	--	---	71	---	12.5	.15	.03	---	.003	.78	.75	21	11.0	85	14
3-20-72	6.4	2	13	1	10.0	5.4	.01	.00	.16	269	.12	.55	21	4.8	22	21
5-22-72	5.4	--	---	--	10.0	5.6	.00	---	---	----	.00	.03	22	2.6	---	---
WELL 18																
11-1-71	5.6	3	30	5	3.0	6.3	.04	.03	---	.004	.52	1.98	24	9.5	39	34
1-18-72	---	--	---	79	---	7.9	.06	.02	---	.003	.70	.79	21	45.0	115	36
3-20-72	5.6	1	19	86	2.0	5.8	.05	.03	.05	.109	.00	.90	21	7.5	119	33
5-22-72	5.2	--	---	---	5.0	3.7	.00	---	---	----	.50	.03	22	3.6	---	--
WELL 19																
7-21-71	6.6	4	40	3	5.0	6.2	.05	.00	.02	.003	.00	.18	23	12.0	81	8
8-10-71	6.1	15	82	49	12.0		.04	.00	---	.006	.28	.00	23	3.4	62	13
9-20-71	7.0	6	30	20	---	8.3	---	---	---	----	.00	.12	23	---	20	0
10-19-71	6.4	10	73	83	11.0	6.0	.03	.00	.03	.004	---	---	24	9.5	106	23
12-7-71	---	--	---	35	13.0	8.1	.10	.00	---	.004	.44	.53	23	4.2	36	1
2-21-72	---	--	---	---	---	6.7	.01	.00	---	.001	.38	.68	22	7.5	---	--
4-17-72	4.8	0	83	---	---	8.7	1.27	.00	.00	.000	.00	.00	21	2.6	---	--

TABLE 22 (CONTINUED)

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
WELL 20																
12-15-70	---	--	---	--	---		.01	.01	.72	.004	.06	.06	20	---	---	--
1-4-71	6.6	21	149	--	14.0	28.3	.08	.01		.004	.00	4.56	22	---	---	--
1-6-71	6.1	32	82	---	15.0	28.2	.01	.00	.01	.003	.00	.31	22	--	---	--
1-11-71	6.3	16	161	---	14.0	17.6	.02	.00	---	.004	.00	1.05	22	--	---	--
1-18-71	7.2	26	26	66	12.0	17.7	.06	.00	.03	.007	.00	.29	22	16.0	101	35
1-25-71	6.9	31	122	84	13.0	19.4	.05	.00	.01	.002	.00	.38	22	15.0	109	25
2-16-71	6.3	20	30	7	13.0	18.5	.02	.01	.00	.000	.00	.00	22	---	42	35
2-22-71	6.1	24	61	34	12.0	16.7	.01	.00		.004	.36	.43	22	---	55	21
3-1-71	6.1	19	97	26	13.0		.06	.01	.00	.005	.00	.67	23	5.7	34	8
4-5-71	5.5	16	99	182	9.0		.01	.00	.05	.005	.03	.33	22	20.0	187	5
5-10-71	5.5	21	136	---	12.0		.30	.00	.00	.001	.23	1.65	22	---	---	--
7-21-71	6.5	21	34	---	4.0	19.5	.03	.00		.003	.00	.00	23	2.1	---	--
8-26-71	6.3	15	58	78	14.0	15.9	.37	.01	.02	.003	---	----	23	2.1	84	6
9-8-71	5.8	14	210	64	29.0	16.5	.06	.00	---	.005	.07	.02	23	3.6	74	10
10-4-71	7.0	9	111	45	12.0	14.9	.02	.00	---	----	.00	.19	23	7.5	50	5
11-15-71	6.5	16	14	-	11.0		.07	.03	---	.007	---	----	25	---	101	--
1-18-72	---	--	--	72	---	16.6	.01	.00	---	.005	.49	.59	21	2.9	76	4
3-20-72	7.0	8	7	14	10.0	11.2	.05	.02	---	.039	.00	.65	21	4.2	17	3
5-22-72	6.5	--	---	2	14.0	12.9	.00	---	.07	----	.00	.03	22	4.9	10	8
WELL 21																
11-15-71	6.9	18	33	89	12.0	15.1	.05	.03	---	.004	.12	.75	25	6.9	121	32
1-18-72	---	--	---	82	---	29.5	.48	.00	---	.001	.76	.71	21	11.0	104	22
3-20-72	6.7	0	9	32	9.0	6.4	.01	.00	.12	.000	.00	.85	21	7.5	54	22
5-22-72	5.4	--	---	---	7.6	3.6	.26	---	.04	.004	.00	.20	22	5.7	---	--
WELL 22																
11-15-71	7.2	20	42	124	11.0	17.8	.64	.04	---	.005	.13	.38	25	6.3	171	47
1-18-72	---	--	---	138	---	12.5	.43	.01	---	.011	.75	.95	21	50.0	196	58
3-20-72	6.6	1	11	60	8.0	8.7	.03	.01	.03	.033	.00	.90	21	9.1	100	40
5-22-72	5.4	--	---	---	11.0	8.4	.29	---	---	----	.00	.12	22	11.0	---	--

TABLE 22 (CONTINUED)

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3 mg N/l	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
WELL 23																
5-17-71	6.9	49	83	21	9.0	14.9	.29	.01	.00	.004	.15	.30	22	32.0	85	64
7-21-71	6.3	5	52	79	2.0		.00	.00	.00	.003	.00	.00	23	12.0	88	9
8-10-71	5.5	15	83	43	12.0		.10	.01	---	.006	.26	.00	23	9.5	69	16
9-20-71	7.3	8	27	26	---	15.5	---	---	---	----	.00	.84	23	---	26	0
10-19-71	6.4	13	203	7	13.0	10.5	.03	.01	.02	.003	.49	.57	24	---	7	0
12-7-71	---	--	---	40	7.0	6.2	.01	.00	---	.004	---	---	23	2.3	40	0
2-21-71	---	--	---	---	11.0	6.0	.02	.00	---	.001	.39	.68	22	5.7	---	--
4-17-71	5.0	1	72	---	13.0	8.0	.71	.01	.01	.003	.00	.00	21	4.2	---	--
WELL 24																
5-17-71	6.0	32	98	---	14.0	19.5	.24	.07		.005	.54	.71	22	25.0	---	--
7-21-71	5.9	16	49	23	3.0	18.0	.36	.00		.003	.00	1.20	23	37.0	59	36
8-10-71	6.2	21	72	125	10.0		.01	.01	---	.006	.15	.00	23	70.0	145	20
9-20-71	7.5	12	36	41	16.0	17.4	---	---	---	----	.00	.48	23	---	49	8
10-19-71	7.2	22	130	23	13.0	15.5	.03	.01	.03	.012	.24	.28	24	15.0	73	50
11-15-71	6.4	6	79	---	11.0	15.4	.03	.01	---	.005	.67	.82	25	12.0	---	---
12-20-71	---	--	---	63	13.0	26.3	---	---	---	.003	.00	.66	24	6.9	91	28
2-7-72	---	--	---	109	22.0	16.8	.01	.01	---	.003	.00	.25	21	9.8	162	53
4-3-72	6.6	11	24	---	---	16.6	.83	.00	.05	.003	.40	.70	21	6.0	103	-
6-5-72	5.8	--	---	57	---	16.0	.29	---	---	----	.00	.10	21	5.1	71	14
WELL 25																
11-15-71	7.5	14	31	35	12.0	19.3	.04	.01	---	.011	.18	1.96	25	55.0	219	184
12-20-71	---	---	---	59	16.0	168.0	---	---	---	.018	.00	1.35	24	12.0	467	408
2-7-72	---	--	---	186	14.0	34.9	---	---	---	.011	.80	1.38	21	---	713	527
4-3-72	6.4	11	23	49	---	18.9	---	.01	.05	.000	.00	.85	21	3.2	171	122
6-5-72	5.6	--	---	30	---	45.0	.43	---	---	----	.04	.23	21	37.0	265	235

TABLE 22 (CONTINUED)

GROUND WATER
PHYSICAL AND CHEMICAL DATA

NOVEMBER 1970 THROUGH JUNE 1972

Date	pH LAB	ALK mg/l ($CaCO_3$)	ACID mg/l	TDS mg/l	Cl- mg/l	HARDNESS $CaCO_3$ mg/l	PHOSPHATE TOTAL mg P/l	PHOSPHATE ORTHO mg P/l	NO_3	NITROGEN NO_2 mg N/l	NITROGEN NH_3	ORG	TEMP C	TURB JTU	SOLIDS TOTAL mg/l	SOLIDS SUSP mg/l
WELL 26																
11-15-71	6.8	16	31	---	12.0	16.9	.01	.00	---	.008	.19	.52	25	50.0	---	--
12-20-72	---	---	---	5	14.0	16.0	---	---	---	----	.17	.21	24	3.4	79	74
2-7-72	---	---	---	65	20.0	7.5	.00	.00	---	.001	.39	.12	21	11.0	104	39
4-3-72	5.7	2	21	28	27.0	10.4	---	.00	.01	.003	.00	.30	21	8.1	45	17
6-5-72	5.2	--	---	28	21.0	6.7	.01	---	---	----	.00	.10	21	7.6	58	30

TABLE 23

GROUND WATER
ADDITIONAL PHYSICAL AND CHEMICAL DATA
MILLIGRAMS PER LITER

MAY 1971 THROUGH JUNE 1972

Date	CONDUCTIVITY (micromhos/cm)	SO_4	COD	pH (field)
WELL 3				
4-5-71	133	----	-----	---
12-20-71	520	----	-----	---
1-18-72	---	----	1,370.0	---
2-7-72	679	----	-----	---
4-3-72	1435	4.2	2,970.0	---
6-5-72	1400	15.7	4,040.0	---
WELL 4				
12-20-71	74	----	-----	---
2-7-72	69	----	-----	---
4-3-72	98	3.7	20.0	---
6-5-72	80	5.1	38.0	---
WELL 5				
4-5-71	56	----	-----	---
1-3-72	46	----	-----	---
3-6-72	----	----	3.8	4.8
5-8-72	84	3.2	6.1	---
WELL 6				
4-5-71	33	----	-----	---
WELL 9				
2-21-72	124	----	-----	---
4-17-72	153	14.8	44.0	---
WELL 10				
4-5-71	33	----	-----	---
3-6-72	---	.0	1.6	4.9
5-8-72	47	3.4	1.6	---
WELL 11				
1-3-72	39	----	-----	---
3-6-72	---	3.0	5.4	5.0
5-8-72	51	4.6	0	---
WELL 12				
1-3-72	45	----	-----	---
3-6-72	---	4.5	3.8	5.0
5-8-72	49	2.5	0	---
WELL 13				
2-21-72	67	----	-----	---
4-17-72	9	3.0	4.0	---

TABLE 23 (CONTINUED)

GROUND WATER
ADDITIONAL PHYSICAL AND CHEMICAL DATA
MILLIGRAMS PER LITER

MAY 1971 THROUGH JUNE 1972

Date	CONDUCTIVITY (micromhos/cm)	SO_4	COD	pH (field)
WELL 16				
4-5-71	56	----	-----	---
1-18-72	52	----	-----	---
3-20-72	---	2.6	18.0	---
5-22-72	55	5.8	19.0	---
WELL 17				
1-18-72	47	----	-----	---
3-20-72	---	3.0	19.0	---
5-22-72	50	----	23.0	---
WELL 18				
1-18-72	27	----	-----	---
3-20-72	--	4.6	9.9	---
5-22-72	30	9.1	16.0	---
WELL 19				
2-21-72	57	----	-----	---
4-17-72	90	2.6	3.2	---
WELL 20				
4-5-71	100	----	-----	---
1-18-72	68	----	7.3	---
3-20-72	--	2.7	14.0	---
5-22-72	70	4.0	15.0	---
WELL 21				
1-18-72	54	----	-----	---
3-20-72	--	2.6	16.0	---
5-22-72	55	5.5	11.0	---
WELL 22				
1-18-72	56	----	-----	---
3-20-72	---	5.6	23.0	---
5-22-72	53	7.6	18.0	---
WELL 23				
2-21-72	38	----	-----	---
4-17-72	81	2.5	5.7	---
WELL 24				
12-20-71	80	----	-----	---
2-7-72	81	----	-----	---
4-3-72	92	3.3	16.0	---
5-5-72	100	3.8	18.0	---

TABLE 23 (CONTINUED)

GROUND WATER
ADDITIONAL PHYSICAL AND CHEMICAL DATA
MILLIGRAMS PER LITER

MAY 1971 THROUGH JUNE 1972

Date	CONDUCTIVITY (micromhos/cm)	SO_4	COD	pH (field)
WELL 25				
12-20-71	102	----	-----	---
2-7-72	92	----	-----	---
4-3-72	103	13.3	18.0	---
6-5-72	105	31.5	29.0	---
WELL 26				
12-20-71	64	----	-----	---
2-7-72	75	----	-----	---
4-3-72	92	2.0	.4	---
6-5-72	10	3.6	39.0	---
WELL 27				
1-3-72	63	----	-----	---
3-6-72	--	4.3	16.0	5.0
5-8-72	70	7.3	18.0	---
WELL 28				
1-3-72	63	----	-----	---
3-6-72	--	11.5	25.0	4.9
5-8-72	88	16.2	8.2	---

