TECHNICAL MEMORANDUM

SOUTH DADE AGRICULTURAL PILOT STUDY

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INTRODUCTION

The South Dade Agricultural Pilot Site in southern Dade County, Florida consists of approximately 147 square miles of agriculture and residential development (Figure 1). The Biscayne Aquifer underlies the entire pilot site area and is the primary source of fresh water for southern Dade County. The East Everglades Area, where the pilot site is located, is a groundwater recharge area for the unconfined Biscayne Aquifer in south Dade County.

Prompted by the Department of Environmental Regulation and the Water Quality Assurance Act of 1983, the South Florida Water Management District initiated the study of the South Dade Agricultural Pilot Site. The purpose was to investigate the effects of certain agricultural land uses on groundwater quality within the Biscayne Aquifer. This was accomplished by drilling and sampling 21 well sites within the pilot study area.

The sample sites were selected based on the wide variety of typical agricultural use and distinct water quality variations within the pilot study area. The well sites were sampled during August and September of 1984 to establish background values for the agricultural pilot site during months of no farming activities. All water quality samples were evaluated by using the state established surface and groundwater standards for drinking water.

EXISTING DATA

In 1974 the Department of Environmental Resource Management (DERM) was founded as a regulatory agency of Metropolitan Dade County. In the early 1970's, the National Organics Reconnaissance Survey was conducted by DERM to collect data on 15 volatile organic compounds and 12 organochlorine pesticides. During this study, neither pesticide nor herbicide contamination of the Biscayne Aquifer was evident. In 1975 DERM initiated a special groundwater study

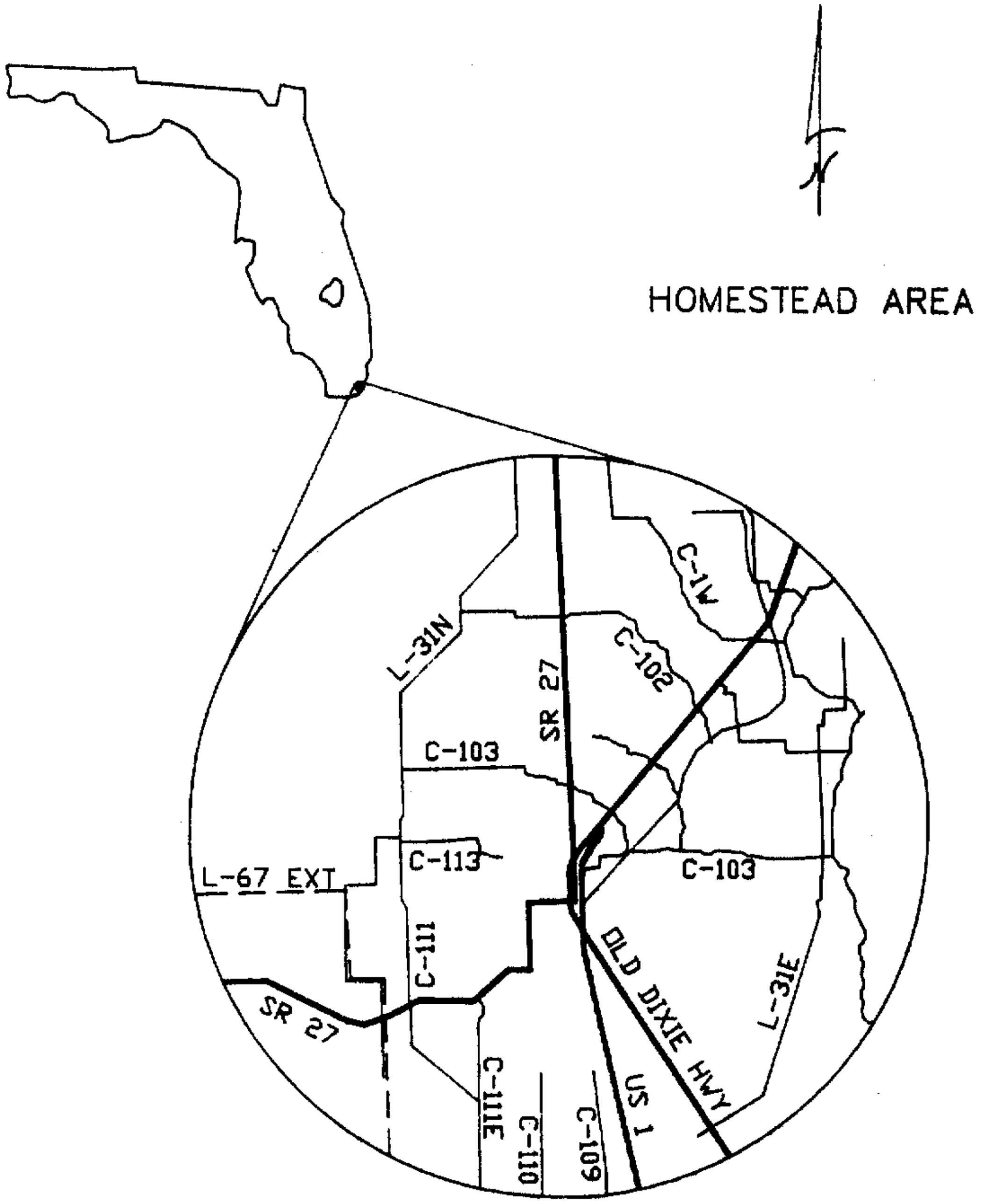

Figure 1. LOCATION OF STUDY AREA, EAST EVERGLADES GROUNDWATER MONITORING PROGRAM

required by the Clean Water Act which included analyses for pesticides, herbicides, trihalomethanes and other volatile organics in the groundwater. During this study, high nitrate values were detected in surface and groundwater in the southern Dade County agricultural areas (Yoder, 1982).

A study entitled "Nutrient Fluctuation in Groundwater Under An Agricultural Area" (1976) by the University of Florida Agricultural Research Center in southwest Dade County illustrated that nitrate-N increased as water in the aquifer traveled through agricultural areas. In that study the average nitrate-N levels were 2 mg/L and the average potassium levels were 5 to 11 mg/L. The data indicated that the highest levels of nitrate-N and potassium occurred in agricultural areas. Baseline water quality monitoring of the East Everglades Resource Planning Project, Work Element IA, (1978), has provided an additional source of groundwater quality data from water samples that have been collected and analyzed by the U.S. Geological Survey in a cooperative effort with the Dade County Planning Department. The effects of certain types of land uses on the quality of groundwater in the east Everglades showed potassium and nitrate concentrations in certain samples higher than background levels. Chlorinated-hydrocarbon insecticide residues were reported higher than background concentrations in agricultural areas (Waller, 1982).

A network was designed by DERM in 1982 to monitor the quality of groundwater and surface water in Dade County during wet and dry seasons. The objectives of that study were to characterize groundwater quality associated with various land uses. Some of the conclusions of this report are that concentrations of the inorganic ions in groundwater reach a maximum level at the end of the dry season and decrease due to dilution during the wet season. Additional sodium and potassium values were higher near seawater-intruded areas. Potassium also showed elevated concentrations, which resulted from fertilizer application in some sites in south Dade. The sulfate concentrations in south Dade were considerably higher due to greater permeability, allowing oxidation of sulfide to sulfate, as well as agricultural enrichment.

LAND USE AND CROP TYPE OF THE AREA

The study area was predominately agricultural land use with the exception of the Homestead and Florida City urban areas. These urban areas are under increasing pressure to expand, at the expense of the adjacent agricultural areas, as agricultural lands are converted to urbanized areas.

Agricultural uses in these areas are characterized primarily by truck crops, occupying about 53,000 planted acres, and a substantial amount of fruit trees, 18,000 planted acres. Together these are the primary activities occurring in the south Dade agricultural area. The total acreage of the 1983 growing season, compared to the 1965 growing season, confirms that the amount of land under cultivation has been relatively constant since the early 1960's with a slight increase in activity in the early 1980's. A dramatic increase in agricultural activity occurred during the 1950's, probably due to improved drainage conditions. The increase in agricultural activity that is taking place in the 1980's follows the recently issued permits in the area west of Levee 31 West. Table 1 contains a historical comparison of approximate acreage planted to truck crops and fruit trees.

The steady increase in truck crops is due to increased tomato, bean, and corn production. Fruit crop production has increased dramatically in the 1980's due to increased avocado production.

