Metropolitan Dade
County, Florida

# Department of Environmental Resources Management

1987 Intensive Canal Study:
Evaluation of Water Quality
in the L—31N Canal

DERM Technical Report 90-12

# 1987 INTENSIVE CANAL STUDY
# EVALUATION OF WATER QUALITY IN THE L-31N CANAL

Maxine Cheesman

DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT

Environmental Planning and Evaluation Section

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Metro-Dade Department of Environmental Resources Management
33 SW. 2nd Ave.
Miami, Florida 33130-1540

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## Executive Summary

The L-31N canal is a 19-mile segment of a canal system which (1) conveys water from Conservation Areas for recharging south Dade groundwater supplies and (2) drains stormwater from surrounding rural areas for eventual disposal to coastal areas. Land uses in the L-31N canal drainage basin having some potential to degrade areawide water quality include a small municipal airport (with potential for expansion), a cement manufacturing plant and agricultural fields. The canal is subject to illegal dumping and to canal maintenance activities that entail occasional treatment with aquatic weed control chemicals. Because the L-31N canal will become increasingly important to public drinking water supplies as it recharges the West Wellfield in the early 1990's and a future regional wellfield in far south Dade, it was selected for intensive study of water and sediment quality in 1987.

Water quality samples were taken quarterly (June 1987 to February 1988) from six monitoring stations for general analytical parameters characteristic of water quality and for specific parameters indicative of land use activities within the L-31N drainage basin. Canal sediment samples were collected twice from the monitoring stations. Results were compared to drinking water standards, surface water standards and background data determined from previous studies.

Findings:

1. There were no violations of drinking water standards or Class I and III surface water standards. Levels of Dissolved Oxygen (D.O.) in canal samples were not in compliance with surface water standards, due primarily to the influx of groundwater (which by nature has low D.O. levels) rather than degradation of water quality.

2. Levels of nitrates/nitrites, potassium, magnesium and chlorides found in water samples collected from monitoring stations in agricultural areas, were slightly elevated above background values indicating slight water quality degradation related to farming activities.

3. No polychlorinated biphenyls, volatile organic compounds, pesticides or herbicides were detected in water or sediment samples. Pesticide testing, primarily for farming and landscaping residues, includes 26 organochlorines, 5 organophosphates, and 5 carbamates; 8 PCBs; 47 volatile organic compounds and 7 herbicides. Analysis did not include herbicides used for aquatic weed eradication.

4. The trihalomethane formation potentials measured in the water samples were expectedly high (averaging 2,353 μg/l), principally due to the presence of naturally occurring

organic compounds from the soils in water conservation areas. These organics do not pose a water quality problem to the canal ecosystem or recreational use of the canal water. The significance is their potential for undergoing chemical reactions with chlorine used for treating public drinking water supplies. These reactions form undesirable by-products (trihalomethanes) in drinking water.

5. Analyses of sediments indicated the presence of low levels of zinc and lead. There was no detection of other metals, polychlorinated biphenyls, pesticides, or herbicides that were analyzed.

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## ACKNOWLEDGEMENTS

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## Introduction

Dade County's canals are used for flood control, water conservation and maintenance of groundwater levels. During heavy rains, the groundwater moves into the canals and is discharged to tidewater to minimize land flooding. In periods of drought, high water levels used to recharge groundwater and retard salt water intrusion are maintained in the canals by transfers from the western water conservation areas. The close interconnection between the ground and surface waters in Dade County requires that water quality of the canals be carefully monitored to protect the aquifer.

Each year the Department of Environmental Resources Management (DERM) conducts a program to intensively monitor the water quality in a major Dade County canal. Previous Intensive Canal Studies include:

| | |
|---|---|
| 1980 | Snapper Creek Canal |
| 1981 | Miami Canal |
| 1982 | Tamiami/Dressels Canals |
| 1983 | Black Creek Canal |
| 1984 | Coral Gables Waterway |
| 1985 | Snake Creek Canal |
| 1986 | C-103 Canal |

The L-31N canal, a primary conveyer for southern Dade County, was selected for study during 1987. A key factor in choosing the L-31N is related to plans to use its waters to recharge two regional wellfields: the proposed West Wellfield, which is scheduled to supply municipal water to central Dade by 1995; and, more than a decade later, construction of an additional regional wellfield serving far South Dade. The L-31N is also a part of the South Dade Conveyance System (SDCS), mandated by an act of Congress, whose primary function is to supply 55,000 acre-feet of water each year to the Everglades National Park (ENP). The L-31N is of concern because it traverses through land uses such as cement manufacturing, heavy agriculture, and airport maintenance, which have potential to degrade canal water quality.

Free interchange between the L-31N canal and groundwater necessitates assessment for compliance with drinking water quality standards (Table 6), as well as surface water standards (Department of Environmental Regulation Class III standards for recreational use - Table 7). The data must also be evaluated in terms of increases above expected background concentrations of indicator parameters to provide early detection of possible water quality perturbations.