TABLE 24

GROUND WATER
pH MEASUREMENTS

FEBRUARY 1971 THROUGH MAY 1972

	Well																				
Date	3	4	5	6	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28
Feb 18, 1971	5.40	--	4.80	4.45	--	4.55	--	--	--	4.45	--	--	--	4.45	--	--	--	--	--	--	--	--
Feb 22	4.50	--	3.20	3.60	--	3.30	--	--	--	3.10	--	--	--	3.10	--	--	--	--	--	--	--	--
Mar 8	5.30	--	4.45	4.60	--	4.60	--	--	--	4.50	--	--	--	4.90	--	--	--	--	--	--	--	--
Apr 5	4.50	--	3.60	3.70	--	3.40	--	--	--	3.40	--	--	--	3.40	--	--	--	--	--	--	--	--
May 17	5.95	--	5.20	5.30	--	5 20	--	--	--	5.15	--	-	--	5.75	--	--	--	--	--	--	--	--
June 2	--	6.25	--	--	7.20	--	--	--	5.60	--	--	--	5.15	--	--	--	5.50	5.72	--	--	--	--
July 9	5.50	--	5.05	5.15	--	5.10	--	--	--	5.00	--	--	--	5.70	--	--	--	--	--	--	--	--
July 22	--	5.75	-	--	6.80	--	--	--	5.50	--	--	--	5.00	--	--	--	5.70	5.60	--	--	--	--
Aug 10	6.00	--	5.65	5.90	--	5.75	--	--	--	5.80	--	--	--	5.80	--	--	--	--	--	--	--	--
Aug 25	-	5.70	--	--	6.50	--	--	--	5.55	--	--	--	4.95	--	--	--	5.40	5.85	-	--	--	--
Sept 16	5.70	--	6.45	--	--	5.25	--	--	--	5.55	--	--	--	5.40	--	--	--	--	--	--	--	--
Sept 20	--	5.85	--	--	6.05	--	--	--	5.20	--	--	-	4.80	--	--	--	5.15	5.30	--	--	--	--
Oct 4	5.60	--	4.85	--	--	4.95	--	--	--	5.20	--	--	--	5.30	--	--	--	--	--	--	--	--
Oct 19	--	5.90	--	--	6.10	--	--	--	5.00	--	--	--	5.00	--	--	--	5.20	9.90	--	--	--	--
Nov 1	--	--	5.73	--	--	5.15	5.23	5.24	--	5.30	5.25	5.15	--	--	--	--	--	--	--	--	6.45	5.40
Nov 15	--	--	--	--	--	--	--	--	--	--	--	--	--	5.40	5.45	5.35	--	5.40	5.40	5.40	--	--
Dec 7	6.07	6.05	--	--	6.00	--	--	--	5.10	--	--	--	4.93	--	--	--	5.20	--	--	--	--	--
Dec 20	4.90	4.90	--	--	--	--	.	.		--	--	--	--	--	--	--	--	5.10	5.45	9.93	--	--
Jan 3, 1972	--	--	4.90	--	--	5.03	5.10	5.20	.	--	--	--	--	--	--	--	--	--	--	--	5.60	5.30
Jan 18	4.65	--	--	--	--	--	--	--	--	4.90	4.87	5.38	--	5.00	5.20	4.90	--	--	--	--	--	--
Feb 7	4.40	5.40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.13	5.40	4.90	--	--
Feb 21	--	--	--	--	--	--	--	--	4.93	--	5.85	--	4.75	--	--	--	5.00	--	--	--	--	--
Mar 6	--	--	4.74	--	--	4.80	4.95	5.05	--	--	--	--	--	--	--	--	--	--	--	--	5.20	4.85
Mar 20	--	--	--	--	--	--	--	--	--	5.30	5 50	5.60	--	5.80	5.55	5.35	--	--	--	--	--	--
Apr 3	4.36	5.45	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-	5.20	5.15	5.02	--	--
Apr 17	4.45	--	--	--	5.63	--	--	--	4.36	--	--	--	4.80	--	--	--	4.96	--	--	--	--	--
May 8	--	--	5.20	-	--	4.91	4.93	4.93	--	--	--	--	--	--	--	--	--	--	--	--	4.95	4.95
May 22	--	--	--	--	--	--	--	--	-	4.80	4.77	4.81	--	5.32	4.90	4.85	--	--	--	--	--	--

Note: Sample Analysis at FTU Laboratory

TABLE 25

GROUND WATER
pH MEASUREMENTS
EFFECT OF ONE HOUR AERATION

FEBRUARY 1971 THROUGH MAY 1972

	Well Number											
Date	3	3A	5	5A	6	6A	10	10A	16	16A	20	20A
Feb 22, 1971	4.50	6.80	3.20	6.80	3.60	6.80	3.30	6.90	3.10	6.90	3.10	6.90
Jan 18, 1972	4.65	4.70	--	--	WELL DESTROYED IN LANDFILLING		--	--	4.90	6.65	5.00	6.84
Feb 7	4.40	4.40	--	--			--	--	--	--	--	--
Mar 6	--	--	4.74	6.48			4.80	6.50	--	--	--	--
Mar 20	--	--	--	--			--	--	5.30	7.30	5.80	7.25
Apr 3	4.36	4.35	--	--			--	--	--	--	--	--
May 8	--	--	5.20	7.10			4.91	6.75	--	--	--	--
May 22	--	--	--	--			--	--	4.80	6.97	5.32	7.30

Note: Sample Analysis at FTU Laboratory.

Descriptive data. Data from all other shallow wells show a similar rise on aeration but are not included for brevity.

A = aerated pH

TABLE 26

GROUND WATER
METAL DATA
(MILLIGRAMS PER LITER)

JANUARY 1971 THROUGH JUNE 1972

DATE	Ca	Mg	Fe	Al	Zn	K	Na	Cu
WELL 3								
1-4-71	12.80	.65	.45	---	.08	.65	8.3	.00
1-6-71	14.20	.60	.70	---	.07	.60	8.2	.00
1-11-71	10.60	.70	.50	---	.05	.70	6.9	.00
1-18-71	12.50	.60	.75	---	.07	.60	8.2	.01
1-25-71	12.40	.65	.65	---	.04	.52	8.1	.01
2-16-71	10.50	.60	.40	---	.03	.52	7.8	.00
2-22-71	---	.55	.40	---	.02	.75	7.5	.00
5-10-71	13.40	.50	.35	---	.01	.30	6.7	.00
7-21-71	3.95	.55	.55	---	.01	.20	6.9	.00
10-4-71	10.80	.60	.40	.00	.01	.20	6.2	.01
12-7-71	54.00	4.75	3.70	1.00	.01	.90	27.0	.02
12-20-71	59.00	6.00	4.60	.75	.00	1.40	36.0	.00
1-18-72	64.00	5.90	4.96	4.25	.00	4.10	52.0	.00
2-7-72	36.00	6.80	5.40	6.60	.00	8.65	73.0	.00
4-3-72	61.00	9.10	6.60	9.00	.04	14.40	92.0	.00
6-5-72	58.00	6.90	4.30	13.00	.00	20.60	102.0	.01
WELL 4								
5-17-71	18.00	.50	2.20	---	.15	.60	4.1	.00
9-20-71	17.00	.60	.90	---	.09	.52	4.0	.00
10-19-71	19.00	.75	.86	.25	.03	.33	3.6	.00
12-7-71	18.40	.55	1.15	.50	.03	.90	3.3	.00
12-20-71	5.05	.40	1.10	.75	.03	.20	3.1	.00
2-7-72	5.40	.40	.80	.80	.04	.15	3.4	.00
4-3-72	5.40	.45	.60	.60	.06	.15	4.1	.00
6-5-72	5.40	.35	.45	.00	.03	.10	3.9	.00
WELL 5								
1-4-71	.55	.75	.40	---	1.75	.30	4.0	.00
1-6-71	5.60	.70	.45	---	.12	.15	4.4	.02
1-11-71	3.95	.75	.35	---	.29	.10	4.3	.00
1-18-71	1.90	.75	.50	---	.14	.10	4.3	.01
1-25-71	1.45	.75	.45	---	.16	.10	4.3	.00
2-16-71	.40	.75	.00	---	.88	.23	3.9	.00
2-22-71	.70	.70	.20	---	.08	.10	4.3	.00
7-21-71	.30	.65	.00	---	.05	.10	4.4	.00
9-8-71	5.80	.70	.22	---	.02	.30	7.1	.00
10-4-71	.70	.80	.10	.50	.02	.05	4.5	.00
11-1-71	12.40	.90	.18	.00	.01	.10	4.7	.00
1-3-71	.40	.50	.38	.50	.01	.05	4.7	.00
3-6-72	0.10	.55	.50	.80	.03	.15	4.8	.00
5-8-72	0.00	.65	.40	.80	.01	.20	5.2	.00

TABLE 26 (CONTINUED)

GROUND WATER
METAL DATA
(MILLIGRAMS PER LITER)

JANUARY 1971 THROUGH JUNE 1972

DATE	Ca	Mg	Fe	Al	Zn	K	Na	Cu
WELL 27								
11-1-71	131.00	1.00	.88	1.50	.18	.60	4.8	.00
1-3-72	9.60	.60	.58	.75	.08	.05	4.8	.00
3-6-72	0.40	.60	.90	1.80	.10	.15	5.8	.03
5-8-72	0.30	.60	.45	.60	.05	.15	5.7	.00
WELL 28								
11-1-71	4.00	2.95	.24	1.35	.32	.35	8.9	.00
1-3-72	1.50	1.50	.62	.50	.07	.15	5.4	.00
3-6-72	0.30	1.20	.45	1.20	.13	.35	7.0	.02
5-8-72	0.00	1.40	.90	.80	.07	.30	7.0	.00
WELL 6								
1-6-71	.85	.75	.20	---	1.83	.30	3.6	.00
1-18-71	.35	.75	.10	---	1.25	.25	3.8	.03
1-25-71	.55	.75	.00	---	1.36	.23	3.8	.01
2-16-71	.70	.70	.10	---	.08	.10	4.3	.00
2-22-71	.30	.75	.00	---	.76	.20	4.0	.00
5-10-71	.15	.75	1.00	---	.39	.15	4.3	.02
7-21-71	.35	.80	.00	---	.27	.15	4.4	.00
9-8-71	.40	.80	.30	---	.08	.20	4.2	.00
WELL 9								
5-17-71	63.00	.15	.20	---	.02	2.50	6.8	.00
9-20-71	41.50	.50	1.80	---	.03	.45	5.3	.01
10-19-71	30.50	1.00	1.75	.25	.01	.35	5.8	.00
12-7-71	18.80	.80	1.00	.50	.01	.30	5.1	.00
2-21-72	10.00	1.00	1.20	.60	.02	.35	5.5	.04
4-17-72	10.60	1.10	.90	.60	.00	.35	6.3	.00
WELL 10								
1-4-71	.55	1.00	1.00	---	.48	.15	4.2	.00
1-6-71	.45	1.05	.00	---	.55	.15	4.5	.00
1-11-71	.75	1.00	.00	---	.60	.15	4.5	.01
1-18-71	.45	1.00	.00	---	.53	.20	4.8	.02
1-25-71	.40	1.00	.00	---	.41	.20	4.5	.00
2-16-71	.45	.85	.00	---	.19	.10	4.4	.00
2-22-71	.30	.90	.00	---	.20	.10	4.3	.00
5-10-71	.40	.90	.00	---	.08	.15	3.8	.00
7-21-71	.30	.75	.00	---	.04	.20	3.3	.00
9-8-71	.30	.90	.30	---	.05	.10	3.5	.00
10-4-71	.35	.85	.01	.50	.03	.10	3.3	.00
11-1-71	.45	.95	.00	.00	.05	.10	3.5	.00
1-3-72	.30	.55	.24	.00	.03	.10	3.3	.00
3-6-72	.20	.65	.50	.40	.04	.20	3.7	.04
5-8-72	.10	.60	.20	.40	.02	.20	3.3	.00

TABLE 26 (CONTINUED)

GROUND WATER
METAL DATA
(MILLIGRAMS PER LITER)

JANUARY 1971 THROUGH JUNE 1972

DATE	Ca	Mg	Fe	Al	Zn	K	Na	Cu
WELL 11								
11-1-71	.80	1.00	.02	.30	.08	.10	3.9	.00
1-3-72	.40	.75	.36	.80	.05	.05	3.4	.00
3-6-72	.10	.65	.80	1.60	.07	.15	3.8	.02
5-8-72	.20	.70	.30	.40	.02	.10	3.1	.00
WELL 12								
11-1-71	.85	1.05	.20	.30	.03	.20	5.2	.00
1-3-72	.50	.80	.22	.30	.02	.08	4.3	.00
3-6-72	.00	.70	.50	1.00	.03	.10	5.3	.02
5-8-72	.00	.70	.20	.40	.01	.10	4.6	.00
WELL 13								
5-17-71	2.20	.80	.55	---	.05	.52	7.0	.00
9-20-71	2.10	1.35	1.25	---	.05	.20	7.0	.00
10-19-71	.90	1.25	.02	.00	.05	.10	7.2	.00
12-7-71	.60	1.20	.28	.50	.05	.10	7.0	.00
2-21-72	.20	.95	1.10	.20	.03	.20	7.0	.00
4-17-72	.50	.90	1.45	.60	.03	.70	7.2	.00
WELL 16								
1-4-71	1.30	.75	2.00	---	.78	.20	5.1	.00
1-6-71	.95	.75	.15	---	.65	.20	5.2	.00
1-11-71	.90	.75	.30	---	.50	.20	5.3	.02
1-18-71	.95	.75	.10	---	.39	.15	5.5	.00
1-25-71	.55	.75	.20	---	.37	.20	5.4	.00
2-16-71	.55	.75	.08	---	.43	.10	5.4	.00
2-22-71	.35	.75	.20	---	.20	.15	5.7	.00
5-10-71	.50	.60	.20	---	.09	.10	5.0	.00
7-21-71	.35	.40	.10	---	.12	1.25	15.2	.00
8-26-71	.35	.35	.10	---	.13	2.60	10.4	.00
9-8-71	.50	.45	.12	---	.13	1.70	6.5	.00
10-4-71	.45	.60	.56	1.00	.11	1.60	4.4	.00
11-1-71	1.50	.75	.54	.30	.07	.80	2.9	.00
1-18-72	.40	.80	.86	.80	.05	.20	4.7	.00
3-20-72	.30	.70	.60	.20	.04	.25	5.7	.00
5-22-72	.60	.75	.70	.00	.08	.30	5.4	.00
WELL 17								
11-1-71	.80	.55	.10	.00	.03	.10	1.5	.00
1-18-72	.30	.70	.30	1.50	.00	.13	4.4	.00
3-20-72	.00	.60	.25	.40	.00	.15	4.5	.00
5-22-72	.20	.80	.40	.20	.01	.15	4.3	.00

TABLE 26 (CONTINUED)

GROUND WATER
METAL DATA
(MILLIGRAMS PER LITER)