The primary truck crops are tomatoes, beans, potatoes, and sweet corn. Other truck crops grown within the study area include cabbage, squash, okra, strawberries, peppers, calabaza, and bonitos. The main fruit crops are avocados,

TABLE 1. - PLANTED ACREAGE

Years	Truck Acres	Fruit Acres	Total Acres
1929	15,200	7,300	22,500
1939	18,800	7,000	25,800
1949	23,900	7,500	31,400
1965	52,200	10,700	62,900
1970	47,300	11,900	59,200
1974	41,000	11,800	52,800
1981	45,500	17,300	62,800
1982	48,200	18,000	66,200
1983	53,000	17,980	70,900

limes, and mangos. Other fruit crops include papaya, lychee, guava, and other subtropical fruits.

The Dade County Agricultural Extension Agent estimates that 80 percent of truck crops and fruit trees is currently under some type of irrigation. Areas planted with fruit trees are generally irrigated using permanent sprinkler systems. Areas planted with row crops are irrigated with large volume portable sprinkler guns which pump one to two thousand gallons per minute from numerous shallow uncased wells which penetrate the top of the Biscayne Aquifer. Some of the agricultural lands are used for more than one truck crop during a given year. The majority of the truck crop production is generally leased land from landowners for the planting of one crop. Both the location and the amount of land planted varies considerably from year to year, with a slight increase almost every year.

The soils within the study area are very low in organic matter and require frequent applications of fertilizer. The soils are very thin and in some areas do not exist; the practice of rock plowing is used in these problem areas. Rock plowing entails scrapping the top of the Biscayne Aquifer with large plows. This breaks up the solid limestone rock. The broken pieces are then worked by large discs until the material is suitable for planting. This process sometimes takes years before a field can be planted. Rock plowing and "ridge and furrow" methods of land preparation (which breaks up the surface layer) enhances the infiltration of rainfall. Further investigation into these land use practices and the impact on groundwater quality will be addressed in future studies by the South Florida Water Management District.

HYDROGEOLOGY OF THE AREA

The Biscayne Aquifer underlies the entire study area and is the only source of fresh groundwater in Dade County. The Biscayne Aquifer slopes downward from west to east. At the western boundary of the study area the aquifer is approximately 30 feet thick and 70 feet thick at the eastern boundary of the study area. In most of Dade County, the upper part of the Biscayne Aquifer is composed of oolitic limestone which thins towards the west as shown in Figure 2. The study area is located in the southern part of Dade County where the Biscayne Aquifer lies nearly at the surface and is composed primarily of highly porous, solution riddled, cavernous limestone. The solution cavities are primarily in a vertical direction, and therefore rainfall infiltrates rapidly to the water table (Parker, 1951).

The second part of the Biscayne Aquifer within the study area is the underlying cavernous limestone (Fort Thompson Formation) which is also highly permeable. Municipal and irrigation wells of high yield (as much as 7,000 gal/min) penetrate the permeable limestone in the lower part of the aquifer (Pitt and others, 1975). The effective porosity ranges in value from 0.10 to 0.35 for the Biscayne Aquifer (Parker, 1951). The higher values are typical of the lower cavernous section of the Biscayne Aquifer. The Biscayne Aquifer has been

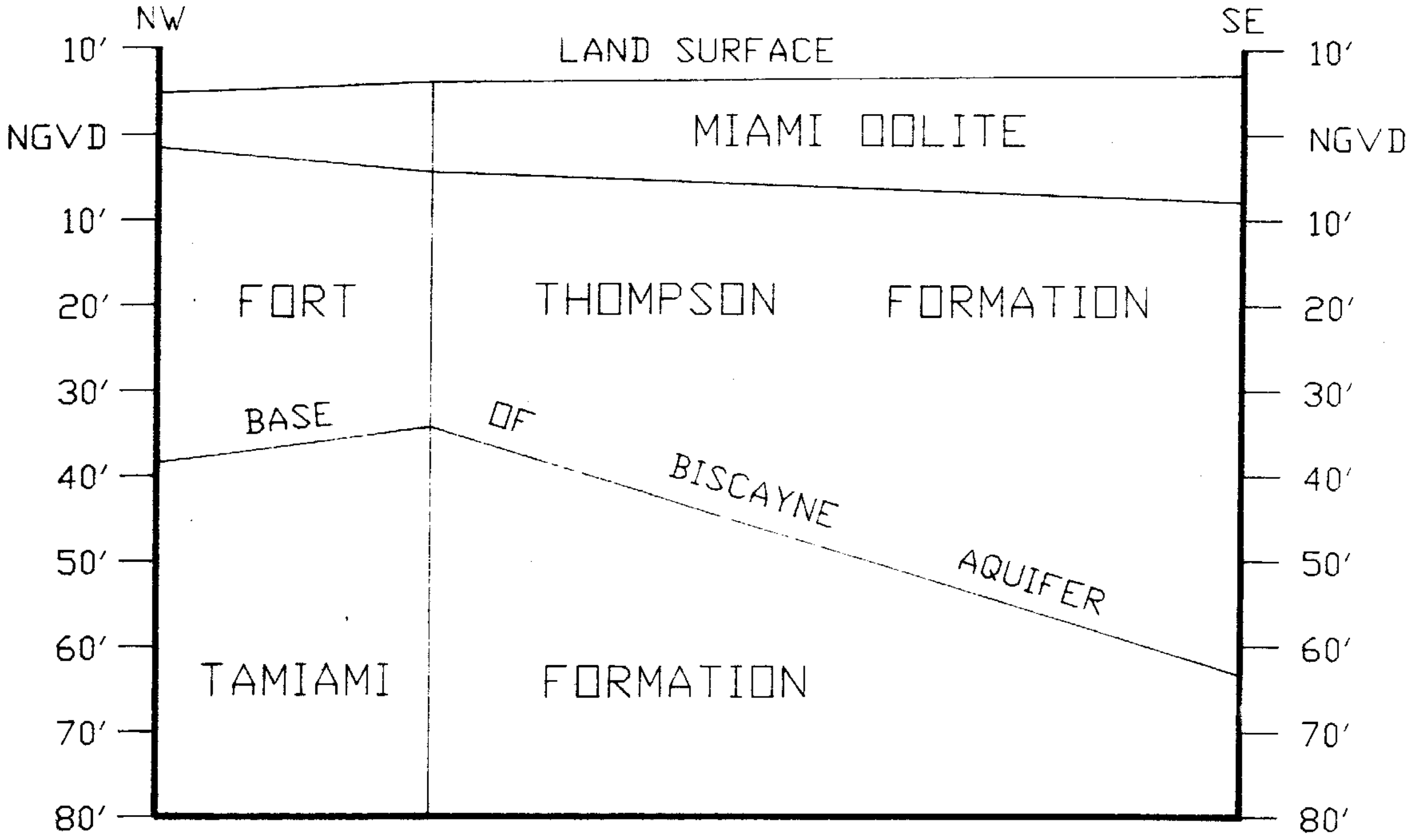

Figure 2. TYPICAL GEOLOGIC SECTION WITHIN STUDY AREA OF THE BISCAYNE AQUIFER (SOUTH DADE COUNTY), MODIFIED FROM WALLER, 1982.

reported to have an average hydraulic conductivity which ranges from 6,700 ft/day to 9,400 ft/day (Parker and others, 1955). Both the Miami Oolite and the Fort Thompson Formation are highly permeable, with transmissivities of one half to 1 million square feet per day (Appel, 1973). The transmissivity values near Homestead are approximately 2.0 million square feet per day (Meyer, 1974).

The recharge is usually highest during September and October (rainy season) and lowest during April and May (dry season). Groundwater recharge occurs both by direct infiltration of rainfall and by leakage from canals when canal stages are higher than the groundwater level. Groundwater discharge from the area is by leakage to the canals when canal stages are lower than groundwater levels, and by evapotranspiration. The Biscayne Aquifer underlies the entire county and, because of the good hydraulic connection between the canals and the aquifer, the canal drainage system in Dade County is a major influence on the movement of groundwater. The effect of the canals decreases with distance from the canals. The rate of groundwater movement is greatest adjacent to the canals, decreasing with distance.

Since groundwater moves down-gradient, the direction of flow within the aquifer system is generally southeast to south in south Dade County. Influence on the movement of groundwater in Dade County is also affected by the large withdrawals from the municipal well fields. The Florida Keys Aqueduct Authority's Navy Wellfield is located within the study area and could possibly influence the groundwater movement.

MONITORING WELL DESCRIPTION

The monitoring network was designed to monitor the groundwater quality within the study area. The monitoring wells were sampled once for the following parameters; field analyses, nutrients, major ions, metals, volatile organics, priority pollutants, and pesticides.