Analytical parameters were selected by considering the types of land uses proximal to the canal and their associated impacts on water quality. Adverse impacts of agriculture on water quality have been documented by various agencies in past studies. Chlorinated hydrocarbon pesticides (e.g., DDT, DDE, DDD, dieldrin, chlordane and endrin), PCBs and herbicides (e.g., 2,4-D and 2,4,5-TP) have been detected in sediments and/or surface water samples by the South Florida Water Management District (SFWMD)[1]. Chlorinated pesticides such as aldrin, chlordane, DDD, DDE, DDT, dieldrin, endosulfan, endrin, heptachlor, and lindane were found in groundwater wells by Dade County DERM during a 1987 pesticide study which was funded by State of Florida, Department of Environmental Regulation (DER)[2]. Elevated concentrations of nutrients and high conductivity in Lake Okeechobee have been cited by the DER as originating from agricultural activities on the southern rim of the lake[3]. Other sources have found volatile organic carbons and selenium in groundwater samples (in Kansas) as a result of agricultural pollution[4]. Preliminary surface water data (May 1987 - August 1989) from a SFWMD Routine Pesticide Monitoring Program include detections of atrazine, 2,4,5-TP (Silvex) and Diuron in various canals in South Florida. Hydrosoil data from the same source indicated levels of eight different pesticides: DDD, DDE, DDT, delta-benzenehexachloride (BHC), ethion, chlorpyrifos, endosulfan and atrazine.

Potential types of contaminants which may result from runoff from the airport and the cement manufacturing plant in the vicinity of the L-31N canal include volatile organics, metals, phenols, hydrocarbons, oil and grease, and solvents. These have been associated with industrial activities by the United States Environmental Protection Agency (EPA) and DERM in sampling studies since the mid-1970's.

## Current Studies and Historical Data

The United States Geological Survey (USGS) collected data from the L-31N canal between 1972 to 1980. Results indicated that levels of dissolved oxygen, cadmium and mercury were not in compliance with Class III standards of the Florida Administrative Code, Chapter 17-3, which pertain to surface waters designated for recreational usage[5] (Table 7).

The Florida Department of Environmental Regulation (DER) sampled the L-31N canal between 1969-1982. Based on the results, the DER designated the water quality in the L-31N as "Fair", with the scale varying from "Poor" to "Good" (see section on Other Water Quality Considerations on page 37). This assessment was derived using data from six categories: water clarity, dissolved oxygen, oxygen demanding substances, nutrients, bacteria and macroinvertebrate diversity index[6].

SFWMD, ENP and the U.S. Army Corps of Engineers conduct a quarterly pesticide monitoring program which samples the following: one site on the L-31N (gated spillway S-176), one site along the L-31W (pump station S-332), and three sites on the C-111 (spillways S-177 and S-18C and gated culvert S-178). Monitoring includes twice monthly analyses of nutrients, inorganic and physical parameters; monthly and twice yearly analyses of selected trace metals, and quarterly analyses for pesticides in sediments and water.

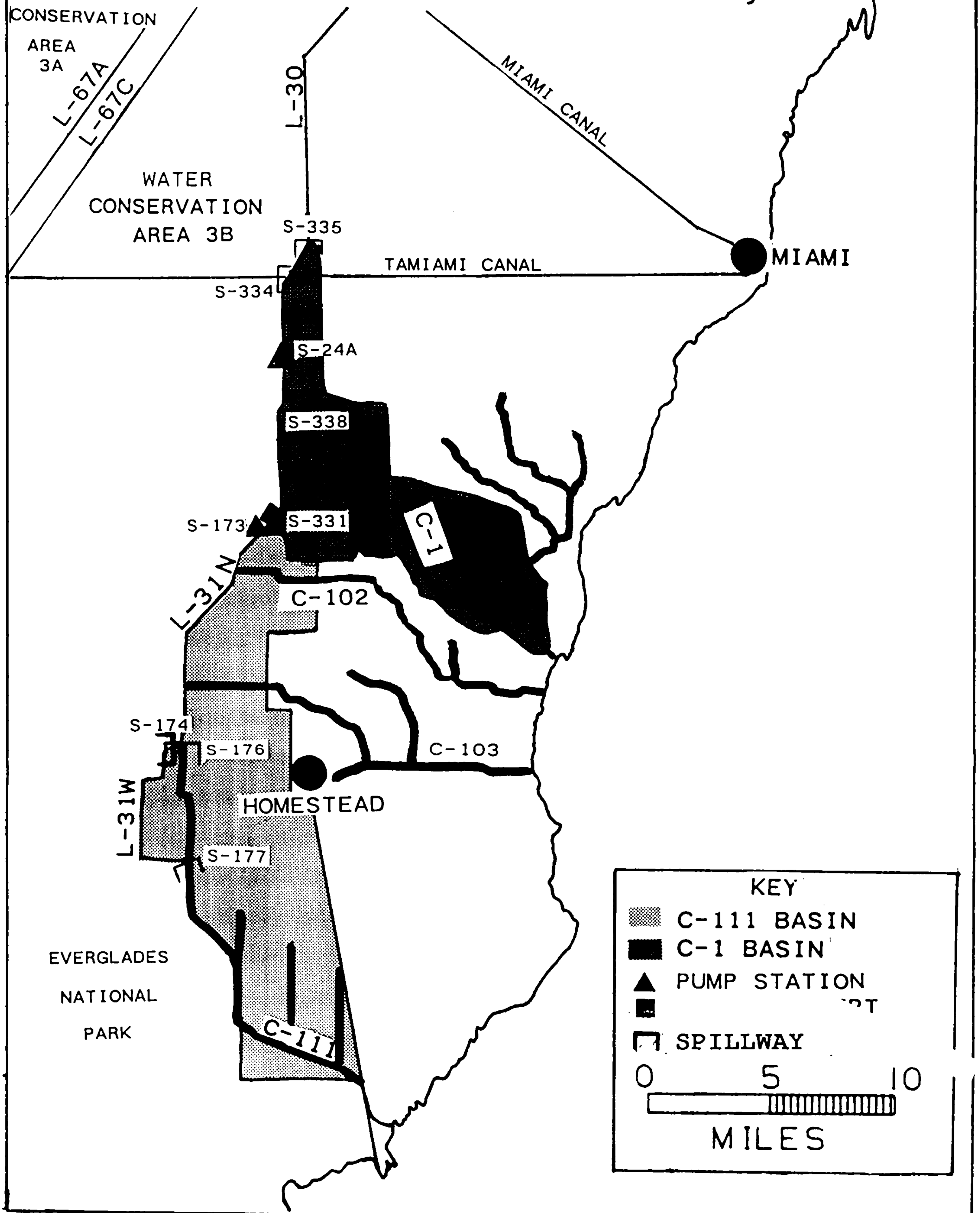
An assessment of the 1987-1988 preliminary data obtained from this study indicated that average levels of inorganic parameters of the L-31W canal were comparable to other canals in Dade County. However, atrazine was detected in the L-31N and C-111 canals during the 1988 row crop growing season. In the C-111 canal, p,p'-DDE and p,p'-DDD were also detected in April 1988; and 2,4,5-TP (Silvex) was detected in January 1987. Although the levels detected were low, any detection of pesticides or herbicides is of concern.