JANUARY 1971 THROUGH JUNE 1972

DATE	Ca	Mg	Fe	Al	Zn	K	Na	Cu
WELL 18								
11-1-71	.45	.80	.20	.30	.08	.23	1.8	.00
1-18-72	.30	.60	.32	.80	.00	.15	1.1	.00
3-20-72	.00	.65	.35	.40	.03	2.50	1.0	.00
5-22-72	.10	.65	.40	.00	.03	.35	.8	.00
WELL 19								
7-21-71	.35	1.30	.00	---	.01	.10	7.2	.00
9-20-71	.80	1.15	.90	---	.01	.05	5.7	.00
10-19-71	.40	1.20	.05	.00	.01	.08	5.7	.00
12-7-71	.30	1.10	.78	.30	.01	.05	5.6	.00
2-21-72	.10	.95	.80	.20	.01	.15	6.4	.00
4-17-72	.30	1.00	.90	.40	.02	.30	6.8	.01
WELL 20								
1-4-71	5.20	.90	.20	---	.12	.20	6.6	.00
1-6-71	5.95	.95	1.60	---	.18	.20	6.5	.00
1-11-71	5.35	.90	.04	---	.32	.20	6.5	.02
1-18-71	5.45	.95	.00	---	.14	.20	7.0	.00
1-25-71	6.20	.90	.00	---	.14	.20	6.7	.00
2-16-71	5.90	.90	.00	---	.07	.20	6.9	.00
2-22-71	5.00	1.00	.00	---	.07	.15	6.7	.00
7-21-71	6.25	.90	.10	---	.05	.20	7.5	.00
8-26-71	4.80	.90	.06	---	.07	.20	7.5	.00
9-8-71	4.05	.90	.65	.30	.07	.20	7.4	.00
10-4-71	4.30	.90	.22	.00	.05	.15	7.1	.00
11-15-71	---	1.85	.18	---	.20	.60	7.1	.02
1-18-72	3.80	.55	.44	.80	.00	.05	6.2	.00
3-20-72	2.20	.65	.40	.40	.03	.15	6.7	.00
5-22-72	3.40	.65	.30	.20	.03	2.00	6.4	.00
WELL 21								
11-15-71	4.60	.80	.12	.00	.05	.10	6.7	.00
1-18-72	.70	4.75	.70	1.30	.00	.10	6.4	.00
3-20-72	.20	.40	.50	.60	.05	.15	7.1	.00
5-22-72	.10	.50	.70	.00	.02	.10	5.7	.00
WELL 22								
11-15-71	4.35	.85	.22	.00	.03	.15	6.6	.01
1-8-72	.55	.50	.40	1.50	.02	.10	6.5	.00
3-20-72	.20	.45	.40	1.00	.04	.20	6.7	.00
5-22-72	.10	.45	.40	1.00	.01	.15	5.8	.01

TABLE 26 (CONTINUED)

GROUND WATER
METAL DATA
(MILLIGRAMS PER LITER)

JANUARY 1971 THROUGH JUNE 1972

DATE	Ca	Mg	Fe	Al	Zn	K	Na	Cu
WELL 23								
5-17-71	3.00	1.50	.70	---	.01	1.10	5.3	.02
9-20-71	3.90	1.20	.46	---	.01	.15	4.6	.00
10-19-71	1.65	1.55	.02	.00	.01	.10	4.5	.00
12-7-71	.35	1.20	.22	.00	.01	.05	4.3	.00
2-21-72	.30	1.10	.40	.00	.01	.10	5.0	.01
4-17-72	.40	.95	.45	.40	.02	.35	4.5	.01
WELL 24								
5-17-71	5.90	.95	.40	---	.07	.30	6.1	.01
7-21-71	5.55	.90	.20	---	.05	.25	5.4	.00
9-20-71	4.20	1.10	1.10	---	.27	.20	6.4	.00
10-19-71	4.30	1.05	.19	.00	.08	.23	6.2	.00
11-15-71	4.15	1.15	.14	.00	.03	.20	6.3	.00
12-20-71	4.50	.85	.95	1.80	.07	.23	6.0	.00
2-7-72	2.20	.95	.95	1.00	.06	.30	6.3	.01
4-3-72	2.40	1.05	1.00	.80	.06	.30	7.4	.00
6-5-72	4.20	1.00	.75	.00	.02	.30	6.2	.01
WELL 25								
11-15-71	4.40	1.20	.34	.50	.03	.25	6.2	.02
12-20-71	1.20	.70	7.00	25.00	6.90	.75	8.0	.00
2-7-72	.20	.50	4.60	3.60	2.66	.35	7.9	.00
4-3-72	.60	.90	.23	2.00	1.41	.25	7.7	.00
6-5-72	.10	.70	4.20	5.60	2.08	.40	7.4	.01
WELL 26								
11-15-71	4.70	1.15	.20	.00	.05	.23	6.1	.00
12-20-71	4.00	.75	.86	.30	.00	.05	8.1	.00
2-7-72	.00	.65	.85	.60	.01	.10	7.9	.00
4-3-72	.20	.75	.70	1.00	.01	.10	9.1	.00
6-5-72	.10	.85	1.00	.20	.01	.05	8.9	.01

TABLE 27

GROUND WATER
TOTAL DISSOLVED SOLIDS
(MILLIGRAMS PER LITER)

JANUARY 1971 THROUGH OCTOBER 1971

	Well Number											
Date	3	5	6	10	16	20	4	9	13	19	23	24
Jan. 18, 1971	3,920	2,230	1,030	235	400	1,300	--	--	--	--	--	--
Jan 18	3,795	255	--	--	--	--	--	--	--	--	--	--
Feb 8	300	360	122	220	116	230	--	--	--	--	--	--
Feb 15	200	200	200	200	200	300	--	--	--	--	--	--
Feb 22*	70	13	20	13	27	40	--	--	--	--	--	--
Feb 22*	77	7	--	--	--	40	--	--	--	--	--	--
Feb 22**	78	54	4	10	3	68	--	--	--	--	--	--
Feb 22**	94	80	38	18	40	76	--	--	--	--	--	--
Mar 8**	164	60	47	40	37	56	--	--	--	--	--	--
Apr 5**	124	52	44	38	36	58	--	--	--	--	--	--
May 5**	212	81	51	30	37	104	--	--	--	--	--	--
May 12**	136	67	69	54	66	97	--	--	--	--	--	--
May 17**	70	24	23	19	54	62	--	--	--	--	--	--
June 2**	--	--	--	--	--	--	125	205	71	7	6	46
July 9**	79	36	32	29	35	71	--	--	--	--	--	--
July 22**	--	--	--	--	--	--	104	198	116	24	30	88
Aug 10**	62	22	20	12	61	56	--	--	--	--	--	--
Aug 25**	--	--	--	--	--	--	95	219	87	65	76	92
Sept 16**	60	106	--	9	48	78	--	--	--	--	--	--
Sept 20**	--	--	--	--	--	--	74	176	59	14	111	57
Oct 4**	64	15	--	23	47	55	--	--	--	--	--	--
Oct 19**	--	--	--	--	--	--	36	138	20	4	21	120
Average After Feb 15	99	47	35	25	41	66	--	--	--	--	--	--
Average	--	--	--	--	--	--	86	187	71	23	49	81

Note: Sample Analysis at FTU Laboratory

After October 1971, solids analysis was accomplished by Orange County Pollution Control only.

*Duplicate samples, 30 milliliters
**Duplicate samples, 50 milliliters

TABLE 28

GROUND WATER
DISSOLVED ORGANIC MATERIAL
FEBRUARY 22, 1971

Well Number	Milligrams per liter*
3	62.9
5	11.9
6	10.1
10	1.48
16	13.5
20	7.2

*Spectrophotometric analysis

TABLE 29

GROUND WATER
CARBON ANALYSES

MAY 1971 THROUGH MAY 1972

Date	Total Carbon	Total Inorganic Carbon	Total Organic Carbon	CO_2 Carbon	Carbonate Carbon
WELL 3					
5-17-71	----	----	----	----	----
7-9-71	52.5	38.5	14.0	28.0	9.5
8-10-71	47.5	23.0	24.5	22.5	0.5
9-16-71	28.8	11.5	17.3	9.6	1.9
10-4-71	28.0	10.0	18.0	5.0	5.0
12-7-71	102.7	54.0	48.7	27.0	27.0
12-20-71	186.0	90.7	95.3	90.2	0.5
1-18-72	200.0	7.5	192.0	6.7	0.8
2-7-72	336.0	1.0	353.3	0.3	0.7
4-3-72	650.0	80.0	570.0	79.5	0.5
4-17-72	1,227.0	50.0	1,177.0	30.0	20.0
WELL 4					
6-2-71	----	----	----	----	----
7-22-71	40.0	26.0	14.0	20.0	6.0
8-25-71	39.0	19.5	10.5	10.5	9.0
9-20-71	48.5	31.5	17.0	20.5	11.0
10-19-71	49.2	31.5	17.7	19.5	12.0
12-7-71	46.9	40.7	6.2	31.4	9.3
12-20-71	72.0	43.0	29.0	36.0	7.0
2-7-72	50.3	43.8	6.5	38.3	5.5
4-3-72	50.3	35.0	15.2	31.0	4.0
WELL 5					
5-17-71	----	----	----	----	----
7-9-71	56.0	43.5	12.5	37.5	6.0
8-10-71	51.5	33.0	18.5	32.5	0.5
9-16-71	37.0	23.5	13.5	6.5	16.0
10-4-71	36.3	25.7	10.6	21.7	4.0
11-1-71	34.7	32.3	2.4	26.3	6.0
1-3-72	35.7	21.7	14.0	20.7	1.0
3-6-72	37.5	34.0	3.5	33.3	0.7
5-8-72	22.2	3.0	19.2	1.0	2.0
WELL 6					
5-17-71	----	----	----	----	----
7-9-71	43.0	38.5	4.5	32.5	6.0
8-10-71	35.0	24.0	11.0	23.5	0.5
9-16-71	----	----	----	----	----

TABLE 29 (CONTINUED)

GROUND WATER
CARBON ANALYSES

MAY 1971 THROUGH MAY 1972

Date	Total Carbon	Total Inorganic Carbon	Total Organic Carbon	CO_2 Carbon	Carbonate Carbon
WELL 9					
6-2-71	----	----	----	----	----
7-22-71	69.0	37.0	32.0	12.5	24.5
8-25-71	69.0	30.0	39.0	7.0	23.0
9-20-71	81.0	42.0	39.0	22.0	20.0
10-19-71	66.0	32.0	34.0	17.0	15.0
12-7-71	55.0	40.0	15.0	33.5	6.5
4-17-71	40.0	10.0	30.0	2.0	8.0
WELL 10					
5-17-71	----	----	----	----	----
7-9-71	36.0	31.5	4.5	26.5	5.0
8-10-71	30.0	21.5	8.5	21.0	0.5
9-16-71	16.0	12.5	3.5	10.8	1.7
10-4-71	24.7	19.5	5.2	15.5	4.0
11-1-71	27.0	31.0	Trace	30.0	1.0
1-3-72	28.3	26.0	2.3	24.5	1.5
3-6-72	27.8	26.3	1.5	25.0	1.3
5-8-72	24.2	3.0	21.2	1.0	2.0
WELL 11					
11-1-71	17.0	20.3	Trace	18.3	2.0
1-3-72	24.3	23.0	1.3	21.5	1.5
3-6-72	21.0	21.0	0.0	19.6	1.4
5-8-72	20.0	3.0	17.0	1.0	2.0
WELL 12					
11-1-71	21.3	22.3	Trace	20.3	2.0
1-3-72	22.0	13.0	9.0	11.5	1.5
3-6-72	18.7	11.6	7.1	10.2	1.4
5-8-72	20.3	2.0	18.3	0.0	2.0
WELL 13					
6-2-71	----	----	----	----	----
7-22-71	37.0	35.0	2.0	31.0	4.0
8-25-71	32.0	21.0	11.0	16.0	5.0
9-20-71	40.0	32.0	8.0	30.0	2.0
10-19-71	34.0	23.0	11.0	22.0	1.0
12-7-71	35.0	34.3	0.7	33.3	1.3
2-21-72	44.7	37.5	7.2	36.4	1.1
4-17-72	30.0	21.0	8.0	19.3	1.7
WELL 16					
5-17-71	8.0	0.0	----	----	0.0
7-9-71	47.0	40.5	6.5	36.5	4.0
8-10-71	44.0	28.0	16.0	27.0	1.0

TABLE 29 (CONTINUED)

GROUND WATER
CARBON ANALYSES

MAY 1971 THROUGH MAY 1972

Date	Total Carbon	Total Inorganic Carbon	Total Organic Carbon	CO_2 Carbon	Carbonate Carbon
9-16-71	30.0	23.5	6.5	19.5	4.0
10-4-71	33.3	19.2	14.1	14.4	4.8
11-1-71	25.0	20.3	4.7	18.8	1.5
1-18-72	34.0	24.5	9.5	23.2	1.3
3-20-72	22.7	15.7	7.0	14.7	3.0
5-22-72	34.0	12.3	21.7	11.3	1.0
WELL 17					
11-1-71	17.0	11.0	6.0	10.0	1.0
1-18-72	18.0	10.0	8.0	8.2	1.8
2-21-72	67.3	38.3	29.0	30.7	7.6
3-20-72	21.3	15.3	6.0	14.3	1.0
5-22-72	23.0	13.3	9.7	12.3	1.0
WELL 18					
11-1-71	18.3	14.7	3.6	13.7	1.0
1-18-72	15.3	8.0	7.3	6.2	1.8
3-20-72	15.0	12.0	3.0	12.0	1.0
5-22-72	43.0	6.3	33.7	5.3	1.0
WELL 19					
6-2-71	----	----	----	----	----
7-22-72	30.0	27.5	2.5	26.5	1.0
8-25-71	35.0	24.5	11.5	22.8	1.7
9-20-71	48.0	35.0	13.0	32.0	3.0
10-19-71	41.0	29.5	10.5	29.0	0.5
12-7-71	60.0	42.0	18.0	41.0	1.0
2-21-72	59.0	49.7	9.3	48.4	1.3
4-17-72	26.0	24.0	2.0	23.0	1.0
WELL 20					
5-17-71	7.0	7.0	0.0	----	----
7-9-71	39.0	38.5	0.5	32.5	6.0
8-10-71	44.0	34.0	10.0	31.0	3.0
9-16-71	27.5	13.0	14.5	12.0	1.0
10-4-71	36.5	26.5	8.8	19.0	7.5
11-15-71	44.7	33.7	11.0	28.7	5.0
1-18-72	31.7	19.5	12.2	17.5	2.0
3-20-72	29.3	4.3	25.0	0.3	4.0
5-22-72	99.0	21.0	78.0	18.0	3.0
WELL 21					
11-15-71	36.0	30.0	6.0	25.0	5.0
1-18-72	27.3	18.9	8.4	16.6	2.3
3-20-72	24.0	17.3	6.7	16.3	1.0
5-22-71	26.0	12.0	14.0	13.5	1.5

TABLE 29 (CONTINUED)