The monitoring wells were sampled as two different sets. The first set consisted of recorder wells used by the U.S. Geological Survey. Eleven of these wells were sampled during the month of August, 1984. The wells are constructed of six inch P.V.C. or steel with a recorder platform on the top of the well head. The casing was usually ten to twenty-five feet deep with several feet of open hole at the bottom of the well. It is important to note that water quality data had not been collected from the first set of wells in the past. These wells were used exclusively for water levels studies. The second set of monitoring wells were water quality wells designed by the U.S. Geological Survey to evaluate the effects of land use on groundwater quality. This set of monitoring well sites were better suited for groundwater quality sampling. The second set of wells were sampled during the month of September, 1984. The wells were rotary drilled in 1978 and were constructed of two inch black iron. They were located at the top or middle of the Biscayne Aquifer, which was usually ten to twenty feet deep within the study area. The wells typically had one to two feet of open hole below the casing. The casing was cement grouted at the top of the well near land surface.

Sampling well locations are described in Table 2 and depicted in Figure 3.

SAMPLE PROCEDURES

The sampling procedures used during the pilot study conformed to the procedures set forth by the Department of Environmental Regulation prior to the commencement of this pilot study.

All sample sites were pumped, using a 2 inch centrifugal pump, until the borehole was evacuated for three overall volumes and a representative sample could be procured.

TABLE 2. - WELL LOCATIONS SOUTH DADE AGRICULTURAL PILOT STUDY

SFWMD Sample Station #	LAT	LONG	USGS Well #	Selection	Township	Range
LEC 04	25 30 56	80 30 53	*C103(6A)	33	56S	38E
LEC 05	25 30 58	80 30 53	*C103(1)	33	56S	38E
LEC 06	25 30 29	80 29 56	S196A	35	56S	38E
LEC 07	24 32 33	80 30 10	G-1353	23	56S	38E
LEC 08	25 35 37	80 28 44	G-757A	01	56S	38E
LEC 09	25 39 53	80 32 14	G-3272	09	55S	38E
LEC 10	24 37 44	80 34 36	G-3273	24	55S	37E
LEC 11	25 36 56	80 35 03	G-1502	25	55S	S7E
LEC 12	24 34 45	80 34 03	*200 ST	06	56S	S8E
LEC 13	25 34 45	80 34 03	*200 ST	06	56S	S8E
LEC 14	25 30 42	80 29 40	*C103(12A)	33	56S	S8E
LEC 22	25 39 07	80 31 43	G-3189	16	55S	38E
LEC 23	25 38 42	80 31 43	G-3187	15	55S	38E
LEC 24	25 36 30	80 31 18	G-3201	28	55S	38E
LEC 25	25 36 56	80 35 03	G-3204	25	55S	37E
LEC 26	25 35 30	80 34 32	G-3124	01	56S	38E
LEC 27	25 35 10	80 32 07	G-3198	04	56S	38E
LEC 28	25 31 12	80 34 15	G-3175	30	56S	38E
LEC 29	25 30 18	80 34 12	G-3177	31	56S	38E
LEC 30	25 29 48	80 34 18	G-3117	01	57S	37E
LEC 31	25 29 48	80 35 27	RECORDER	01	57S	37E
LEC 32	25 24 13	80 33 58	G-3184	06	58S	38E

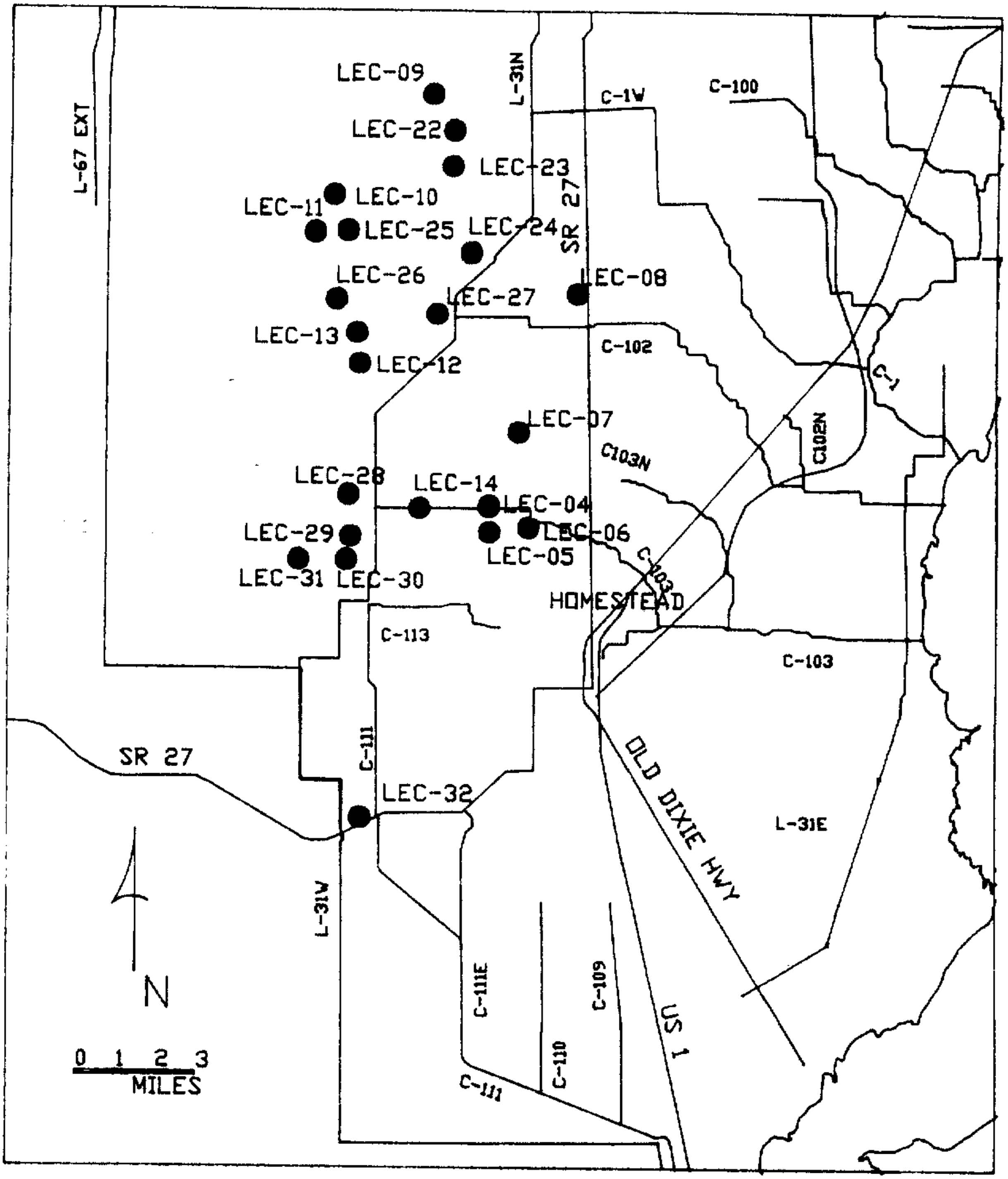

Figure 3. SAMPLE LOCATIONS
SOUTH DADE AGRICULTURAL PILOT SITE

Sampling was initiated after pumping using a portable Masterflex sampling pump. Specific conductance, temperature, alkalinity, and pH measurements were performed on unfiltered samples in the field. After field measurements, three unfiltered samples were collected to analyze for fluoride, total trace metals, total nutrients, and other physical determinations. Following the unfiltered samples, a 0.45 micron filter was used to collect five samples which were analyzed for major cations and anions, total dissolved solids, nutrients, and trace metals. All samples were analyzed by the South Florida Water Management District's water chemistry lab. In addition to the above mentioned inorganic sampling, a Teflon bailer was used to collect water quality samples for organic analyses. Four septum vials were collected at each sampling site and were analyzed by the laboratory at the University of Miami, School of Medicine. The first set of groundwater quality samples were collected in mid August 1984. The samples were analyzed for total organic carbon, volatile organic carbon, and priority pollutants, which include purgeable compounds, base/neutral extractable, acid extractable, and pesticide extractable. The second set of samples were collected in mid September 1984. The samples were analyzed for total organic carbon and the purgeable compounds. All samples taken were immediately marked, tagged, and placed on ice.

RESULTS OF WATER QUALITY ANALYSES

Results from the South Dade Agricultural Pilot Study suggest that past agricultural activity has impacted the water quality within the Biscayne Aquifer. The laboratory analyses showed that only pesticides once used in the agricultural area were still persistent in the groundwater. Table 3 consists of a list of positive results from the pesticide extractable group for the 130 organic compounds on the EPA priority pollutant list.