## Location and Description of Study Area

The L-31N canal is a part of the South Dade Conveyance System[7] (SDCS). This system was primarily designed to supply water to the Everglades National Park to meet the minimum delivery schedule. In addition, during periods of low flow, the SDCS supplies water to South Dade County canals to maintain canal stages and prevent salt water intrusion.

The L-31N is a part of the SDCS which delivers water from the northern Water Conservation Areas to the C-1 (Black Creek) and C-111 Basins in the south. It is aligned along the western boundary of these basins (figure 1).

Figure 1: Drainage Basins of the L-31N Canal
1987 Intensive Canal Study



The Black Creek (C-1) Basin, located in the southeastern section of Dade County, includes 56.9 square miles through which pass the Black Creek Canal (C-1), C-1W, C-1N and the L-31N canals. L-31N connects with the C-1 canal at approximately S.W. 112 Street.

The C-111 Basin covers approximately 100 square miles and comprises the L-31N, C-111, C-113 and the L-31W canals. This basin lies entirely west of the urban development boundary in Dade County. The L-31N enters this basin at approximately S.W. 168 Street through the gated culvert S-173. The canal discharges around S.W. 304 Street into the C-111 through spillway S-176 and into the L-31W canal via S-174.[7]

The L-31N is the western boundary of a series of levees which were implemented to prevent overflow of excess water from the Everglades area into the agricultural regions of South Dade. The L-31N borrow canal conveys runoff into the C-111 canal from the area between the levee drainage divide and the South Dade area.

L-31N canal lies about 4.5 miles west of Homestead and extends for 10.4 miles from the southeastern corner of Water Conservation Area 3B to Everglades National Park, where it flows into the C-111 and the L-31W canals. The structures on the L-31N include a gated culvert (S-173), a pumping station (S-331) and a gated spillway (S-176). The S-331 pumping station is adjacent to S-173 and is located at the divide between the C-1 and C-111 basins.

S-173 is closed when the pumps at S-331 are operating or during storm events to prevent flood flows from passing from the Black Creek to the C-111 basins. Operation of the S-331 pump station serves to protect the residential areas to the west of L-31N from flooding and serves to supply water to the southern C-1 basin and the Everglades National Park. S-176 is located at the southern end of the L-31N canal and is used to control the canal stage to regulate discharges to the C-111 and L-31W canals.[7]

The L-31N is connected to the C-102 canal at theoretical S.W. 192 Street and to the C-103 canal at around S.W. 268 Street. Under normal conditions, the areas tapped by these canals drain to the east towards Biscayne Bay. In flood conditions, these areas drain westward to the L-31N canal.

Under normal conditions, when the L-31N is used to recharge the C-111 basin, the flow is to the south. During a storm event, flow is to the east via the C-1 canal. The stage and operation of the canal is managed by the SFWMD according to strict Design and Operating Criteria established by the United Stated Army Corps of Engineers.

The average depth of the L-31N canal is 14.5 feet while ranging from 12 feet to a maximum of 21 feet at mid-canal.

## Land Usage

The L-31N affords a good study of possible adverse impacts on water quality from agricultural practices as well as from a small airport and a cement plant. Table 1 lists the sampling sites and nearby land uses. Figure 2 maps the locations.

Site L-31N-1 is approximately 50 feet south of the intersection of the L-29 and L-31N canals. Potential sources that may degrade the water quality in this portion of the canal are runoff from the US 41 and from a small trailer campsite to the northwest. This site serves to characterize the background conditions to contrast potential impact from land use types further south.

Site L-31N-2 is approximately 1.5 miles downstream of General Portland Cement facility, which ceased operations in 1984.

Sites L-31N-3, L-31N-4, L-31N-5 and L-31N-6 are used for seasonal agricultural activities. Row crop vegetables such as tropical vegetables, beans, corn and tomatoes are grown in the general vicinity.