GROUND WATER
CARBON ANALYSES

MAY 1971 THROUGH MAY 1972

Date	Total Carbon	Total Inorganic Carbon	Total Organic Carbon	CO_2 Carbon	Carbonate Carbon
WELL 22					
11-15-71	41.3	32.0	9.3	27.0	5.0
1-18-72	31.0	17.9	13.1	16.3	1.6
3-20-72	17.0	7.3	9.7	6.3	1.0
5-22-72	20.7	16.0	3.3	14.0	2.0
WELL 23					
6-2-71	----	----	----	----	----
7-22-71	29.5	29.0	0.5	25.0	4.0
8-25-71	32.0	25.0	7.0	20.3	4.7
9-20-71	41.0	33.5	7.5	30.5	3.0
10-19-71	31.0	27.0	4.0	25.0	2.0
12-7-71	44.7	38.3	6.4	37.3	1.0
2-21-72	50.8	46.7	4.1	44.7	2.0
4-17-72	21.0	18.3	1.7	16.1	2.2
WELL 24					
6-2-71	----	----	----	----	----
7-22-71	46.0	44.0	2.0	40.0	4.0
8-25-71	35.0	25.0	10.0	19.0	6.0
9-20-71	39.0	31.5	7.5	27.5	4.0
10-19-71	36.7	27.0	9.7	23.0	4.0
11-15-71	31.7	28.0	3.7	22.3	5.7
12-20-71	51.0	45.0	6.0	41.0	4.0
2-7-72	55.3	55.3	0.0	51.8	3.5
4-3-72	30.7	22.3	8.4	20.5	1.8
WELL 25					
11-15-71	38.3	34.3	4.0	29.3	5.0
12-20-71	36.3	28.0	8.3	23.5	4.5
2-7-72	42.7	35.8	6.9	34.2	1.6
4-3-72	40.0	31.8	8.2	28.8	3.0
WELL 26					
11-15-71	42.0	35.0	7.0	30.0	5.0
12-20-71	40.3	28.7	11.6	27.9	0.8
2-7-72	26.0	27.3	0.0	26.5	0.8
4-3-72	12.5	10.0	2.5	9.5	0.5
WELL 27					
11-1-71	46.3	36.4	9.9	11.4	25.0
1-3-72	37.3	26.0	11.3	24.5	1.5
3-6-72	35.0	24.8	10.2	23.1	1.7
5-8-72	34.8	3.0	31.8	1.0	2.0

TABLE 29 (CONTINUED)

GROUND WATER
CARBON ANALYSES

MAY 1971 THROUGH MAY 1972

Date	Total Carbon	Total Inorganic Carbon	Total Organic Carbon	CO_2 Carbon	Carbonate Carbon
WELL 28					
11-1-71	26.7	13.3	13.4	12.3	1.0
1-3-72	30.0	12.0	18.0	7.0	5.0
3-6-72	23.5	10.8	12.7	9.8	1.0
5-8-72	25.7	2.5	23.2	0.5	2.0

Note: Average milligrams carbon/liter for triplicate samples.

TABLE 30

GROUND WATER
AEROBIC BACTERIA
VIABLE ORGANISMS PER MILLILITER

FEBRUARY 1971 THROUGH MAY 1972

Date	Well Number 3	4	5	6	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28
Feb 15, 1971	11,000	–	3,500	11,000	–	7,800	–	–	–	850	–	–		1,250	–	–	–	–	–	–	–	–
Feb 22	16,900	–	2,900	3,500	–	295	–	–	–	420	–	–	–	1,980	–	–	–	–	–	–	–	–
Mar 1	23,000	–	6,300	4,100	–	11,300	–	–	–	1,210	–		–	3,150	–	–	–	–	–	–	–	–
Mar 8	17,450	–	3,550	3,475	–	305	–	–	–	430	–		–	1,850	–	–	–	–	–	–	–	
Apr 5	4,266	–	840	1,033	–	677	–	–	–	443	–	–	–	4,775	–	–	–	–	–	–	–	–
May 12	3,800		110	375	–	620	–	–	–	360	–	–		320	–	–	–	–	–	–	–	–
July 10	5,000		540	660	–	240	–	–	–	220	–	–	–	230	–	–	–	–	–	–	–	–
July 27	–	1,900	–	–	3,700	–	–	–	2,000	–	–	–	625	–	–	–	25,280	7,480	–	–	–	–
Aug 16	–	–	510	740	–	640	–	–	–	1,650	–		–	750	–	–	–	–	–	–	–	–
Aug 25	–	3,320	–	–	3,050	–	–	–	3,100	–	–	–	705	–	–	–	9,300	10,800	–	–	–	–
Sept 16	5,700	–	3,195	–	–	510	–	–	–	820	–	–	–	705	–	–	–	–	–	–	–	–
Sept 20	–	2,500	–	–	5,000	–	–	–	1,290	–	–	–	60	–	–	–	9,500	5,100	–	–	–	–
Oct 4	8,200	–	760	–	–	1,320	–	–	–	1,050	–	–	–	192	–	–	–	–	–	–	–	–
Oct 19	–	4,000	–	–	5,300	–	–	–	950	–	–	–	775	–	–	–	8,200	5,400	–	–	–	–
Nov 1	–	–	5,300	–	–	640	5,250	6,175	–	620	4,100	10,450	–	–	–	–	–	–	–	–	11,000	4,750
Nov 15	–	–	–	–	–	–	–	–	–	–	–	–	–	1,540	10,000	580	–	3,300	2,630	3,100	–	–
Dec 13	10,300	2,500	–	–	3,400	–	–	–	1,390	–	–	–	1,450	–	–	–	3,100	–	–	–	–	–
Dec 21	55,000	1,875	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1,100	3,150	2,075	–	–
Jan 3, 1972	–	–	430	–	–	350	13,200	5,200	–	–	–	–	–	–	–	–	–	–	–	–	4,500	5,600
Jan 18	–	–	–	–	–	–	–	–	–	300	4,800	11,500	–	600	14,600	6,330	–	–	–	–	–	–
Feb 7	37,400	760	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4,400	11,000	1,870	–	–
Feb 21	–	–	–	–	2,380	–	–	–	450	–	–	–	251	–	–	–	2,250	–	–	–	–	–
Mar 6	–	–	87	–	–	8,400	7,500	–	–	–	–	–	–	–	–	–	–	–	–	–	3,800	2,500
Mar 21	–	–	–	–	–	–	–	–	–	380	3,000	7,600	–	1,440	15,600	12,500	–	–	–	–	–	–
Apr 3	2,250	1,870	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3,600	16,700	3,800	–	–
Apr 17	18,500	–	–	–	1,280	–	–	–	57	–	–	–	103	–	–	–	2,260	–	–	–	–	–
May 8	9,340	–	90	–	–	120	4,100	2,400	–	–	–	–	–	–	–	–	–	–	–	–	1,550	1,200
May 22	–	–	–	–	–	–	–	–	–	300	2,700	1,900	–	1,780	6,700	8,600	–	–	–	–	–	–

TABLE 31

GROUND WATER
ANAEROBIC BACTERIA
VAIBLE ORGANISMS PER MILLILITER

FEBRUARY 1971 THROUGH MAY 1972

Date	Well Number 3	4	5	6	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28
Feb 15, 1971	4,100		260	360	-	60	-	-	-	143	-	-	-	210	-	-	-	-	-	-	-	-
Feb 22	1,800	-	185	180	-	60	-	-	-	98	-	-	-	175	-	-	-	-	-	-	-	-
Mar 1	4,300	-	125	165	-	66	-	-	-	40	-	-	-	183	-	-	-	-	-	-	-	-
Mar 8	5,200	-	152	1,010	-	185	-	-	-	120	-	-	-	530	-	-	-	-	-	-	-	-
Apr 5	17,600	-	178	725	-	153		-	-	42	-	-	-	625	-	-	-	-	-	-	-	-
May 12	8,300	-	70	177	-	75	-	-	-	32		-	-	1,580	-	-	-	-	-	-	-	-
July 10	2,000	-	95	150	-	200	-	-	-	28		-	-	480	-	-	-	-	-	-	-	-
July 27	-	290	-	-	280	-	-	-	337	-	-	-	88	-	-	-	2,500	3,200	-	-	-	-
Aug 16	-	-	84	50	-	692			-	58	-	-	-	50	-	-	-	-	-	-	-	-
Aug 25	-	325	-	-	200	-	-	-	905	-	-	-	56	-	-	-	2,300	3,675	-	-	-	-
Sept 16	410	416		-	-	73	-	-	-	20	-	-	-	40	-	-	-	-	-	-	-	-
Sept 20	-	352	-	-	350	-	-	-	1,500	-	-	-	54	-	-	-	1,620	3,400	-	-	-	-
Oct 4	240	-	80	-	-	30	-	-	-	55	-	-	-	70	-	-	-	-	-	-	-	-
Oct 19	-	280	-	-	395	-	-	-	1,050	-	-	-	115	-	-	-	3,150	3,500	-	-	-	-
Nov 1	-	-	60	-	-	30	200	116	-	50	200	140	-		-	-	-	-	-	-	175	300
Nov 15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec 13	6,000	425	-	-	250	-	-	-	100	-	-	-	55	-	-	-	410	-	-	-	-	-
Dec 21	31,000	680	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	400	3,500	2,950	-	-
Jan 3, 1972	-	-	140	-	-	100	700	340	-	-	-	-	-	-	-	-	-	-	-	-	400	395
Jan 18	25,550	-	-	-	-	-	-	-	-	20	560	480	-	33	840	940	-	-	-	-	-	-
Feb 7	19,100	420	-	-	-		-	-	-	-	-	-	-	-	-	-	-	250	7,600	770	-	-
Feb 21	-		-	-	50		-	-	100	-	-	-	27	-	-	-	800	-	-	-	-	-
Mar 6	-	-	20	-	-	28	200	280	-	-	-	-	-	-	-	-	-	-	-	-	240	200
Mar 21	-	-	-	-	-	-	-	-	-	20	140	470	-	60	1,100	690	-	-	-	-	-	-
Apr 3	16,900	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	175	3,200	200	-	-
Apr 17	3,500	-	-	-	148	-	-	-	26	-	-	-	12	-	-	-	660	-	-	-	-	-
May 8	1,000	-	90	-	-	15	65	30	-	-	-	-	-	-	-	-	-	-	-	-	98	50
May 22	-	-	-	-	-	-	-	-	-	16	103	300	-	21	940	220	-	-	-	-	-	-

TABLE 32

GROUND WATER
SULFUR REDUCING BACTERIA
VIABLE ORGANISMS PER MILLILITER

MARCH 1971 THROUGH MAY 1972

Date	Well Number																					
	3	4	5	6	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28
Mar 1, 1971	B	–	50	B	–	100	–	–	–	125	–	–	–	B	–	–	–	–	–	–	–	–
Mar 8	B	–	60	B	–	120	–	–	–	150	–	–	–	B	–	–	–	–	–	–	–	–
Apr 5	145	–	29	145	–	15	–	–	–	205	–	–	–	275	–	–	–	–	–	–	–	–
May 12	140	–	20	70	–	15	–	–	–	63	–	–	–	100	–	–	–	–	–	–	–	–
July 10	260	–	58	115	–	62	–	–	–	138	–	–	–	95	–	–	–	–	–	–	–	–
July 27	–	60	–	–	300	–	–	–	10	–	–	–	10	–	–	–	25	60	–	–	–	–
Aug 16	–	–	15	30	–	25	–	–	–	30	–	–	–	56	–	–	–	–	–	–	–	
Aug 25	–	310	–	–	230	–	–	–	41	–	–	–	24	–	–	–	85	225	–	–	–	–
Sept 16	0	–	0	–	–	0	–	–	–	15	–	–	–	0	–	–	–	–	–	–	–	–
Sept 20	–	170	–	–	40	–	–	–	52	–	–	–	0	–	–	–	30	20	–	–	–	–
Oct 4	375	–	20	–	–	15	–	–	–	0	–	–	–	35	–	–	–	–	–	–	–	–
Oct 19	–	148	–	–	102	–	–	–	50	–	–	–	9	–	–	–	0	78	–	–	–	–
Nov 1	–	–	35	–	–	15	60	100		10	72	150	–	–	–	–	–	–	–	–	175	220
Nov 15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dec 13	80	200	–	–	123	–	–	–	56	–	–	–	0	–	–	–	10	112	72	50	–	–
Dec 21	75	150	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Jan 3, 1972	–	–	0	–	–	5	195	112	–	–	–	–	–	–	–	–	–	–	–	–	300	98
Jan 18	–	–	–	–	–	–	–	–	–	16	100	125	–	10	60	75	–	–	–	–	–	–
Feb 7	40	75	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	67	197	40	–	–
Feb 21	–	–	–	–	143	–	–	–	22	–	–	–	0	–	–	–	7	–	–	–	–	–
Mar 6	–		0	–	–	0	7	5	–	–	–	–	–	–	–	–	–	–	–	–	70	13
Mar 21	–	–	–	–	–	–	–	–	–	0	56	60	–	0	30	50	–	–	–	–	–	–
Apr 3	14	60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	62	20	20	–	–
Apr 17	10	–	–	–	50	–	–	–	10	–	–	–	0	–	–	–	0	–	–	–	–	–
May 8	100	–	0	–	–	5	75	23	–	–	–	–	–	–	–	–	–	–	–	–	86	45
May 22	–	–	–	–	–	–	–	–	–	0	25	27	–	0	27	32	–	–	–	–	–	–

B = black, colonies grown together

TABLE 33

GROUND WATER
SULFUR OXIDIZING BACTERIA
VIABLE ORGANISMS PER MILLILITER

MARCH 1971 THROUGH MAY 1972

Date	Well Number 3	4	5	6	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28
March 1, 1971	5,000	–	800	1,050	–	1,995	–	–	–	2,500	–	–	–	1,430	–	–	–	–	–	–	–	–
Mar 8	1,300		240	560	–	255	–	–	–	180	–	–	–	165	–	–	–	–	–	–	–	–
Apr 5	235	.	–	146	–	134	.	.	–	205	–	–	–	30	–	–	–	–	–	–	–	–
May 12	750	–	20	128	.	85	–	–	–	111	–	–	–	47	–	–	–	–	–	–	–	–
July 10	–	–	–	–	–	.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.
July 27	.	50	–	–	100	–	–	–	200	–		–	60	–	–	–	600	250	–	–	–	–
Aug 16	–	.	630	217	–	289	–	–	–	159	–	–	–	115	–	–	–	–	–	–	–	–
Aug 25	–	235	–	–	120	–	–	–	108	–	–	–	37	–	–	–	168	103	–	–	–	–
Sept 16	162	–	493	–	–	112	–	–	–	37	–	–	–	280	–	–	–	–	–	–	–	–
Sept 20	–	114	–	–	294	–	–	–	30	–	–	–	9	–	–	–	44	176	–	–	–	–
Oct 4	168	–	50	–	–	40	–	–	–	52	–	–	–	35	–	–	–	–	–	–	–	–
Oct 19	–	60	–	–	250	–	–	–	104	–	–	–	23	–	–	–	76	282	–	–	–	–
Nov 1	–	–	54	–	–	75	*	*	–	48	*	*	–	–	–	–	–	–	–	–	*	*
Nov 15	–	–	–	–	–	–	–	–	–	–	–	–	–	150	125	90	–	60	64	60	–	–
Dec 21	417	185	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	40	156	108	–	–
Feb 7, 1972	1,300	57	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	47	340	211	–	–
Feb 21	–	–	–	–	25	–	–	–	12	–	–	–	10	–	–	–	22	–	–	–	–	–
Mar 6	–	–	10	–	–	15	162	137	–	–	–	–	–	–	–	–	–	–	–	–	59	175
Mar 21	–	–	–	–	–	–	–	–	–	100	175	410	–	150	220	500	–	–	–	–	.	–
Apr 3	1,500	75	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	213	180	275	–	–
Apr 17	480	–	–	–	15	–	–	–	10	–	–	–	10		–	–	17	–	–	–	–	–
May 8	840	50	–	–	–	21	58	80	–	–	–	–	–	–	–	–	–	–	–	–	43	48
May 22	–	–	–	–	–	–	–	–	–	23	120	54	–	20	30	20	–	–	.	–	–	–

*Too numerous to count at highest dilution.