TABLE 3. - PRIORITY POLLUTANT
ANALYTICAL RESULTS
August 1984
All Values are in Parts Per Trillion

Sample Station	Parameter	Results
LEC-04	Aldrin	2.4 ppt
LEC-05	Aldrin	2.7 ppt
LEC-06	None	
LEC-07	*Aldrin	5.8 ppt
LEC-08	Aldrin Methoxychlor	4.45 ppt 11.50 ppt
LEC-09	*Aldrin	4.7 ppt
LEC-10	None	
LEC-11	None	
LEC-12	None	
LEC-13	*Aldrin	7.2 ppt
LEC-14	*4,4'-DDT *Dieldrin Alpha-BHC	12.0 ppt 8.5 ppt 1.30 ppt

* Above Established Surface or Groundwater Drinking Standard

CLASS I: Potable Surface
Water Standards

Aldrin	3.0 ppt
DDT	1.0 ppt
Dieldrin	3.0 ppt
Methoxychlor	30.0 ppt

Priority pollutant analyses were performed only on the first set of samples listed on Table 2. Some of these pesticides have been banned from use in the United States because of the long persistence time within the environment and groundwater. All of the positive results for the pesticide compounds that were reported were evaluated using the criteria established by the Florida Department of Environmental Regulation (DER) for safe drinking water. The laboratory results indicated the presence of 4,4'-DDT, Aldrin, and Dieldrin in groundwater in excess of the class IA potable surface water quality standard set by the DER. The values that were reviewed by DER in an Interoffice Memorandum dated March 5,1986, indicated that no immediate and significant public health threat existed for any pesticide compound detected. The surface water quality standards for potable water were used to put the groundwater quality data in perspective because groundwater standards do not exist for the above mentioned compounds. This project used drinking water standards to evaluate shallow groundwater quality samples obtained from wells located directly in agricultural areas. The reason for using the drinking water standards was to compare results with background values obtained from areas outside the influence of agriculture. The agricultural activity near the sampling sites has been in practice for a long period of time and one might expect to see some evidence of impact on the water quality. All water quality data are listed in Appendix 1.

The trace metals that were monitored for this pilot study indicate some impact on groundwater quality by agricultural activity. Water quality values obtained from the South Dade Pilot Site were compared with the DER drinking water standards to evaluate any health concerns. All but three samples were below acceptable Primary Drinking Water Standards (FAC 17-22). Samples marked LEC-22, LEC-23 and LEC-31 had trace metal values that exceeded the maximum allowable concentrations established by the DER potable groundwater. Water sample LEC-31 showed an exceedingly high value of total lead (603.5 micrograms per liter). This well site was an old recorder well used by the U.S. Geologic Survey. Years of vandalism to this facility by gun fire has caused this site to be abandoned. Lead projectiles from target practice activity is one possible explanation for the high lead values in this well. High lead concentrations were not found at any of the other water quality monitoring location.

Contamination of the other two wells could be considered a result of agricultural activity. The analyses show elevated manganese levels above the DER potable groundwater standards. Both wells are located in an area of Latin vegetables at the northern boundary of the pilot site. Elevated copper, iron, and zinc values are detected in the groundwater at the northern section of the agricultural activity. It should be noted that the groundwater flows in a northwest to southeast direction within the northern part of the pilot site. This would indicate that the immediate area surrounding sample sites LEC-22, LEC-23, and LEC-24 are a possible source of the elevated values.

All other parameters indicated few impacts of agricultural activities on water quality within the study area. This could be attributed to the fact that the Biscayne Aquifer has the ability to "flush" itself of lighter elements during times of heavy rainfall. Certain compounds also interact with the Aquifer materials and may not be flushed as easily.

The concentration of major cations and anions show some fluctuations but are relatively the same throughout the agricultural area. Sample locations LEC 09, 10, 11, and 25, which are located on the western side of the study area, show lower concentrations of cations. This area is not farmed. This area is also characterized by a shallow carbonate aquifer with localized recharge.

It is important to note that in order to properly detail water quality variations with time, additional water quality data must be collected and analyzed.

MODEL OF CHEMICAL MOVEMENT

Computer modeling of the different pesticide compounds used within the South Dade agricultural area would be useful in determining contamination potential. Runoff and leaching are the two major mechanisms for pesticides to reach surface water and groundwater. Runoff is the process of transporting pollutants over the surface by rainwater that does not penetrate the soil. Leaching is the mechanism whereby pollutants are flushed through the soil by rain or irrigation water moving downward through the subsurface. Within the South Dade Pilot Study area the leaching is likely to be a more serious problem than runoff due to the lack of relief. The soils are very thin and permeable creating a high potential for leaching into the groundwater.

Two properties control the fate of pesticides applied to soils - persistence and solubility. Persistence is defined as the "lasting power" of a pesticide compound. Solubility is the "movement with water" of each pesticide compound. As pesticides are applied to the different crop types, various changes may occur to the compound. It may move downward in the soil and either adhere to particles or dissolve. Pesticides may be leached out of the root zone by rain or irrigation water. Once washed out of the root zone the potential of reaching the groundwater exists. However, there is still the potential for the breakdown of the pesticide either by biological activity or vaporization.

In order to define a pesticide compound's movement within the soil and groundwater, computer models are used to simulate the actual field conditions. The field conditions have been generalized and defined using existing data to model these compounds. The particular model used for this pilot study ("Chemical Movement in Soil," Nafziger and Hornsby) is a basic model used to calculate the movement potential of various pesticide compounds in the root zone. The model estimates the location of the leading edge of a non-polar organic chemical as it moves downward in the soil. The model also determines the relative amount of the applied organic chemical remaining in the soil as a function of time. This model was very limited because application rates and quantities were not used within the calculation process, many of the presently used compounds were not contained within the model's data base, and varying field practices were not taken into consideration.

Additional models are presently being evaluated for their utility within this study site. Rainfall events and irrigation are the major components that drive the movement of chemical compounds in the soil. The purpose of this modeling effort was to determine the relative amount of organic chemical retained by the soil and the amount of time needed for the non-absorbed solute to possibly reach the groundwater.

One modeling scenario within the South Dade Pilot Site is shown in Figures 4-7. The pesticide compound Lindane is presently being used within the agricultural community as an insecticide and has been detected by other studies, but not by this study. This insecticide is used on fruits and vegetables, (mainly on avocados in the south Dade area). Figure 4 illustrates modeling results for 1984 and assumes a shallow root depth. The actual root depth is an important factor in the amount of non-absorbed solute reaching the groundwater. Figure 4 suggests that the non-absorbed solute could possibly reach the groundwater within 50 days after application. Figure 5 depicts a similar environment but with a greater root depth, similar to south Dade avocado production. Figure 5 indicates the potential for the chemical compound reaching the groundwater within 150 days after application. Lindane was not detected possibly due to sampling on a one time basis only.

Another scenario is shown using the compound Aldrin. This compound was used as an insecticide for row crops and fruit trees in the 1960's and early 1970's. Aldrin was detected but was banned for use (except for termit control) in 1974. Aldrin was then completely banned from use in the United States in 1977. Figure 6 illustrates that the non-absorbed solute could reach the groundwater within 30 days after application. Figure 7 illustrates that a greater root depth would not affect this pesticide compound as (Aldrin) much as Lindane. The non-absorbed solute could reach the groundwater within 90 days after application.