Homestead General Aviation Airport is east of L-31N between monitoring stations L-31N-5 to the north and L-31N-6 downstream to the south. When canal stages are lower than groundwater elevations, groundwater beneath this small airport will flow

TABLE 1: LOCATION AND LAND USES OF THE MONITORING SITES ALONG THE L-31N CANAL

| SITE | LOCATION | MAJOR LAND USE |
|---|---|---|
| L-31N-1 | US 41 & SW 187 Ave. | Background site. Wetlands to the north. |
| L-31N-2 | SW 90 Street & SW 187 Ave. | 1.5 miles south west of Portland cement plant. |
| L-31N-3 | SW 136 Street & SW 187 Ave. | Row crops. |
| L-31N-4 | SW 216 Street & SW 217 Ave. | Row crops. |
| L-31N-5 | SW 272 Street & SW 227 Ave. | Row crops. |
| L-31N-6 | Approximately SW 304 Street & 230 Ave. | Southeast of Homestead General Airport. Row crops. |

spiked samples (in which known amounts of analytes are added to the samples and recoveries calculated).

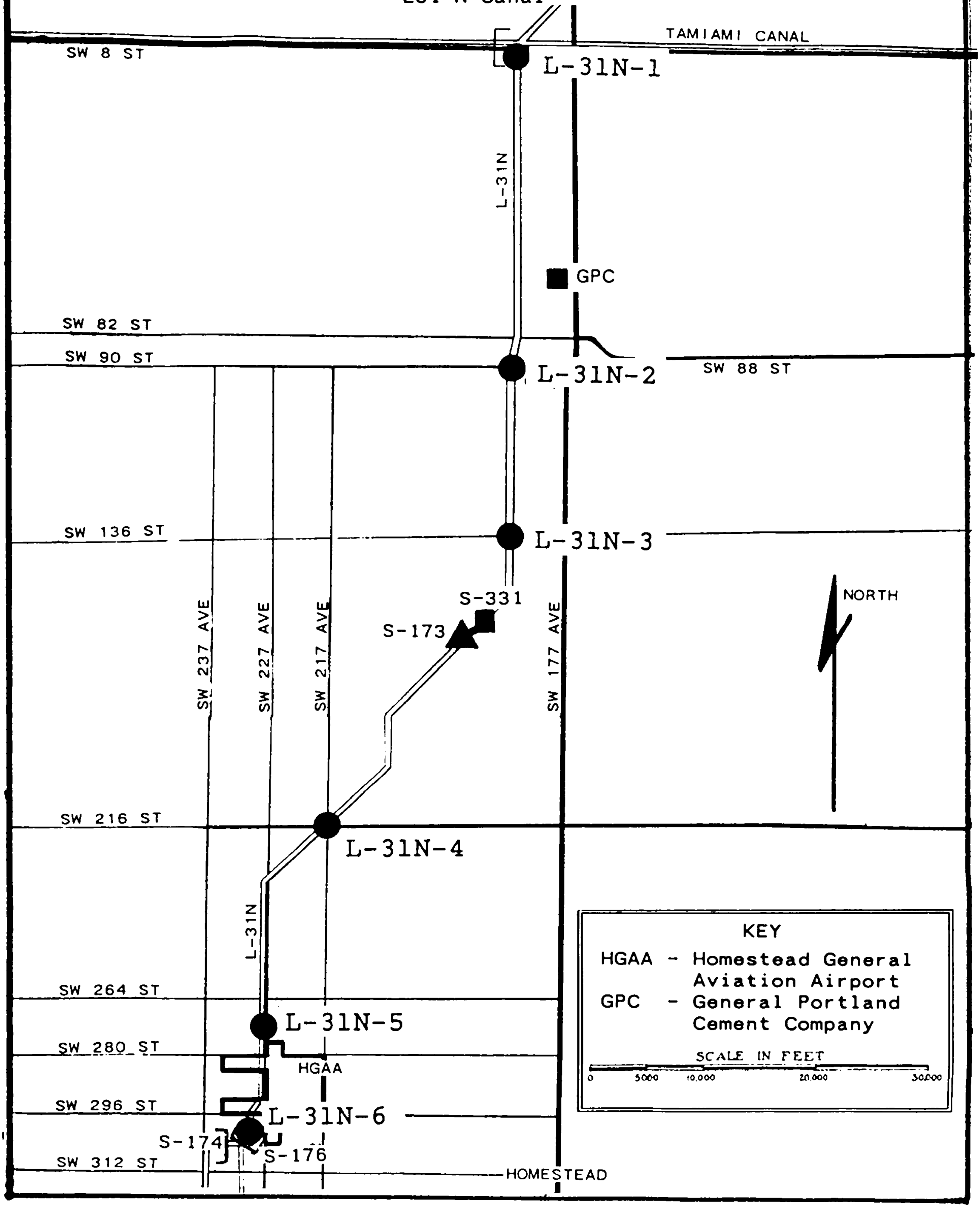
## Statistical Analysis

Statistical analysis was performed using the SYSTAT computer program package. Normalcy was determined from probability plots and skewness.

Levels of parameters in the L-31N were compared to data obtained from other Dade County canals between 1981-86. For data that was normal, significance of variation between the data sets was determined using t-tests. For non-normal data, significance was tested by Mann-Whitney U statistics. Because of variability of the detection limits in the database, the data was truncated by treating the levels below the minimum detection limit as missing in order to obtain means, coefficients of variation, and standard deviations.

Site L-31N-1 served as the background site to estimate the impact of the different land uses on water quality along the canal reaches.

Figure 2: Monitoring stations in the 1987 Intensive Canal Study



towards the canal. L-31N-6 is north of structure S-176, which is sampled routinely by the SFWMD.