TABLE 34

GROUND WATER
POSSIBLE STAPHYLOCOCCUS
PATHOGENIC TYPE
(MANNITOL FERMENTING - GOLDEN PIGMENTATION)
VIABLE ORGANISMS PER MILLILITER

JULY 1971 THROUGH SEPTEMBER 1971

	Well Numbers																					
Date	3	4	5	6	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28
July 10, 1971	100		5	33	--	6	--	--	--	8	--	--	--	40	--	--	--	--	--	--	--	--
July 27	--	12	--	--	10	.	--	--	5	--	--	-	50	--	-	.	135	48	-	--	--	--
Aug 16		--	0	0	--	0	--	--	--	7	--	--	--	0	--	--	--	--	--	--	--	--
Aug 25	--	40	--	--	9	--	--	--	21	--	-	--	21	--	--	--	200	75	.	--	--	--
Sept 16	86	--	15		--	5	.	--	6	--	--	--	--	20	.	--	--	--	--		.	--

TABLE 3

GROUND WATER
POSSIBLE STAPHYLOCOCCUS
(PHENYLETHANOL AGAR)
VIABLE ORGANISMS PER MILLILITER

JULY 1971 THROUGH MAY 1972

Well Number

Date	3	4	5	6	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28
July 10, 1971	125	--	10	23	--	27	--	--	--	12	--	--	--	0	--	--	--	--	--	--	--	--
July 27	--	10	--	--	5	--	--	--	12	--	--	--	35	--	--	--	550	28	--	--	--	--
Aug 16	--	--	130	34	--	26	--	--	--	24	--	--	--	15	--	--	--	--	--	--	--	--
Aug 25	--	52	--	--	56	--	--	--	14	--	--	--	19	--	--	--	585	26	--	--	--	--
Sept 16	75	--	12	--	--	20	--	--		20	--	--	--	12	--	--	--	--	--	--	--	--
Sept 20	--	13	--	--	15	--		--	4	--	--	--	0		--	--	40	--	--	--	--	--
Oct 4	675	--	5	--	--	1	--	--	--	17	--	--	--	2	--		--	--	--	--	--	--
Oct 19	--	15	--	--	32	--	--	--	0	--	--	--	0		--	--	0	14	--	--	--	--
Nov 1	--		15	--	--	0	122	125	--	0	9	150	--	--	--	--	--	--	--	--	220	132
Nov 15	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	--	0	0	0	--	--
Dec 13	75	65	--	--	52	--	--	--	7	--	--	--	15	--	--	--	400		--	--	--	--
Dec 21	20	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	100	35	--	--
Jan 3, 1972	--	--	5	--	--	8	400	100	--	--	--	--	--	--	--	--	--	--	--	--	90	107
Jan 18		--	--	--	--	--	--	--	--	0	0	40	--	0	685	510	--	--	--	--	--	--
Feb 7	66	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	35	145	35	--	--
Feb 21	--	--	--		6	--	--	--	3	--	--	--	0	--	--	--	81	--	--	--	--	--
Mar 6	--	--	7	--	--	7	200	140	--	--		--	--	--	--	--	--	--	--	--	145	122
Mar 21	--	--	--	--	--	--	--	--	--	0	0	463	--	0	190	250	--	--	--	--	--	--
Apr 3	10	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	58	26	--	--
Apr 17	20	--	--	--	5	--	--	--	0	--	--	--	0	--	--	--	10	--	--	--	--	--
May 8	31	--	6	--	--	5	140	100	--	--	--	--	--	--	--	--	--	--	--	--	125	59
May 22	--	--	--	--	--	--	--	--	--	0	44	220	--	0	505	550	--	--	--	--	--	--

TABLE 36

GROUND WATER
FILAMENTOUS FUNGI
MOLD COLONIES PER MILLILITER

JULY 1971 THROUGH NOVEMBER 1971

Date	3	4	5	6	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28
								Well Numbers														
							Insignificant mold counts Feburary 1971 through May 1971															
July 10, 1971	56	--	11	32	--	46	--	--	--	21	--	--	--	38	--	--	--	--	--	--	--	--
July 27	--	3	--	--	5	--	--	--	0	--	--	--	6	--	--	--	5	4	--	--		--
Aug 16	--	--	10	13	--	15	--	--	--	13	--	--	--	8	--	--	--	--	--	--	--	--
Aug 25	--	8	--	--	5	--	--	--	6	--	--	--	6	--	--	--	5	5	--	--	--	--
Sept 16	10	--	10	--	--	10	--	--	--	4	--	--	--	15	--	--	--	--	--	--	--	--
Sept 20	--	5	--	--	0	--	--	--	0	--	--	--	0	--	--	--	7	--	--	--	--	--
Oct 4	5	--	3	--	--	2	--	--	--	13	--	--	--	5	--	--	--	--	--	--	--	--
Oct 19	--	3	--	--	4	--	--	--	2	--	--	--	1	--	--	--	0	3	--	--	--	--
Nov 1	--	--	6	--	--	0	3	6	--	5	3	2	--	--	--	--	--	--	--	--	2	15
Nov 15	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	--	0	0	0	--	--

TABLE 37

DAILY RAINFALL AND TEMPERATURE

JULY 1971 THROUGH MAY 1972

Date		Rainfall Inches	Air Temp. F High	Air Temp. F Low
July	26	.02	95	70
	27	.00	100	74
	28	.04	100	70
	29	.00	95	70
	30	.08	95	70
	31	.00	94	75
August	1	.00	90	70
	2	.05	93	70
	3	.12	95	67
	4	.07	97	70
	5	.01	100	71
	6	.00	98	72
	7	.00	87	67
	8	.00	90	70
	9	.09	95	70
	10	.00	97	68
	11	.36	98	67
	12	.09	96	70
	13	.57	85	72
	14	.47	85	72
	15	.14	88	74
	16	.00	87	70
	17	.00	95	70
	18	.00	95	71
	19	.28	95	70
	20	.01	90	70
	21	.00	95	70
	22	.00	100	70
	23	1.37	97	70
	25	.00	96	70
	26	.00	95	70
	27	.00	97	70
	28	.58	95	70
	29	.00	95	70
	30	.00	95	70
	31	.00	95	72

Date		Rainfall Inches	Air Temp. F High	Air Temp. F Low
September	1	.00	92	73
	2	.00	95	72
	3	.00	97	70
	4	.00	95	71
	5	.00	95	72
	6	.00	95	69
	7	.00	96	70
	8	.00	95	70
	9	.00	85	70
	10	.00	85	70
	11	.00	90	70
	12	.00	87	70
	13	.01	90	72
	14	.00	90	63
	15	.00	80	65
	16	.00	98	70
	17	.00	98	68
	18	.00	100	65
	19	.00	97	67
	20	.07	99	66
	21	.01	93	69
	22	.13	95	70
	23	.02	95	68
	24	.30	90	63
	25	.12	96	66
	26	.00	100	65
	27	.00	88	64
	28	.00	89	70
	29	.19	88	64
	30	.00	95	62
October	1	.00	98	63
	2	.00	95	66
	3	.19	87	65
	4	.00	88	65
	5	.00	98	70
	6	1.08	97	70
	7	.71	90	70
	8	.51	86	70
	9	.59	94	70

TABLE 37 (CONTINUED)

DAILY RAINFALL AND TEMPERATURE

JULY 1971 THROUGH MAY 1972

Date		Rainfall Inches	Air Temp. F High	Air Temp. F Low
October	10	.74	80	60
	11	.95	85	65
	12	.01	85	70
	13	.01	90	70
	14	1.96	90	70
	15	.16	97	69
	16	.02	95	70
	17	.00	90	70
	18	.36	82	69
	19	.67	80	69
	20	2.29	84	66
	21	.00	95	69
	22	.06	90	65
	23	.00	96	66
	24	.36	91	63
	25	.00	82	60
	26	.01	82	59
	27	.00	85	62
	28	.14	82	69
	29	.00	85	69
	30	.00	85	69
	31	.09	87	68
November	1	.00	85	68
	2	.00	87	69
	3	.13	90	60
	4	.00	76	60
	5	.00	79	62
	6	.00	80	65
	7	.00	80	58
	8	.00	75	55
	9	.07	80	60
	10	.00	67	50
	11	.00	70	42
	12	.00	77	42
	13	.00	70	45
	14	.00	76	55
	15	.00	80	64

Date		Rainfall Inches	Air Temp. F High	Air Temp. F Low
November	16	.00	70	65
	17	.00	80	62
	18	.00	80	60
	19	.00	80	58
	20	1.68	80	50
	21	.00	72	44
	22	.00	65	50
	23	.52	75	64
	24	.00	80	60
	25	.00	80	59
	26	.00	86	60
	27	.00	80	50
	28	1.03	75	63
	29	.00	78	64
	30	.00	78	60
December	1	.00	70	63
	2	.75	70	62
	3	.00	75	50
	4	.00	62	55
	5	.00	70	67
	6	.00	80	60
	7	.00	85	63
	8	.00	85	65
	9	.00	87	65
	10	.68	86	60
	11	.82	87	59
	12	.00	89	59
	13	.00	88	60
	14	.00	85	62
	15	.00	86	65
	16	.01	89	60
	17	.00	87	67
	18	.00	85	60
	19	.00	70	50
	20	.00	75	60
	21	.00	72	55
	22	.00	80	65

TABLE 37 (CONTINUED)

DAILY RAINFALL AND TEMPERATURE

JULY 1971 THROUGH MAY 1972

Date		Rainfall Inches	Air Temp. F High	Air Temp. F Low
December	23	.00	80	50
	24	.00	70	42
	25	.00	75	59
	26	.00	70	55
	27	.00	80	59
	28	.00	82	59
	29	.00	83	60
	30	.00	81	60
	31	.00	79	58
January	1	.00	70	52
	2	.00	82	60
	3	.00	85	60
	4	.00	85	64
	5	.00	85	65
	6	.00	70	50
	7	.00	65	48
	8	.00	75	51
	9	.00	82	60
	10	.00	82	60
	11	.00	85	64
	12	.00	85	60
	13	.00	87	58
	14	.00	86	60
	15	.00	52	39
	16	.00	56	40
	17	.00	68	52
	18	.65	70	56
	19	.00	75	55
	20	.05	80	60
	21	.00	84	64
	22	.00	78	63
	23	.00	82	54
	24	.00	86	59
	25	.00	88	65
	26	.00	80	65
	27	.00	84	61
	28	.00	86	57
	29	.00	89	56
	30	.00	85	60
	31	.00	75	60
February	1	1.61	76	67
	2	.00	80	43
	3	.00	57	39
	4	1.47	64	48
	5	.00	78	55
	6	.00	75	61
	7	.00	80	60
	8	.49	67	56
	9	.09	60	52
	10	.76	67	60
	11	.21	63	58
	12	.00	78	62
	13	.00	43	50
	14	.00	70	44
	15	.30	65	60
	16	.00	62	60
	17	.88	78	49
	18	.00	55	44
	19	.00	60	35
	20	.00	65	54
	21	.00	75	50
	22	.00	79	50
	23	.00	80	55
	24	.00	84	60
	25	.00	85	60
	26	.00	89	65
	27	.00	88	62
	28	.22	90	61
	29	.00	88	64
March	1	.00	85	60
	2	.00	84	69
	3	.00	80	57
	4	.00	80	62
	5	.00	78	51
	6	.00	65	54
	7	.00	80	60
	8	.30	85	60
	9	.00	69	55
	10	.00	67	49
	11	.00	72	63

TABLE 37 (CONTINUED)

DAILY RAINFALL AND TEMPERATURE

JULY 1971 THROUGH MAY 1972

Date		Rainfall Inches	Air Temp. F High	Air Temp. F Low	Date		Rainfall Inches	Air Temp. F High	Air Temp. F Low
March	12	.00	84	60	April	19	.00	85	70
	13	.00	82	58		20	.00	90	70
	14	.00	85	60		21	.00	94	74
	15	.00	80	63		22	.00	92	72
	16	.00	75	59		23	.18	90	75
	17	.02	82	65		24	.00	85	72
	18	.00	83	62		25	.00	87	64
	19	.00	81	60		26	.00	74	59
	20	.00	82	58		27	.00	76	60
	21	.00	86	60		28	.00	80	62
	22	.00	78	70		29	.00	83	60
	23	.00	78	65		30	.42	80	60
	24	.00	80	62					
	25	.00	80	72	May	1	.00	80	70
	26	.00	80	58		2	.00	86	69
	27	.00	80	55		3	.03	84	71
	28	.04	82	60		4	.00	89	70
	29	.00	81	57		5	.00	87	70
	30	.00	82	56		6	.00	80	74
	31	2.25	76	66		7	.00	88	72
						8	.45	84	69
April	1	.00	75	54		9	.11	83	68
	2	.00	72	53		10	.02	84	68
	3	.00	77	58		11	.50	85	70
	4	.00	80	57		12	.00	85	67
	5	.00	84	67		13	.00	87	73
	6	1.30	82	63		14	.00	85	76
	7	.00	84	62		15	.00	92	74
	8	.00	86	64		16	.31	91	74
	9	.00	86	63		17	.08	80	70
	10	.02	82	60		18	.25	85	70
	11	.00	84	63		19	.19	90	70
	12	.00	85	63		20	.00	89	67
	13	.00	84	67		21	.00	80	70
	14	.00	90	69		22	.00	89	66
	15	.00	89	69		23	.00	85	67
	16	.00	88	69		24	.19	90	66
	17	.00	86	65		25	.00	80	69
	18	.00	84	73		26	.00	83	70
						27	.00	89	71
						28	.00	85	70
						29	.00	90	72
						30	.00	89	68
						31	.31	89	70

TABLE 38

PRECIPITATION SUMMARY

INCHES

Month	Normal*	Maximum*	Minimum*	1970**	1971**	1972
January	2.00	6.44	.15	4.05	.45	.70
February	2.42	6.77	.10	6.77	2.98	6.03
March	3.41	10.54	.16	3.66	1.46	2.61
April	3.42	6.18	.28	.45	1.52	1.92
May	3.57	8.58	.43	4.08	4.31	2.44
June	6.96	18.28	1.97	4.92	4.39	----
July	8.00	19.57	3.83	5.97	8.29	----
August	6.94	15.19	3.20	5.91	4.21	----
September	7.23	15.87	1.65	3.25	.85	----
October	3.96	14.51	.35	2.60	10.93	----
November	1.57	6.39	.03	.24	3.13	----
December	1.89	4.66	Trace	2.06	2.26	----
Yearly	51.37	59.65***	34.55***	43.96	44.78	----

*U.S. Weather Service, Herndon Airport, 1931 - 1960.
**U.S. Weather Service, Herndon Airport, Jan. 1970 - July 1971
Orange County Sanitary Landfill Weather Station - July 1971 - May 1972.
***U.S. Weather Service, Herndon Airport, 1932 - 1969.