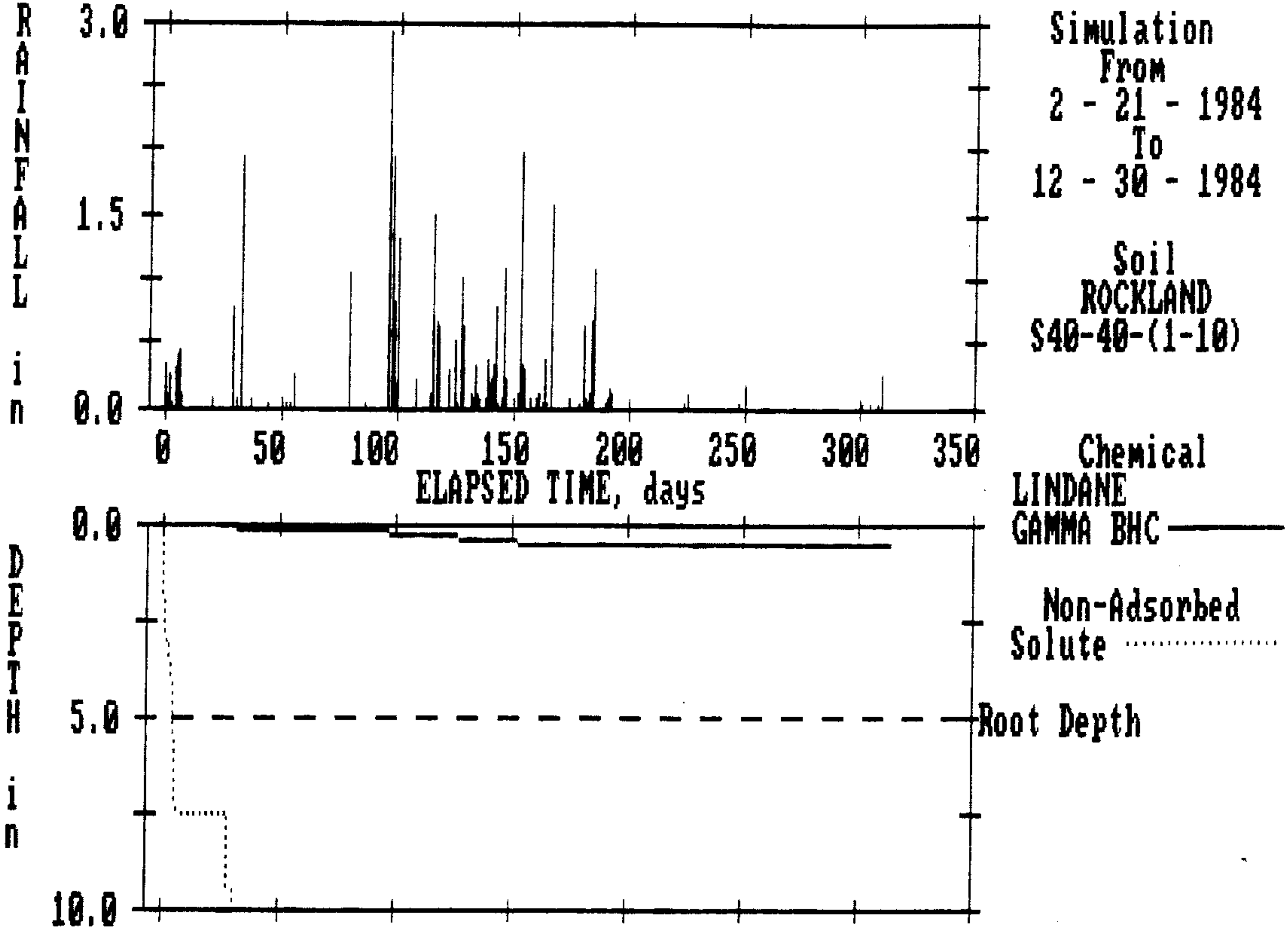

Figure 4. RAINFALL AND DEPTH OF CHEMICAL AS A FUNCTION OF TIME AFTER APPLICATION.

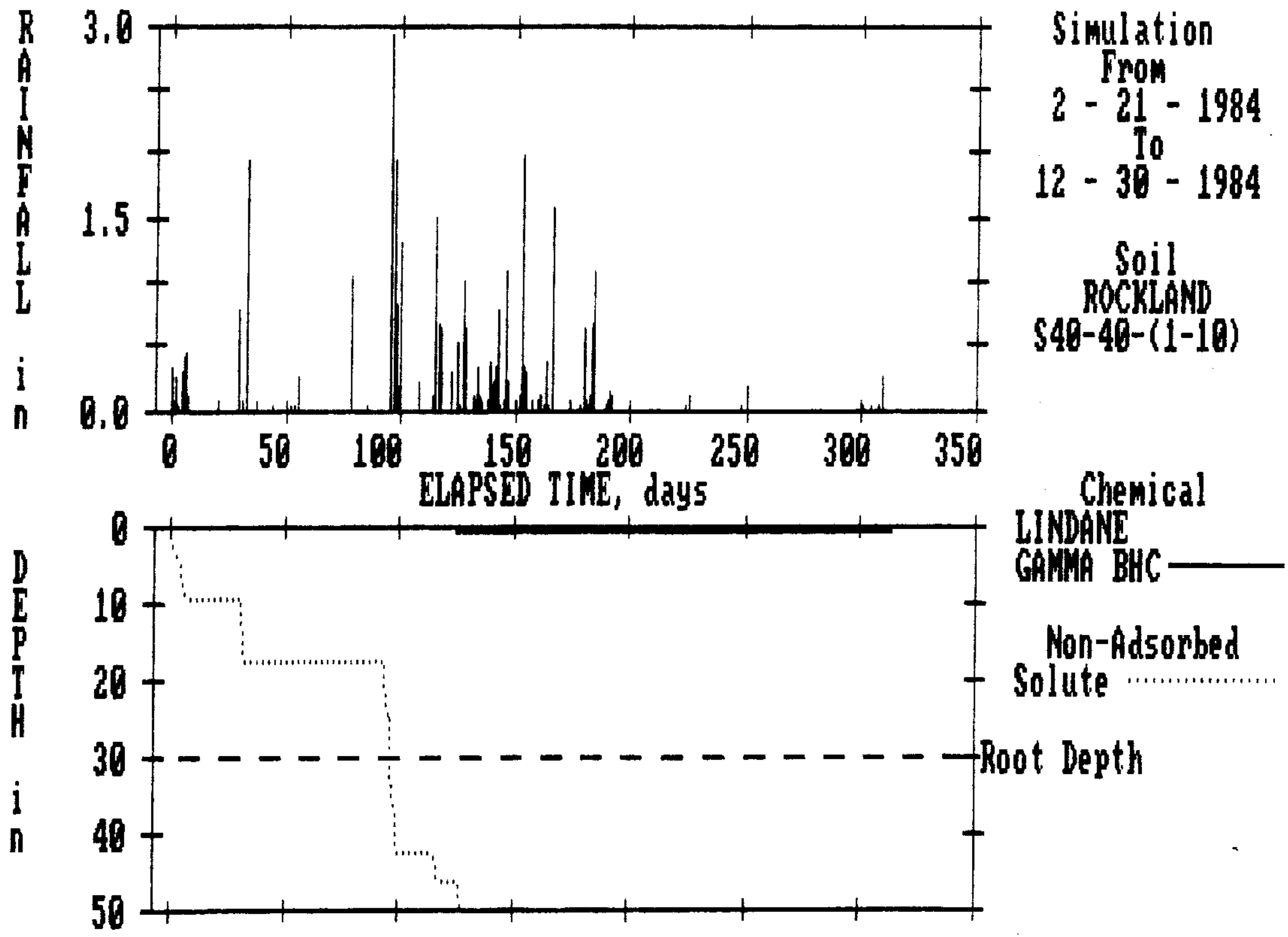

Figure 5. RAINFALL AND DEPTH OF CHEMICAL AS A FUNCTION OF TIME AFTER APPLICATION.