## Sampling Protocol

Water samples were collected with a point source Teflon bailer, which was cleaned as follows: isopropanol wash, two distilled and one sample water rinses. Sample containers were prepared and preservative added in accordance with EPA protocol by the DERM laboratory prior to collection.

Sediment samples were collected with a stainless steel petite ponar sampler. Several portions of sediments were collected from small areas adjacent to the water column monitoring sites and mixed in a stainless steel basin prior to withdrawing samples.

The parameters analyzed and the sampling frequency are listed in Table 2.

Samples were analyzed by the DERM laboratory and by the Florida Health and Rehabilitative Services (HRS) laboratory, which are both certified by the Florida DER. Duplicate samples were collected once every sampling episode, accounting for 16% of the total number of samples. A trip blank was taken for volatile organic compounds on each sampling event. Other quality assurance procedures included analysis of in-house duplicates and

TABLE 2: FREQUENCY OF PARAMETERS ANALYZED IN THE 1987 INTENSIVE CANAL STUDY

| PARAMETERS | JUN '87 | OCT '87 | DEC '87 | FEB '88 |
|---|---|---|---|---|
| WATER COLUMN | | | | |
| I. FIELD: | | | | |
| 1. Conductivity | X | X | X | X |
| 2. Depth | | | | X |
| 3. Dissolved Oxygen | X | X | X | X |
| 4. pH | X | X | X | X |
| 5. Temperature | X | X | X | X |
| II. LABORATORY: | | | | |
| 1. Alkalinity | X | X | X | X |
| 2. Chlorides | X | X | X | X |
| 3. Turbidity | X | X | X | X |
| 4. Total Dissolved Solids | | | | X |
| 5. Calcium | | | | X |
| 6. Magnesium | | | | X |
| 7. Potassium | | | | X |
| 8. Sodium | | | | X |
| 9. Ammonia | X | X | X | X |
| 10. Total Nitrate/Nitrite | X | X | X | X |
| 11. Orthophosphates | X | X | X | X |
| 12. Total Phosphates | X | X | X | X |
| 13. Arsenic | X | X | X | X |
| 14. Cadmium | X | X | X | X |
| 15. Copper | X | X | X | X |
| 16. Chromium | X | X | X | X |
| 17. Lead | X | X | X | X |
| 18. Mercury | X | X | X | X |
| 19. Zinc | X | X | X | X |
| 20. Phenols | X | X | X | X |
| 21. Methylene Blue Active Substances | X | X | X | |
| 22. Organocarbamate Pesticides | X | X | X | X |
| 23. Organophosphorus and Carbamate Pesticide Residues | X | X | X | X |
| 24. Polychlorinated Biphenyls | X | X | X | X |
| 25. EPA 601 compounds | X | X | X | X |
| 26. EPA 602 compounds | X | X | X | X |
| 27. Trihalomethane Formation Potential | | X | | |
| 28. Fecal Coliform | X | X | X | X |
| 29. Fecal Streptococci | X | X | X | X |
| SEDIMENT | | | | |
| 1. Arsenic | | X | | X |
| 2. Cadmium | | X | | X |
| 3. Chromium | | X | | X |
| 4. Copper | | X | | X |
| 5. Lead | | X | | X |
| 6. Zinc | | X | | X |
| 7. Orthocarbamate Pesticides | | X | | X |
| 8. Polychlorinated Biphenyls | | X | | X |