TABLE 39

GROUND WATER LEVEL

OCTOBER 1971 THROUGH JUNE 1972

	WELL LOCATION AND SURFACE ELEVATION										
Date	4 (84.17)	5 (84.00)	9 (83.24)	10 (84.42)	16 (82.73)	19 (81.91)	20 (81.72)	23 (81.24)	24 (80.77)	Variation Per Date	Number of Determinations
10-4-71		77.97		78.38	77.03		76.34			2.04	4
11-1-71	82.06	79.30	80.35			81.16		80.59	77.59	4.47	6
11-15-71							75.84		77.59	1.75	2
12-7-71	81.81		82.35			81.16		80.75		1.60	4
1-13-72	80.56	77.97	80.85		76.03	79.82	75.68	79.17	76.80	5.17	8
2-12-72	80.89								77.17	3.72	2
2-21-72			81.76					80.42		1.34	2
4-3-72	80.66					80.57			76.92	3.74	3
5-8-72	78.39	77.05		77.97					75.46	2.51	4
6-15-72		77.22	79.18	77.93	75.95	77.57		77.17		3.23	6
6-16-72		78.13		79.13						1.00	2
VARIATION PER WELL	3.67	2.25	3.17	1.20	1.08	3.59	.66	3.58	2.13		
NUMBER OF DETERMINATIONS	6	6	5	4	3	5	3	5	6		

TABLE 40

**SOLID WASTE (TONS)
CELL DISTRIBUTION**

	Demonstration Cells Control Cells					Trailer Cells		Public* Cells	
	CC1	CC2	CC3	CC4	CC6	CT0	CT1	CP1, 2	Total Deposits
Jun 71	--	--	--	--	--	--	--	--	--
Jul	--	--	--	--	--	--	--	--	--
Aug	--	--	--	--	--	--	--	--	--
Sep	--	--	--	--	--	15,000	--	--	15,000
Oct	2,352	--	2,352	--	--	4,500	--	1,533	10,737
Nov	3,005	--	3,005	--	--	2,300	--	1,545	9,855
Dec	2,796	--	5,000	--	2,000	--	--	1,748	11,544
Jan 72	1,900	--	2,921	--	2,921	--	--	2,156	9,898
Feb	--	4,274	--	--	6,000	--	--	1,470	11,744
Mar	--	1,300	--	700	4,905	--	3,452	2,403	12,760
Apr	--	--	--	--	--	--	10,436	3,750	14,186
May	--	--	--	--	--	--	8,985	3,131	12,116
Jun	--	--	--	--	--	--	8,241	3,780	12,021
Jul	--	--	--	--	--	--	8,431	2,583	11,014
Totals	10,053	5,574	13,278	700	15,826	21,800	39,545	24,099	130,875

*Cars, station wagons, pickups are not weighed. Tonnages calculated based on cubic yardage.

TABLE 41

EQUIPMENT STATUS

NOVEMBER 1971 THROUGH JULY 1972

Type	In Use (Hrs)	Out of Commission (Hrs.) Servicing	Repairs	Awaiting Parts	Remarks
Dragline No. 0024	298	156	166		Normal Operations: 10 Hrs/Day, 4 Days/Wk Maintenance History: Broken drag cables; oil leaks; fuel pump defective; bucket welding. General History Good. Useage: Operator dual qualified, used elsewhere at times, not needed Nov. 15, 1971 - Dec. 31, 1971. Not required March 1 1972 - May 14, 1972. May 15, 1972 - Jul 31, 1972 used primarily in construction of NW perimeter canal.
Trashmaster No. 0004	571	160	1184.5	75	Normal Operation: 10 Hrs/Day, 60 Hr - Week. Maintenance History: Excessive down time with front drive differential problems. Totally out of commission during Apr. and May 1972. Useage: Generally used in conjunction with a dozer. Most recently used in spreading and compaction in cells CP1 and CT1.
Pan Scraper No. 0001	1527	380.5	670		Normal Operation: 7 Days/Wk; 80 Hr-Week Maintenance History: Steering; Drive transmission; hydraulics are major problem areas. Useage: Primarily cell excavation, some cover filling. Recently working cells CP1, CP2, CT1, CT2, road work and clearing.

TABLE 41 (CONTINUED)

EQUIPMENT STATUS

NOVEMBER 1971 THROUGH JULY 1972

Type	In Use (Hrs)	Out of Commission (Hrs.)			Remarks
		Servicing	Repairs	Awaiting Parts	
Dozer TD-15* No. 0034	226	53	1505.5	250	Normal Operation: Standby Maintenance History: Totally out of commission Nov. 1, 1971 through Jan. 31, 1972, awaiting parts and transmission repairs. Mar andApr, idlers and rollers rework, clutch, final drive. Jul, transmission ring gear replacement - out total month. This equipment is old and will continue to have problems becoming progressively more expensive to eliminate. Useage: Spreading, compaction, fill cover. Approximately 110 hours during May and Jun in cells CP-1 and CT1.
Dozer TD-20* No. 0005	796.5	187	1020.5		Normal Operation: Standby Maintenance History: Primarily steering clutch problems, Track and idlers reworked Nov 1971. 130 hours radiator repairs in Apr and May 1972, and 90 hours in Jul. Transmission seal rework in Jun 72. Some electrical problems. Useage: Spreading, compaction, fill cover, stockpiling. Most recent use in cells CP1, CT1, CT2.
Dozer TD-25C No. 0007	1910	284	205	18	Normal Operation: 10 Hrs/Day, 60 Hr-Week Maintenance History: Very Good. Major work has been on track repairs (140 hours). Minor water and electrical repairs. Useage: Dozing, compaction. Most recent use in cells CP1, CT1 and in NW perimeter canal construction.

*Equipment 14 years old. Used primarily as back-up for Trashmaster or TD-25 Dozer.

TABLE 42

SOLID WASTE DISPOSAL COSTS
OPERATIONS

	Machine Operation (Hrs)	Fuel, Oil Grease, Repairs Costs	Other Costs	Total Salaries Paid	Total Field Costs*	Total Buried (Tons)	Cost/Ton
Oct 71	121	2,239.64	2,220.92	8,496.99	12,957.55	10,737	1.21
Nov	549	4,569.25	649.79	9,377.93	14,596.97	9,855	1.48
Dec	492	3,042.29	2,811.77	9,813.26	15,667.32	11,544	1.36
Jan 72	602	4,040.48	1,771.65	8,429.20	14,241.33	9,898	1.44
Feb	648	5,178.32	1,313.69	7,954.27	14,446.28	11,744	1.23
Mar	687	9,085.65	1,966.90	9,837.77	20,890.32	12,760	1.63
Apr	559	2,092.12	2,336.41	7,932.71	12,361.24	14,186	0.87
May	566	5,031.30	4,567.60	10,419.65	20,018.55	12,116	1.65
Jun	606	8,612.41	2,615.17	8,366.49	19,594.07	12,021	1.63
Jul	553	970.56	1,743.90	9,626.86	12,341.32	11,014	1.12
Totals	5,383	44,862.02	21,997.80	90,255.13	157,214.95*	115,875	1.35

*Direct operating costs only.

THE FOLLOWING PAGES ARE DUPLICATES OF ILLUSTRATIONS APPEARING ELSEWHERE IN THIS REPORT. THEY HAVE BEEN REPRODUCED HERE BY A DIFFERENT METHOD TO PROVIDE BETTER DETAIL.

FIGURE 6 . Cypress Grove in Swampy Area of Landfill Site Prior to Drainage Improvements.

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FIGURE 9 Access Road Under Construction Adjacent to the Outfall Canal.

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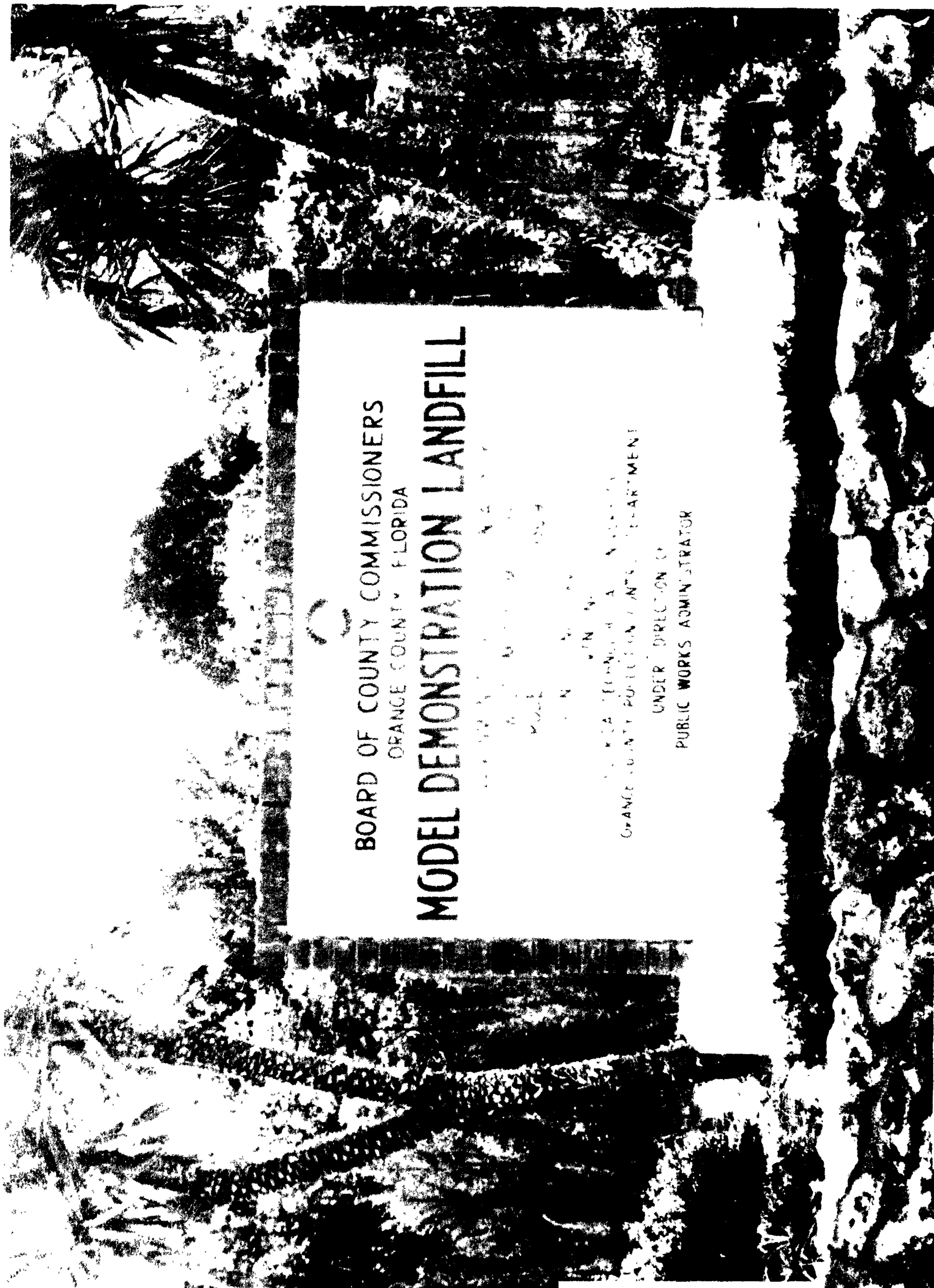

FIGURE 10 Entrance Landscaping and Sign, Orange County Sanitary Landfill.

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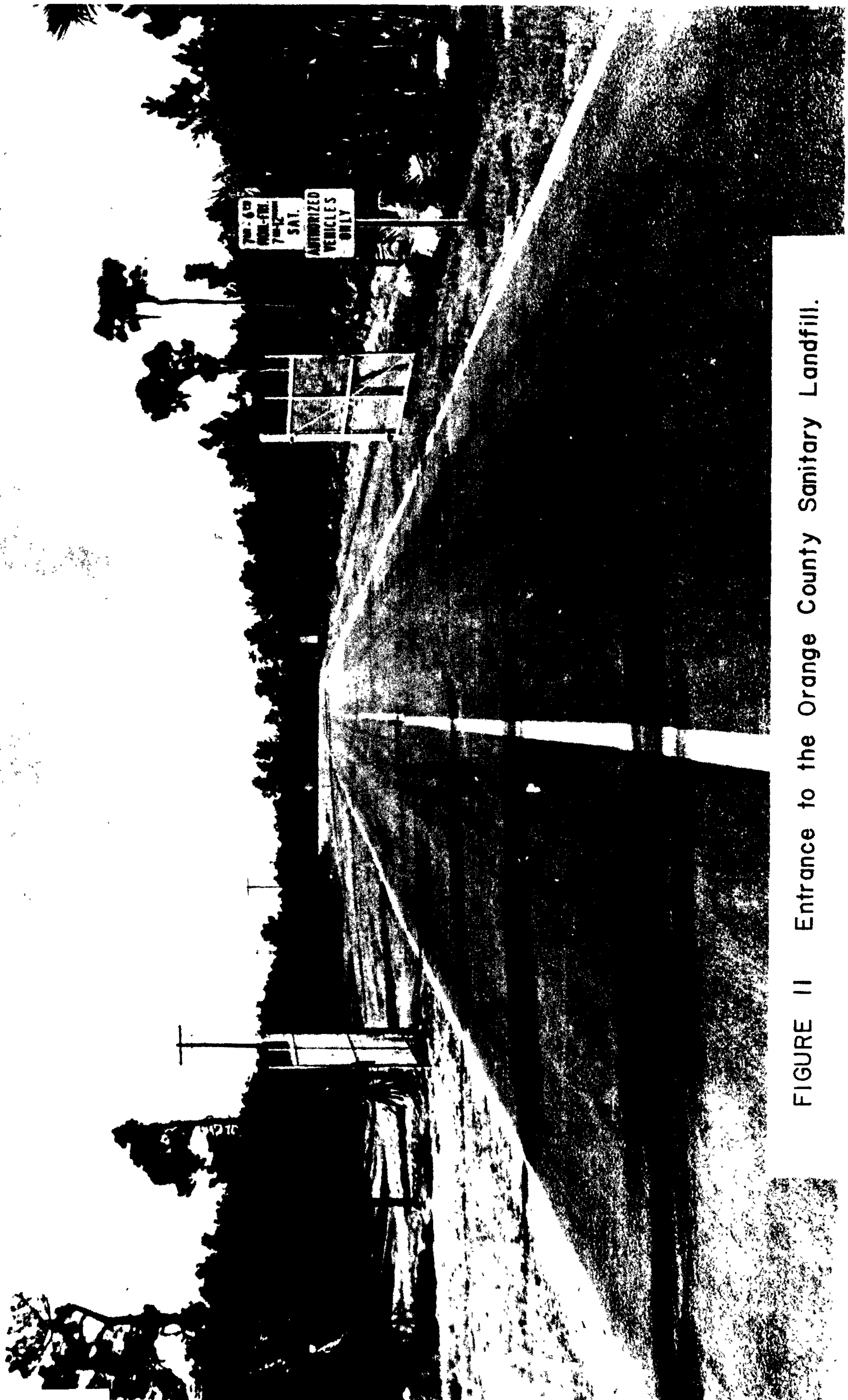

FIGURE II Entrance to the Orange County Sanitary Landfill.