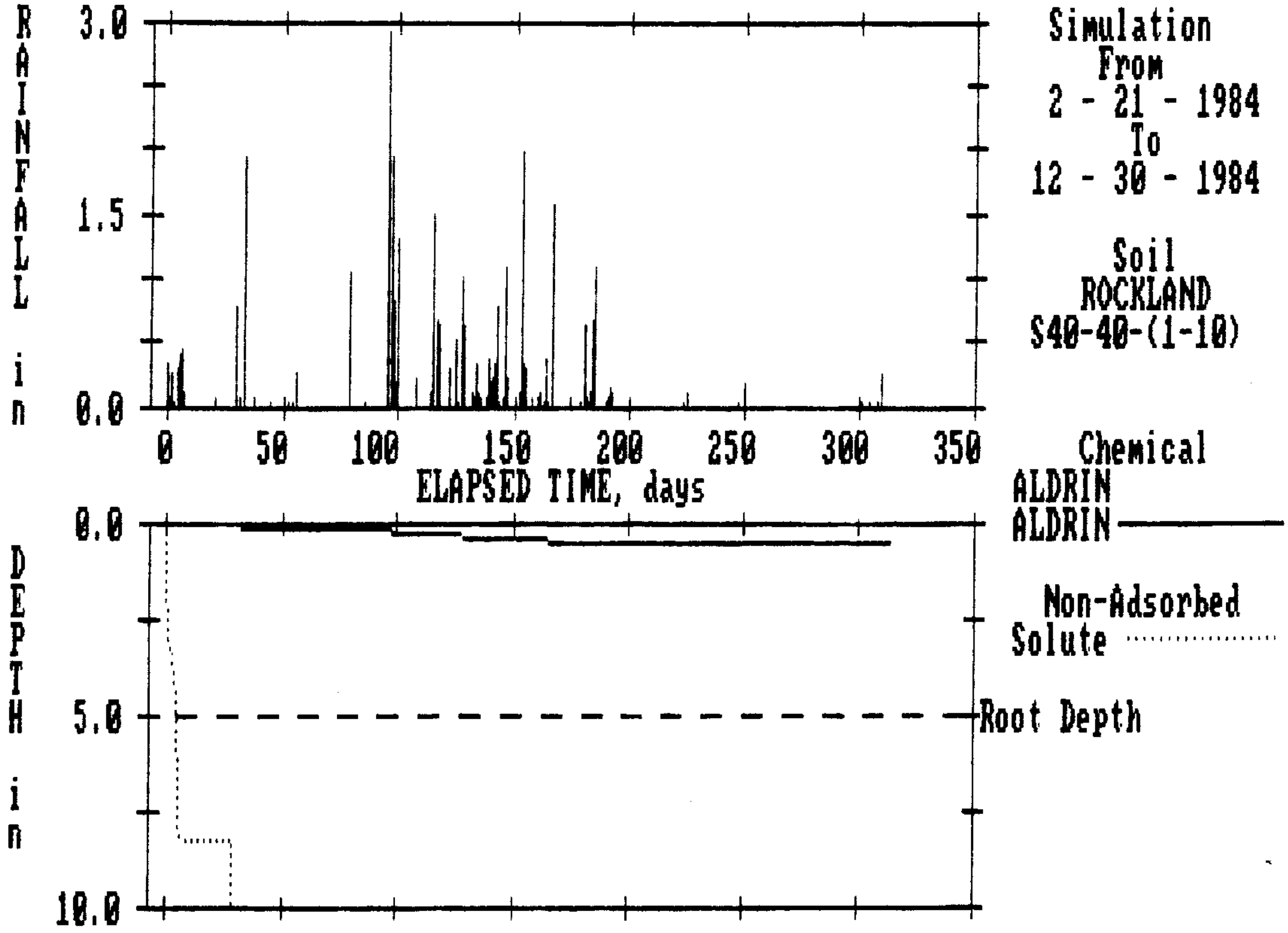

Figure 6. RAINFALL AND DEPTH OF CHEMICAL AS A FUNCTION OF TIME AFTER APPLICATION.

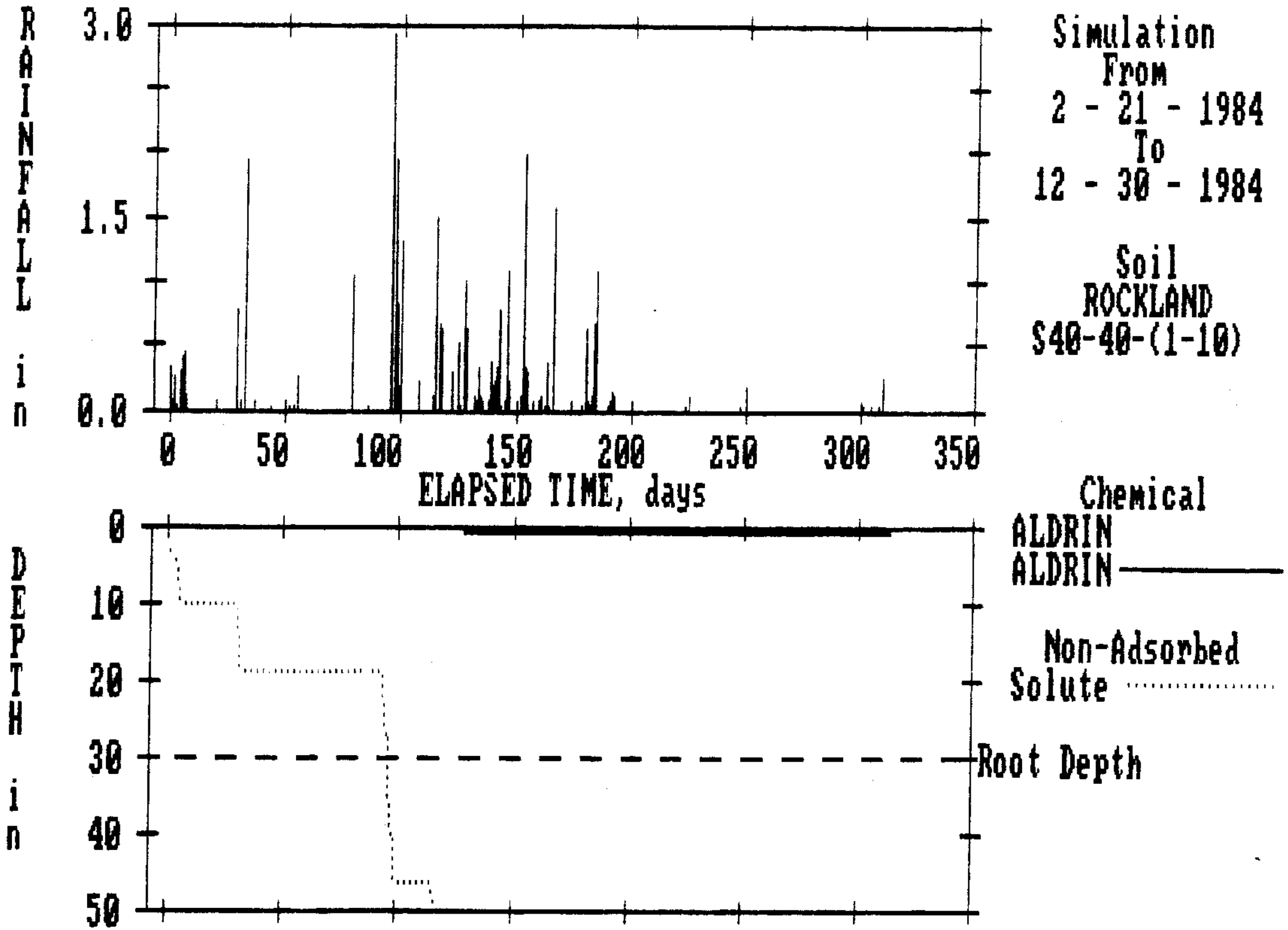

Figure 7. RAINFALL AND DEPTH OF CHEMICAL AS A FUNCTION OF TIME AFTER APPLICATION.

The pesticide compounds that were addressed by this pilot study were determined by formal contractual agreement with the DER. This pilot study does not totally reflect the pesticide compounds that are presently being used within the study area. However, the compounds were modeled in an attempt to evaluate their potential for detection within the groundwater. Further studies will model a number of the more common pesticide compounds currently being used.

DISCUSSION AND SUMMARY

The growing awareness of groundwater quality within the south Dade agricultural community prompted this pilot study. The pilot study was designed to characterize the water quality from an agricultural area. For this project the network was sampled only once; further sampling is required to identify any trends.

Short term evaluation indicated only localized impact on groundwater quality from agricultural activity. Slight elevations of inorganic parameters and trace metals, along with the occurrence of trace amounts of relic pesticides, were the only indication of water quality degradation by farming.

The flow direction within the study area is south to southeast. Previous studies have indicated that the shallow Biscayne Aquifer is controlled to some extent by the canal systems. Canals act as a source of both discharge and recharge to the aquifer during different times of the year. The canal systems would also help flush the aquifer of contaminants.

Infiltration rates within the study area indicate direct recharge to the Biscayne Aquifer. Rainfall and irrigation can cause contaminants to be leached into the groundwater. Modeling efforts illustrate the potential for non-absorbed solute to reach the water table.

This was the first effort by the South Florida Water Management District to initiate a groundwater quality study within south Dade County.

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APPENDIX I

WATER QUALITY

WATER QUALITY ANALYSIS

SOUTH DADE PILOT SITE

	Temp Cent	Sp Cond µmhos/cm	Lab Cond µmhos/cm	Lab pH	T Dis Sd Mg/L
LEC-04	24.90	587.0	510.0	7.55	340.0
LEC-05	28.00	596.0	510.0	7.72	342.0
LEC-06	26.10	558.0	505.0	7.50	331.0
LEC-07	26.80	687.0	645.0	7.53	414.0
LEC-08	27.50	656.0	590.0	7.47	394.0
LEC-09	24.60	400.0	400.0	7.58	254.0
LEC-10	24.70	517.0	495.0	7.45	309.0
LEC-11	23.00	581.0	565.0	7.63	181.0
LEC-12	24.30	517.0	493.0	7.65	281.0
LEC-22	25.20	437.0	428.0	7.71	260.0
LEC-23	24.40	474.0	470.0	7.74	305.0
LEC-24	24.80	415.0	435.0	7.61	257.0
LEC-25	23.50	667.0	605.0	7.57	377.0
LEC-26	25.90	500.0	489.0	7.71	309.0
LEC-27	24.20	668.0	670.0	7.66	393.0
LEC-28	25.90	431.0	408.0	7.66	235.0
LEC-29	26.40	400.0	415.0	7.63	238.0
LEC-30	24.60	399.0	398.0	7.65	234.4
LEC-31	25.60	383.0	375.0	7.61	230.0
LEC-32	24.00	528.0	530.0	7.66	308.7
STDS*	- -	- -	- -	6.5 min	500