## Discussion of Results

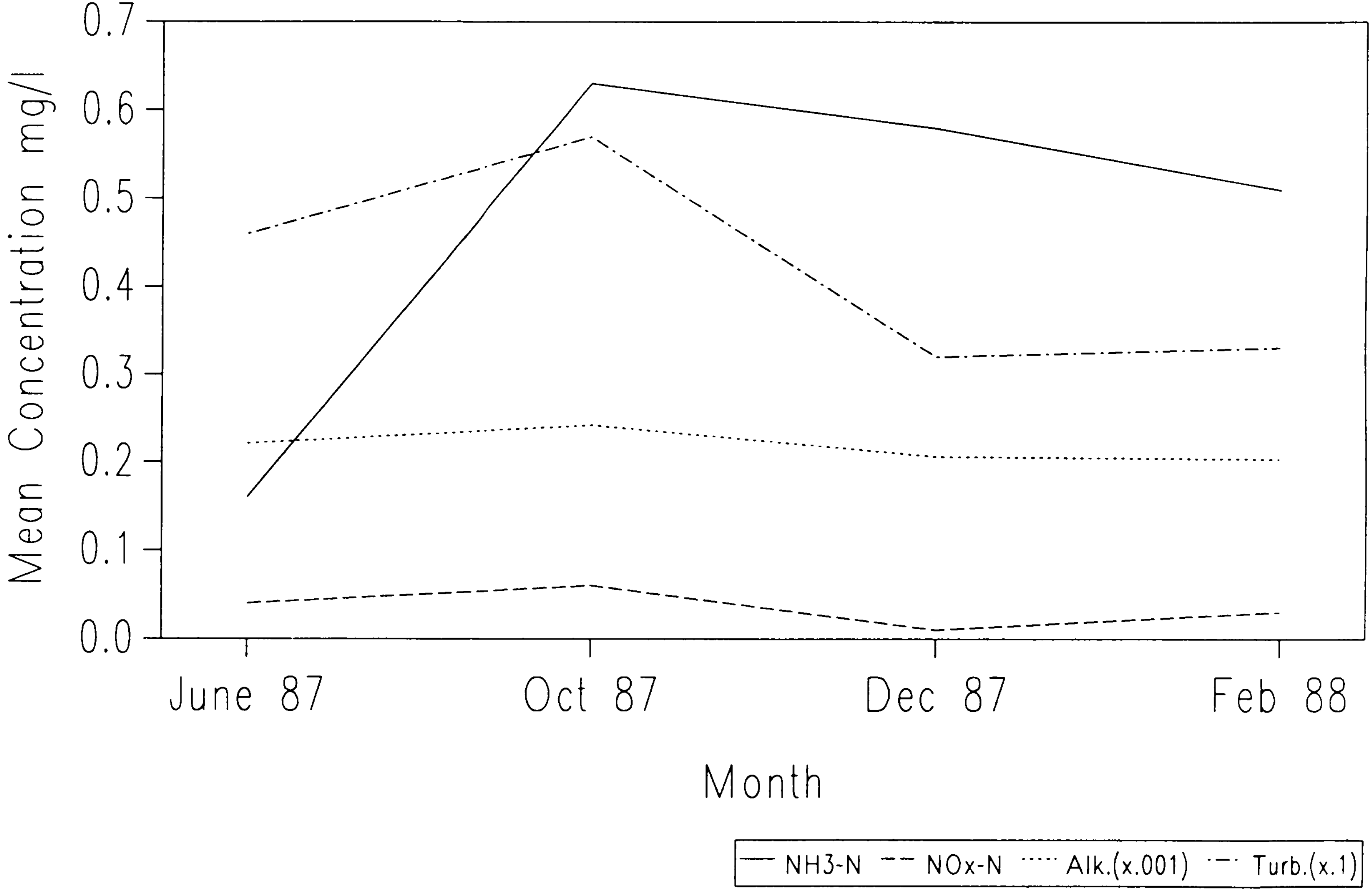
### Temporal Fluctuations

To properly assess temporal fluctuations, sampling should be closely linked to rainfall patterns, and there should be at least three data sets. With the database limited to four sampling events or one data set, no conclusive seasonal trend can be defined. The differences in the data set between the wet and dry seasons were of the order of one standard deviation and cannot be considered significant. However, some useful observations can be made if the limitations of the database are kept in mind.

The levels of dissolved oxygen and chlorides were highest during the wet season (figure 3), during the period of high algal growth. Subsequent decline of the algal population is accompanied by an increase of bacteria and consequent decrease in dissolved oxygen levels. Levels of ammonia, NOx-N, alkalinity and turbidity were highest in the late wet season (figure 4). Other parameters remained fairly constant throughout the year.

# Figure 4: Temporal Variation

## NH3, NOx, Alkalinity & Turbidity in L31—N Canal



## Agricultural Related Parameters

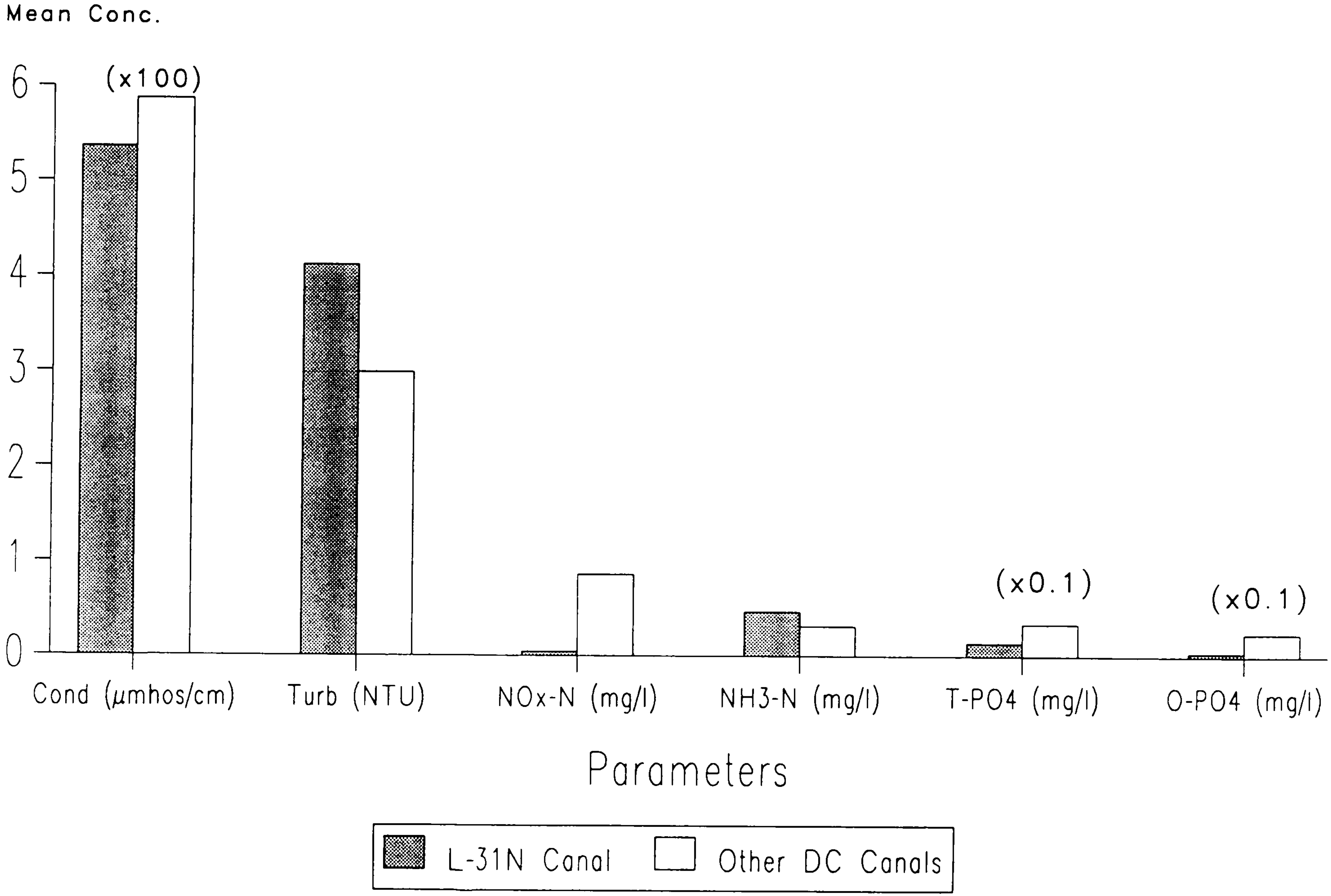
Chemicals likely to be utilized in the row crop growing season are typically applied in the growing season between October and April. Concentrations in water of sediments, nutrients, heavy metals, salts, volatile organic compounds, pesticides and pathogens may be affected by these practices. These may enter surface water bodies during storm water events by either overland runoff or infiltration to the ground water.