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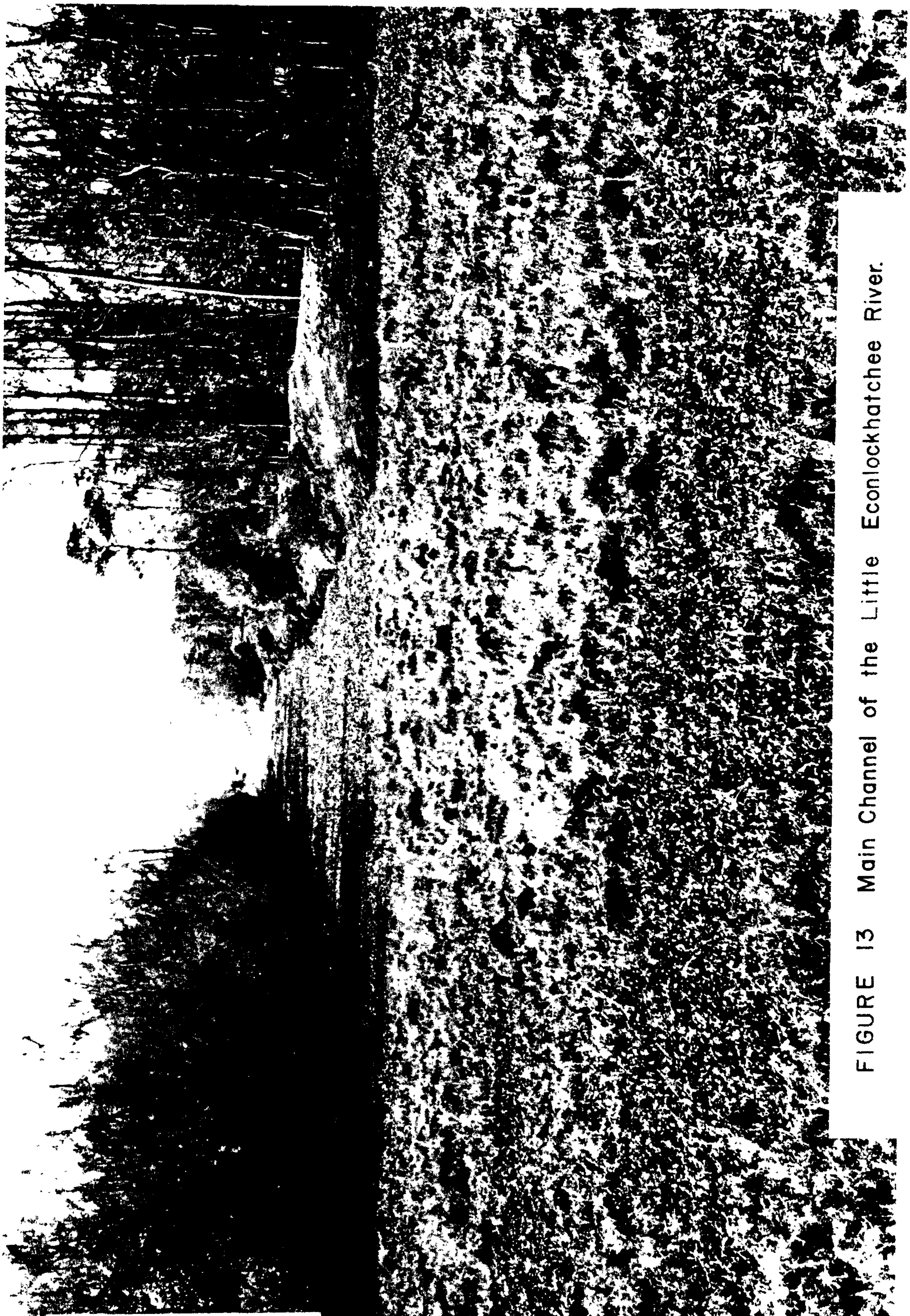

FIGURE 13 Main Channel of the Little Econlockhatchee River.

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FIGURE 15 Drainage Pond A, Orange County Sanitary Landfill.

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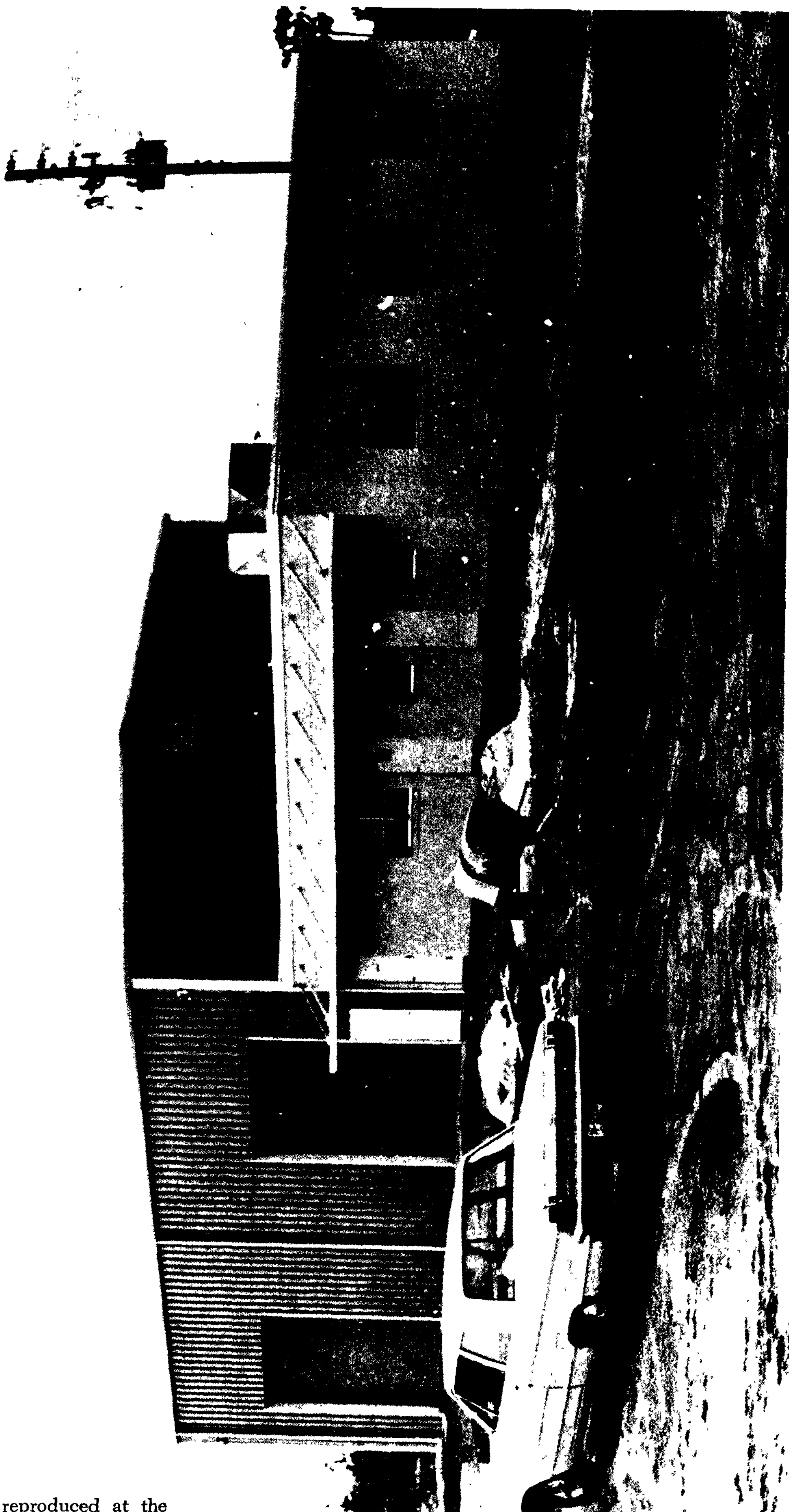

FIGURE 17. Landfill Office and Equipment Maintenance Building.

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FIGURE 18. Scale House and Service Buildings, Orange County Sanitary Landfill.

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FIGURE 27 View of Typical Refuse Being Accepted at the Orange County Sanitary Landfill.

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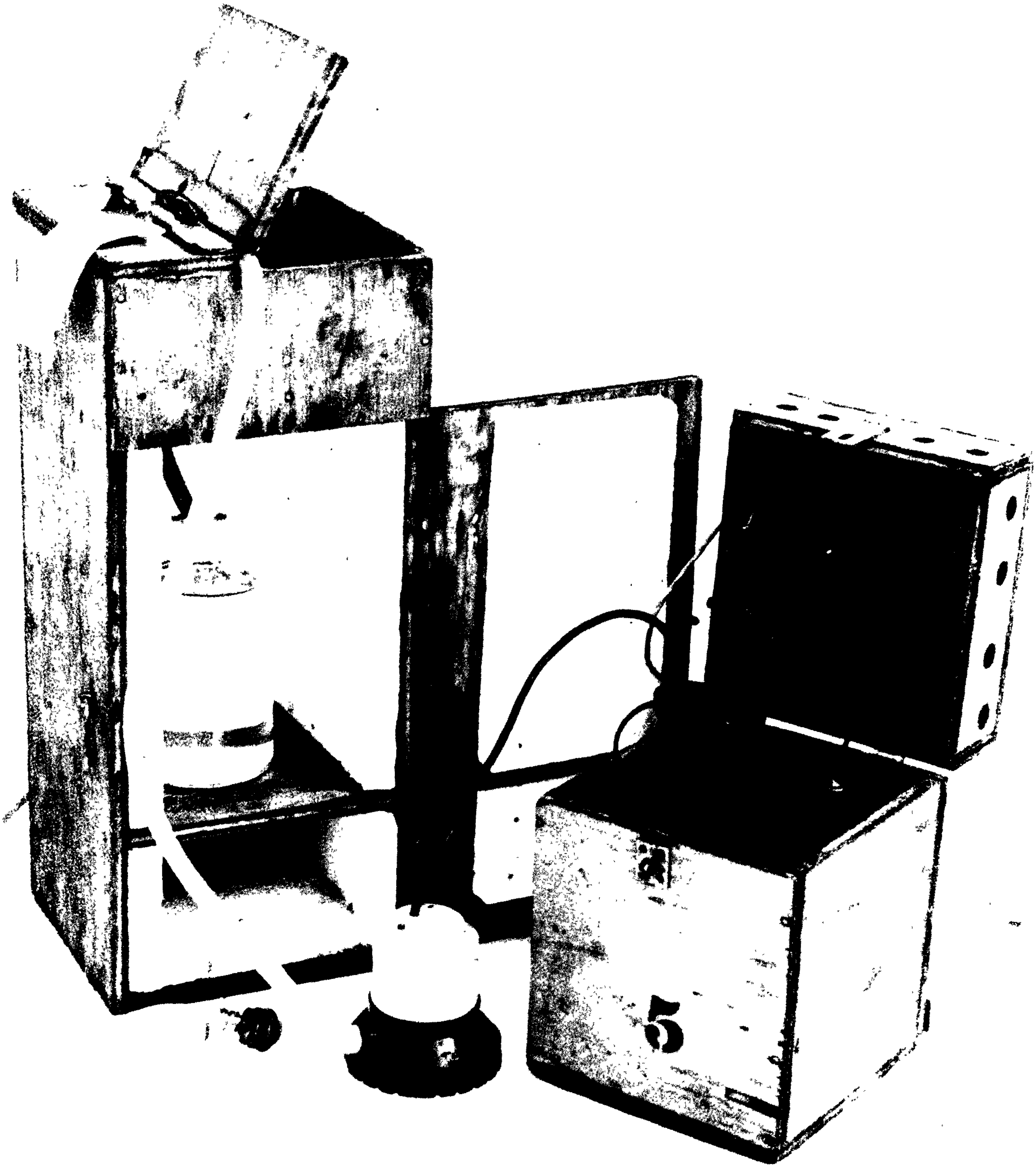

FIGURE 30 24-Hour Composite Sampler for Surface Water Sampling.