*STDS - DER Drinking Water Standards

WATER QUALITY ANALYSIS

SOUTH DADE PILOT SITE

	Na Mg/L	K Mg/L	Ca Mg/L	Mg Mg/L	Cl Mg/L	Alk CaCo$_3$ Mg/L
LEC-04	33.30	1.47	76.60	4.80	46.8	220.0
LEC-05	31.00	1.63	105.90	5.90	45.9	215.0
LEC-06	24.10	3.52	79.70	2.00	33.9	204.0
LEC-07	25.40	8.37	104.60	2.80	47.7	221.0
LEC-08	33.10	8.79	97.30	2.70	47.5	216.0
LEC-09	12.00	.23	67.90	1.80	24.2	181.0
LEC-10	21.60	.20	82.20	2.30	31.5	221.0
LEC-11	14.30	.61	46.30	.90	18.8	120.0
LEC-12	31.40	1.92	70.40	6.10	38.6	205.0
LEC-22	10.80	.20	81.10	3.70	21.1	188.0
LEC-23	11.00	1.23	93.60	4.30	18.6	222.0
LEC-24	10.70	.34	85.30	3.50	18.0	205.0
LEC-25	30.90	2.09	95.20	4.80	55.0	217.0
LEC-26	23.00	2.63	66.60	9.80	38.8	195.0
LEC-27	42.50	5.43	85.20	9.90	63.7	218.0
LEC-28	11.80	.24	79.80	3.10	18.7	193.0
LEC-29	10.50	1.38	79.70	3.00	16.0	190.0
LEC-30	10.00	.30	77.90	2.80	15.9	190.0
LEC-31	9.00	.28	76.30	2.30	14.0	183.0
LEC-32	20.70	6.11	87.60	4.50	33.4	194.0
STDS*	160	- -	- -	- -	250	- -

*STDS - DER Drinking Water Standards

WATER QUALITY ANALYSIS

SOUTH DADE PILOT SITE

	SO_4	NO_x	NO_2	NH_4	TKN	TDKN
LEC-04	5.20	.007	.004	.32	1.11	1.11
LEC-05	11.50	.005	.006	.21	.97	.88
LEC-06	15.10	1.789	.017	.00	.33	.56
LEC-07	61.90	1.626	<.004	.00	.68	.20
LEC-08	31.00	4.102	<.004	.00	.20	.20
LEC-09	<2.00	<.004	<.004	.46	.51	.38
LEC-10	<2.00	<.004	<.004	.47	.65	.62
LEC-11	<2.00	.016	.015	.10	.58	.20
LEC-12	4.60	.005	<.004	.30	.20	.20
LEC-22	4.60	.030	.005	.34	.36	1.16
LEC-23	4.30	.004	<.004	.40	.79	2.66
LEC-24	3.70	.010	<.004	.31	.88	.70
LEC-25	10.40	.007	<.004	.18	.66	1.07
LEC-26	3.80	.004	<.004	.22	.94	1.67
LEC-27	29.10	.006	.006	.13	.68	.60
LEC-28	3.70	.014	.007	.26	.84	1.05
LEC-29	5.80	.015	<.004	.23	1.59	1.03
LEC-30	4.30	.007	.006	.28	1.62	.94
LEC-31	4.70	.007	<.004	.19	4.47	1.50
LEC-32	19.30	.031	<.004	.05	.72	.45
STDS*	250	- -	10	- -	- -	- -

*STDS - DER Drinking Water Standards

WATER QUALITY ANALYSIS

SOUTH DADE PILOT SITE

	OPO_4 Mg N/L	TPO_4 Mg N/L	$TDPO_4$ Mg N/L	PART.P Mg N/L	PART.N Mg N/L
LEC-04	<.004	.006	<.004	<.004	<.004
LEC-05	<.004	.009	.005	.004	.004
LEC-06	<.004	<.004	<.004	<.004	<.004
LEC-07	<.004	<.004	<.004	<.004	<.004
LEC-08	.007	.007	<.004	<.004	<.004
LEC-09	<.004	.007	.006	<.004	<.004
LEC-10	<.004	.011	.009	<.004	<.004
LEC-11	<.004	.029	.044	- -	- -
LEC-12	<.004	<.004	<.004	<.004	<.004
LEC-22	<.004	.017	.009	.008	.008
LEC-23	.005	.030	.008	.022	.022
LEC-24	<.004	.005	<.004	<.004	<.004
LEC-25	.061	.142	.110	.032	.032
LEC-26	.007	.009	.008	<.004	<.004
LEC-27	<.004	.008	<.004	.004	.004
LEC-28	<.004	.005	<.004	<.004	<.004
LEC-29	<.004	.033	.009	.024	.024
LEC-30	<.004	.007	.026	- -	- -
LEC-31	.004	.155	.024	.131	.131
LEC-32	<.004	.005	<.004	<.004	<.004
STDS*	- -	- -	- -	- -	- -

***STDS - DER Drinking Water Standards**

WATER QUALITY ANALYSIS

SOUTH DADE PILOT SITE

	Total HG Microg/L	Total CD Microg/L	Total CU Microg/L	Total ZN Microg/L	Total AS Microg/L	Total PB Microg/L
LEC-04	<.148	<.159	<.394	16.00	<.678	<.606
LEC-05	<.148	<.159	1.442	17.00	6.348	2.086
LEC-06	<.148	<.159	1.023	28.00	.695	1.273
LEC-07	<.148	<.159	.463	31.00	<.678	.948
LEC-08	<.148	<.159	.603	21.00	<.678	.432
LEC-09	<.148	<.159	8.715	25.00	.695	2.249
LEC-10	<.148	<.159	.394	[illegible]1.00	<.678	15.909
LEC-11	<.148	<.159	.394	23.00	<.678	4.851
LEC-12	<.148	<.159	.394	16.00	.695	.606
LEC-22	<.160	<.183	1.850	20.00	<.678	5.170
LEC-23	<.160	<.183	2.661	23.00	1.401	<.513
LEC-24	<.160	<.183	14.491	27.00	1.401	<.513
LEC-25	<.160	<.183	<.437	6.00	1.401	<.513
LEC-26	<.160	<.183	<.437	38.00	.695	.700
LEC-27	<.160	<.183	<.437	15.00	1.048	<.513
LEC-28	<.160	<.183	<.437	49.00	<.678	5.633
LEC-29	<.160	<.183	1.734	55.00	.775	<.513
LEC-30	<.160	<.183	<.437	30.00	<.678	<.513
LEC-31	<.160	<.183	24.928	78.00	<.678	603.543
LEC-32	<.160	<.183	.458	122.00	<.678	<.513
STDS*	2.0	10	1000	5000	50	50

*STDS - DER Groundwater Drinking Standards

WATER QUALITY ANALYSIS

SOUTH DADE PILOT SITE

	Total CR Microg/L	Total MN Microg/L	Total NI Microg/L
LEC-04	- -	- -	- -
LEC-05	- -	- -	- -
LEC-06	- -	- -	- -
LEC-07	- -	- -	- -
LEC-08	- -	- -	- -
LEC-09	- -	- -	- -
LEC-10	- -	- -	- -
LEC-11	- -	- -	- -
LEC-12	- -	- -	- -
LEC-22	2.169	66.579	.865
LEC-23	12.560	41.302	1.899
LEC-24	10.599	56.019	7.758
LEC-25	3.738	17.502	<.672
LEC-26	1.041	10.946	<.672
LEC-27	.404	10.551	<.672
LEC-28	.698	8.418	.865
LEC-29	2.855	10.867	<.672
LEC-30	1.286	14.343	<.672
LEC-31	7.317	15.606	<.672
LEC-32	4.718	10.393	<.672
STDS*	50	50	- -

*STDS - DER Drinking Water Standards

WATER QUALITY ANALYSIS

SOUTH DADE PILOT SITE

	TDISS HG Microg/L	TDISS CD Microg/L	TDISS CU Microg/L	TDISSl ZN Microg/L	TDISS AS Microg/L	TDISS PB Microg/L
LEC-04	<.148	<.190	<.354	18.000	4.852	<.526
LEC-05	<.148	<.190	<.354	13.000	6.086	<.526
LEC-06	<.148	<.190	3.451	20.000	<.816	.869
LEC-07	<.148	.229	.774	17.000	<.816	<.526
LEC-08	<.148	.395	1.220	14.000	<.816	<.526
LEC-09	<.148	<.190	<.354	17.000	<.816	<.526
LEC-10	<.148	.436	<.354	17.000	<.816	<.526
LEC-11	<.148	.229	<.354	6.000	<.816	<.526
LEC-12	<.148	<.190	<.354	15.000	<.816	1.014
LEC-22	<.160	<.183	<.354	16.000	<.816	<.526
LEC-23	<.160	<.183	1.488	11.000	<.816	<.526
LEC-24	<.160	<.183	<.354	12.000	<.816	<.526
LEC-25	<.160	<.183	<.354	7.000	.943	<.526
LEC-26	<.160	<.183	<.354	7.000	<.816	1.302
LEC-27	<.160	<.183	<.354	7.000	.943	<.526
LEC-28	<.160	<.183	<.354	13.000	<.816	<.526
LEC-29	<.160	<.183	<.354	7.000	.943	<.526
LEC-30	<.160	<.183	<.354	6.000	<.816	<.526
LEC-31	<.160	<.183	<.354	9.000	<.816	27.271
LEC-32	<.160	<.183	<.354	4.000	1.354	<.526
STDS*	- -	- -	- -	- -	- -	- -