Historical data for Dade County have shown that significant increases in levels of some nutrients exist in canals in agricultural versus non-agricultural areas. Data are not sufficient for comparisons of most other parameters.

In this study most data for the L-31N canal were evaluated for similarity to all other canals using t-tests or Mann-Whitney U statistics. Although the study results may not prove significance, parameter concentrations of 2-3 standard deviations above background may indicate the onset of agricultural impact and are worthy of further investigation.

As figure 5 shows, levels in the L-31N for ortho and total phosphates, nitrates/nitrites and conductivity were significantly lower (probability >0.05) than in other canals traversing agricultural communities. Levels of ammonia and turbidity were higher in the L-31N, but this may be the result of high organic

Figure 5: Comparison of L–31N with Dade County Canals in Agricultural Areas



matter and not necessarily an impact of agriculture. Based on this analysis, it may be concluded that the water in L-31N has not been impacted by agricultural activity to the extent that other canals in agricultural areas have (ref: DERM technical publications 88-10 and 88-15).

When a comparison is made between the background site (no agriculture) and other sites downstream on the L-31N, statistical analysis shows no significant difference between ammonia, turbidity, nitrates/nitrites, and ortho and total phosphates data.

Fertilizers containing nitrogen, phosphorus and potassium are used to supplement soil nutrients, to improve plant quality and to optimize crop yield. The quantity of nutrients that may enter the surface water depends on rainfall, soil properties, plant uptakes, and on the frequency, methods and amounts of applications and the type of fertilizers that are applied. High concentrations of nitrogen and phosphorus can stimulate algal blooms which, upon decay, deplete the dissolved oxygen in water. This can cause fish kills and adversely affect the taste and odor of water.

Levels of nutrients in the L-31N were lower than other canals in Dade County which were noticeably affected by agricultural land usage. The differences in the levels between agricultural and non-agricultural areas along the L-31N were insignificant (figure