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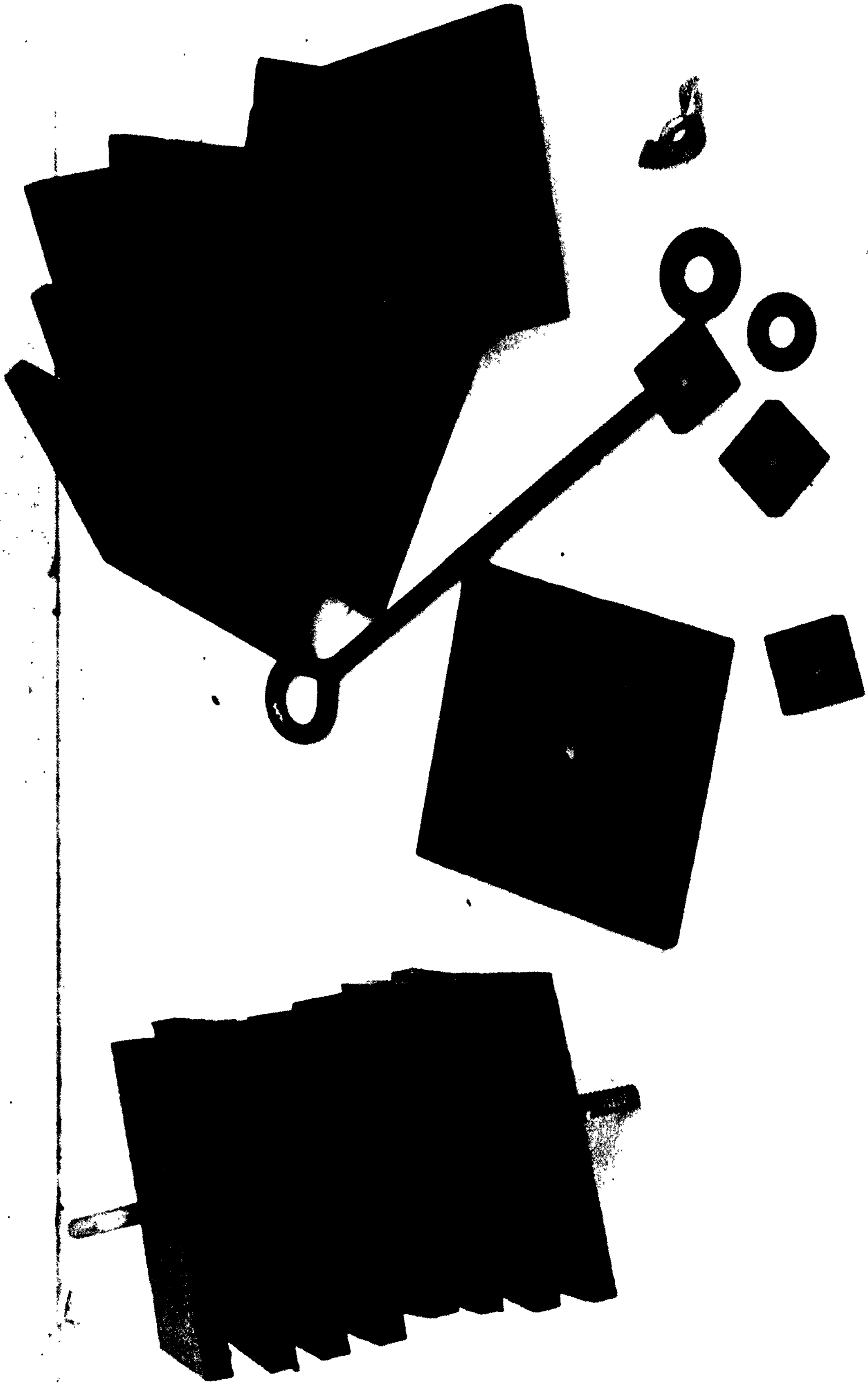

FIGURE 31 Multiple-Plate Macroinvertebrate Sampler.

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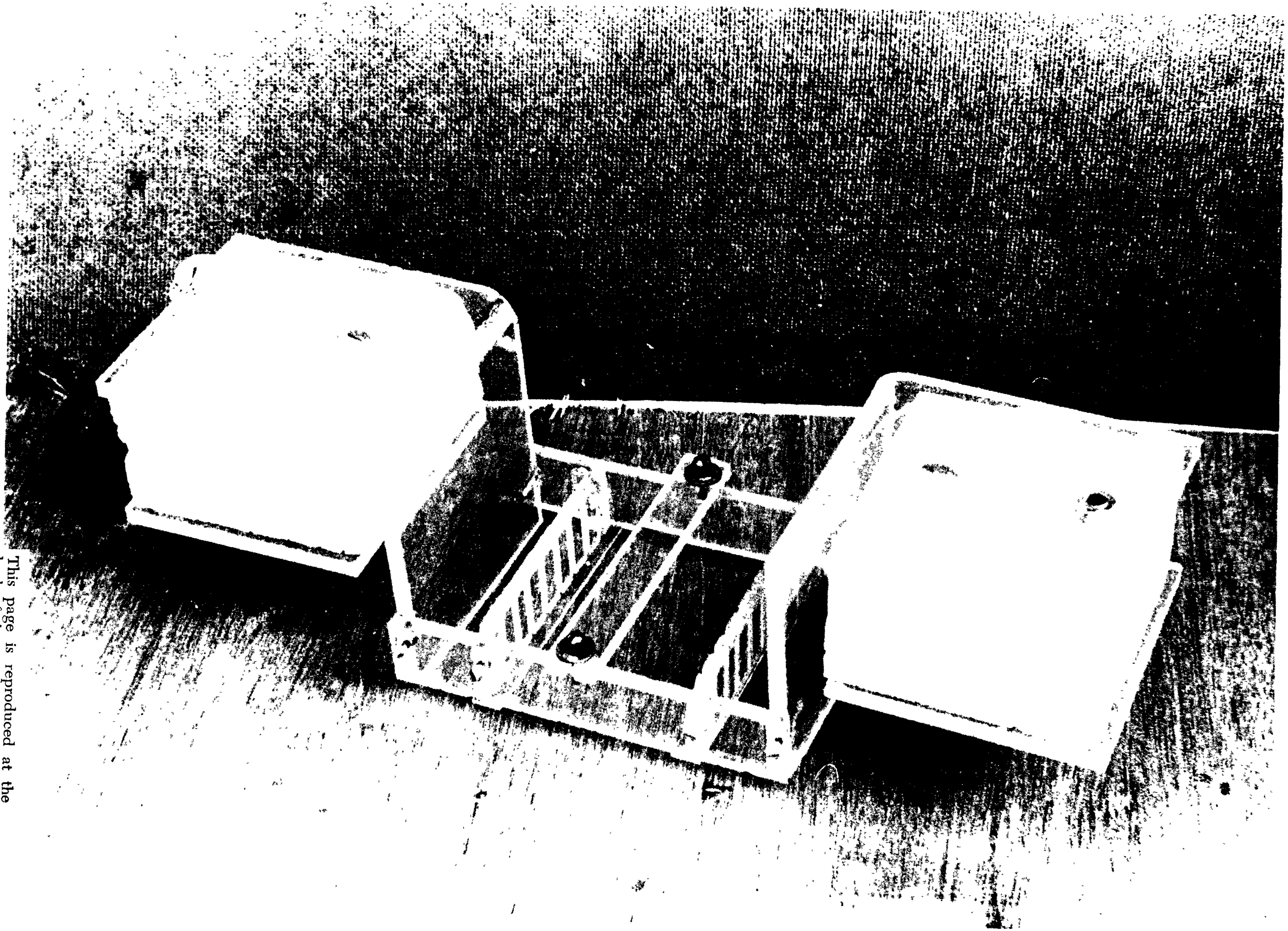

FIGURE 32 Periphyton Sampler for Surface Water Analysis.

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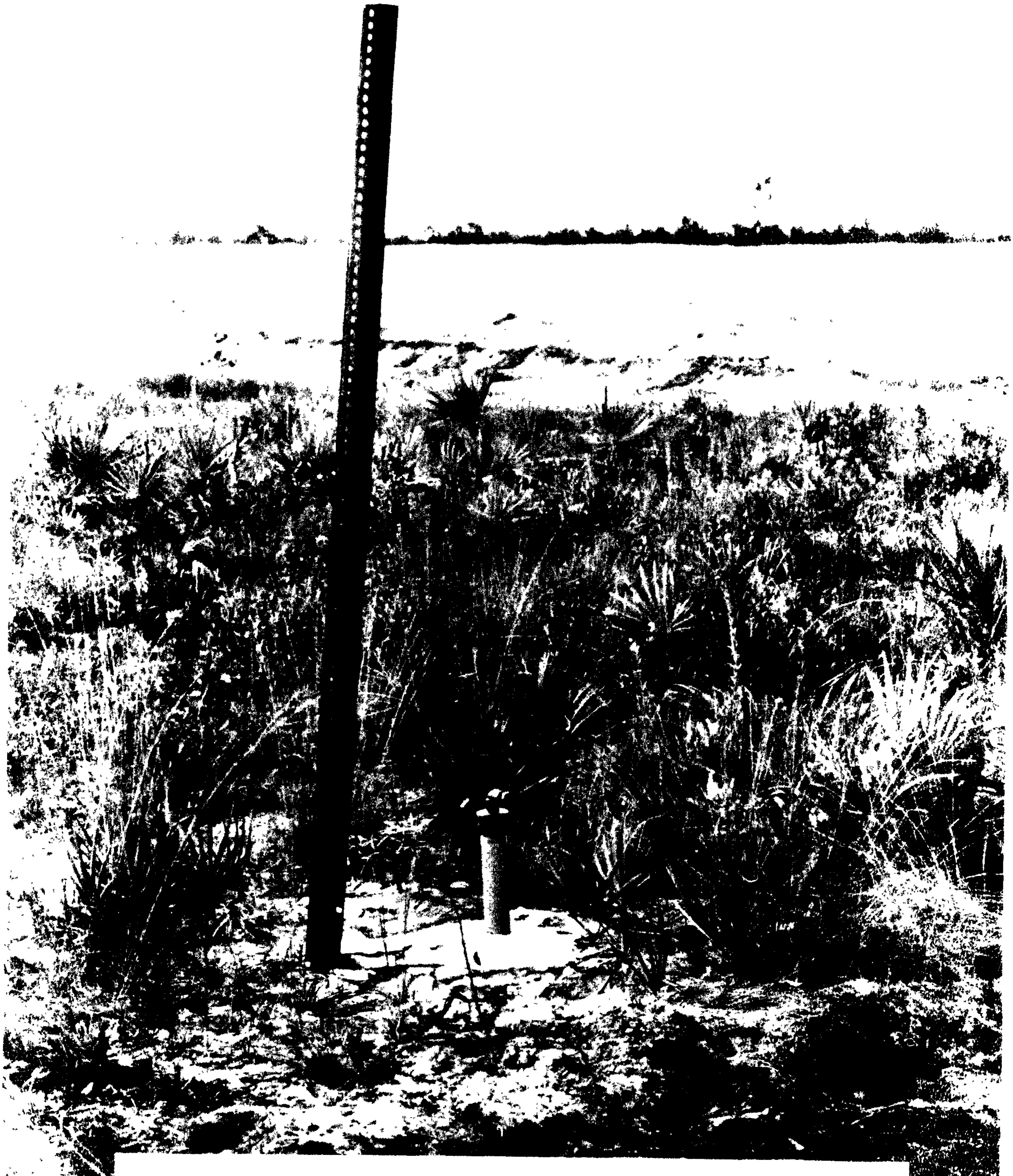

FIGURE 35 Shallow Well for Ground Water Sampling.

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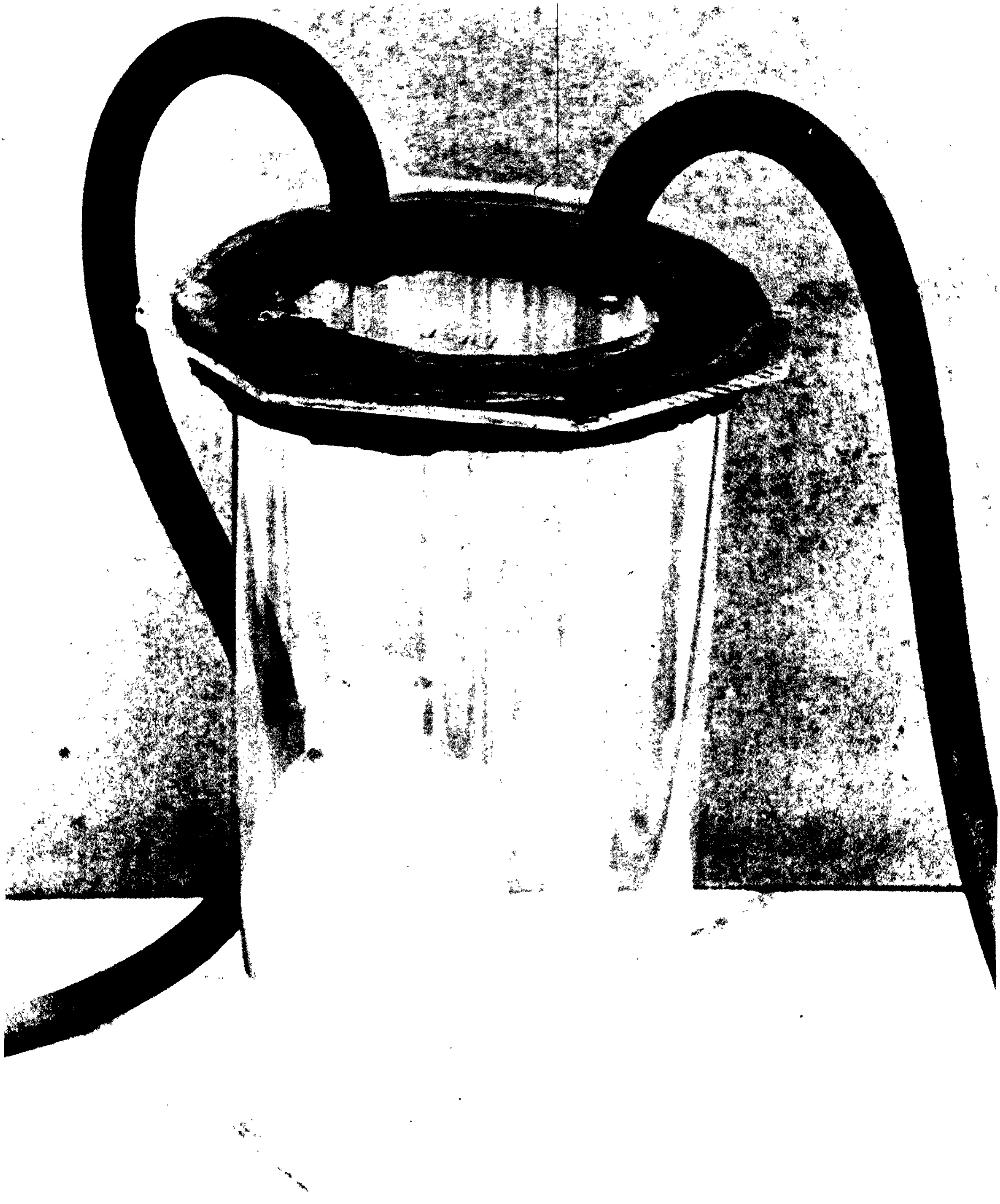

FIGURE 36 Vacuum Chamber for Shallow Well Sampling.

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