*STDS - DER Drinking Water Standards

WATER QUALITY ANALYSIS

SOUTH DADE PILOT SITE

	TDISS CR Microg/L	TDISS SR Mg/L	TDISS MN Microg/L	TDISS NI Microg/L	TDISS FE Mg/L	Total FE Mg/L
LEC-04	<.186	1.500	- -	- -	1.63	1.25
LEC-05	<.186	16.500	- -	- -	2.50	2.19
LEC-06	<.186	16.800	- -	- -	<.01	<.02
LEC-07	<.186	1.800	4.470	- -	.04	.03
LEC-08	<.186	2.060	- -	- -	.03	.05
LEC-09	<.186	1.920	- -	- -	.72	.67
LEC-10	<.186	1.760	- -	- -	.78	.63
LEC-11	<.186	.640	- -	- -	3.77	3.30
LEC-12	<.186	.900	- -	- -	.46	.43
LEC-22	.596	.660	26.293	<.523	1.66	7.20
LEC-23	.248	.740	24.591	<.523	1.77	7.17
LEC-24	.209	.620	15.358	<.523	.97	1.88
LEC-25	<.186	.810	17.144	<.523	.80	2.97
LEC-26	<.186	.700	12.551	<.523	.33	.37
LEC-27	<.186	.790	12.551	<.523	.91	.95
LEC-28	<.186	.630	9.318	<.523	.54	.60
LEC-29	<.186	.690	8.298	<.523	- -	1.37
LEC-30	<.186	.590	6.341	<.523	- -	.76
LEC-31	.286	.530	12.296	<.523	- -	1.21
LEC-32	<.186	.890	7.532	<.523	- -	.32
STDS*	- -	- -	- -	- -	- -	- -

*STDS - DER Drinking Water Standards

RESULTS FOR SFWMD/TOC

Sample Number	Well Number	X TOC (mg/L)	Date Sampled
LEC-04	C-103 6A	11.9	8/08/84
LEC-05	C-103 1	10.1	8/08/84
LEC-06	S-196A	7.1	8/08/84
LEC-07	G-1363	3.9	8/08/84
LEC-08	G-757A	2.3	8/08/84
LEC-09	G-3272	6.1	8/09/84
LEC-10	G-3273	12.3	8/09/84
LEC-11	G-1502	5.3	8/09/84
LEC-12	200 St.	4.6	8/09/84
LEC-13	200 St.	5.4	8/09/84
LEC-14	C-103 12A	7.5	8/09/84
LEC-22	G-3189	5.4	9/20/84
LEC-23	G-3187	5.1	9/20/84
LEC-24	G-3201	5.2	9/20/84
LEC-25	G-3204	6.9	9/21/84
LEC-26	G-3124	6.4	9/21/84
LEC-27	G-3198	4.9	9/21/84
LEC-28	G-3175	4.7	9/21/84
LEC-29	G-3177	4.2	9/21/84
LEC-30	G-3117	4.4	9/21/84
LEC-31	RECORDER	6.6	9/21/84
LEC-32	G-3184	4.8	9/21/84

APPENDIX II

PRIORITY POLLUTANT LIST

LIST OF 130 ORGANIC COMPOUNDS ON PRIORITY POLLUTANT LIST

PURGEABLES

Parameter	MDL
1. Acrolein	25
2. Acrylonitrile	25
3. Benzene	5
4. Bromodichloromethane	5
5. Bromoform	5
6. Bromomethane	5
7. Carbon tetrachloride	5
8. Chlorobenzene	5
9. Chloroethane	5
10. 2-Chloroethylvinyl ether	5
11. Chloroform	5
12. Chloromethane	5
13. Dibromochloromethane	5
14. Dichlorodifluoromethane	5
15. 1,1-Dichloroethane	5
16. 1,2-Dichloroethane	5
17. 1,1-Dichloroethane	5
18. 1,2-Dichloroethane	5
19. 1,2-Dichloropropane	5
20. cis-1,3-Dichloropropene	5
21. trans-1,3-Dichloropropene	5
22. Ethylbenzene	5
23. Methylene chloride	5
24. 1,1,2,2-Tetrachloroethane	5
25. Tetrachloroethene	5
26. 1,1,1-Trichloroethane	5
27. 1,1,2-Trichloroethane	5
28. Trichloroethene	5
29. Trichlorofluoromethane	5
30. Toluene	5
31. Vinyl chloride	5
32. Xylene	5
33. Styrene	5
34. Dichlorobenzene	5
35. o-Chlorobenzene	5
36. n-Propylbenzene	5
37. n-Butylbenzene	5
38. Trimethylbenzene	5
39. 1,2-Dibromoethane	5

ACID EXTRACTABLES

Parameters	MDL
1. 4-Chloro-3-methyl phenol	10
2. 2-Chlorophenol	15
3. 2,4-Dichlorophenol	10
4. 2,4-Dimethylphenol	5

5. 2,4-Dinitrophenol	30
6. 2-Methyl-4,6-Dinitrophenol	20
7. 2-Nitrophenol	10
8. 4-Nitrophenol	20
9. Pentachlorophenol	30
10. Phenol	5
11. 2,4,6-Trichlorophenol	20

BASE NEUTRAL EXTRACTABLES

Parameters	MDL
1. Acenaphthene	10
2. Acenaphthylene	10
3. Anthracene	10
4. Benzo(a)anthracene	10
5. Benzo(b)fluoranthene	10
6. Benzo(k)fluoranthene	10
7. Benzo(a)pyrene	10
8. Benzo(g,h,i)perylene	
9. Benzidine	10
10. Bis(2-chloroethyl)ether	10
11. Bis(2-chloroethoxy)methane	10
12. Bis(2-ethylhexyl)phthalate	10
13. Bis(2-chloroisopropyl)ether	10
14. 4-Bromophenyl phenyl ether	10
15. Butyl benzyl phthalate	10
16. 2-Chloronaphthalene	10
17. 4-Chlorophenyl phenyl ether	10
18. Chrysene	10
19. Dibenzo(a,h)anthracene	25
20. Di-n-butylphthalate	10
21. 1,3-Dichlorobenzene	10
22. 1,4-Dichlorobenzene	10
23. 1,2-Dichlorobenzene	10
24. 3,3-Dichlorobenzidine	10
25. Diethylphthalate	10
26. Dimethylphthalate	10
27. 2,4-Dinitrotoluene	10
28. 2,6-Dinitrotoluene	10
29. Dioctylphthalate	10
30. 1,2-Diphenylhydrazine	10
31. Fluoranthene	10
32. Fluorene	10
33. Hexachlorobenzene	10
34. Hexachlorobutadiene	10
35. Hexachloroethane	10
36. Hexachlorocyclopentadiene	10
37. Indeno (1,2,3,-cd)pyrene	
38. Isophorone	10
39. Naphthalene	10
40. Nitrobenzene	10
41. N-Nitrosodimethylamine	
42. N-Nitrosodi-n-proplamine	10

43. N-Nitrosodiphenylamine	10
44. Phenanthrene	10
45. Pyrene	10
46. 2,3,7,8-Tetrachlorodibenzo-p-dioxin	
47. 1,2,4-Trichlorobenzene	10

PESTICIDE EXTRACTABLES

Parameters	MDL
1. Aldrin	01
2. a-BHC	01
3. b-BHC	01
4. g-BHC	01
5. d-BHC	01
6. Chlordane	25
7. 4,4'-DDD	03
8. 4,4'-DDE	03
9. 4,4-DDT	03
10 Dieldrin	03
11. Endosulfan I	03
12. Endosulfan II	03
13. Endosulfan Sulfate	03
14. Endrin	03
15. Endrin Aldehyde	03
16. Heptachlor	01
17. Heptachlor Epoxide	01
18. Toxaphene	25
19. PCB-1016	25
20. PCB-1221	25
21. PCB-1232	25
22. PCB-1242	25
23. PCB-1248	5
24. PCB-1254	5
25. PCB-1260	5
26. 2,4-D	2
27. 2,4,5-TP	05
28. Demeton	
29. Guthion	2.0
30. Malathion	2
31. Methoxychlor	06
32. Mirex	03
33. Parathion	07

MDL = Minimum Detection Level in Parts Per Billion