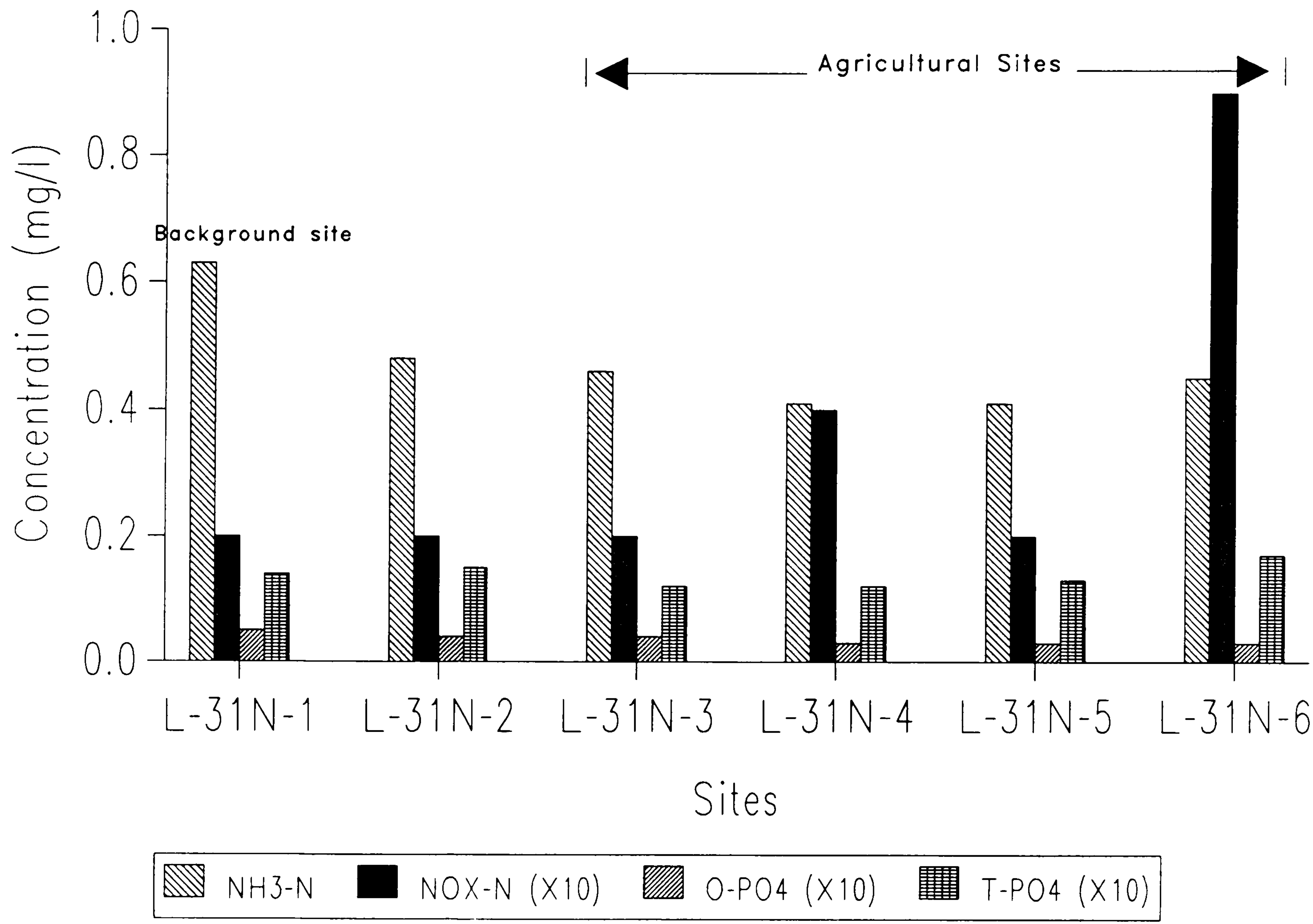
6). Slight increases (one standard deviation) in concentrations were noted for nitrate/nitrites and were generally associated with agricultural activities.

While nitrate/nitrite levels in other Dade County canals show significant differences between agricultural and non-agricultural areas, this trend was not evident from the L-31N data. The median level of nitrate/nitrites was below the detection limit of 0.01 mg/l. The highest level of 0.25 mg/l in October did not correspond to the field duplicate (0.02 mg/l) and was not confirmed in subsequent samplings. Levels in the agricultural areas (sites L-31N-4 and L-31N-6) were one standard deviation higher than background values. Overall, NOx-N levels were lower than in other Dade County canals not impacted by agricultural activities.

Analysis of the phosphate data for canals in county-wide studies (DERM, unpublished data) resulted in no significant difference between background and agricultural sites. One probable reason for this is that phosphate is readily assimilated by plants. Similarly, the data from L-31N was not indicative of agricultural impact and averages were lower in the L-31N canal than in other canals. Levels of total phosphates ranged from 0.007-0.030 mg/l with a median level of 0.012 mg/l. Ortho-phosphates ranged from <0.001 mg/l to 0.007 mg/l with a median value of 0.005 mg/l.

Ammonia may be applied as ammonium compounds such as ammonium

# Figure 6: L-31N Canal Nutrients Data



nitrate ($NH_4NO_3$), ammonium phosphates (mono or diammonimum phosphates), or ammonium sulfate ($(NH_4)_2SO_4$). Analysis of the ammonia data from all county canals and from the L-31N canal indicated no difference between agricultural and non-agricultural sites. The average ammonia level was higher in the L-31N than in other Dade County canals, with the background site, L-31N-1, having the highest levels. These concentrations are probably an indication of proximity to wetlands which naturally have high ammonia levels. Values of ammonia averaged 0.47 mg/l, ranging from 0.11-0.85 mg/l.

Potassium salts are used to stimulate growth of strong stems, tubers and seeds and to improve the resistance of plants to certain diseases. It is also important in the formation of plant essentials such as starch, oils and sugars. Common sources of potassium used as fertilizers include potassium chloride (KCl), potassium sulfate ($K_2SO_4$), potash ($K_2O$) and a range of potassium phosphates.

Potassium was analyzed once in the program during the dry season (February 1988), and ranged from 0.94 - 1.60 mg/l with a median of 1.58 mg/l. Data from other Dade County canals is limited. However, levels of potassium were comparable to the Coral Gables Waterway (average of 2.0 mg/l)[9] and lower than the C-103 canal or the North Canal (averages of 5.8 and 4.5 mg/l, respectively)[12].

Magnesium is a secondary plant nutrient that is required in large amounts for the production of chlorophyll. It may be applied to agricultural fields in a number of different compounds, including magnesium ammonium phosphate ($MgNH_4PO_4 \cdot 6H_2O$), magnesium carbonate ($MgCO_3$), magnesium nitrate ($Mg(NO_3)_2$), magnesium oxide (MgO) and magnesium sulfate ($MgSO_4$). Magnesium was analyzed once during the study and had a median level of 7.4 mg/l and ranged from 6.4 - 7.9 mg/l. Levels were comparable to those found in the limited database on county canals.

Chlorides in surface water may result from natural minerals or from its application on agricultural fields as fertilizer (as KCl), or as fungicides and bactericides ($CaOCl_2$), or as degradation products of pesticides and herbicides. Levels of chloride averaged 66 mg/l and ranged from 48 - 94 mg/l. The sites with the highest chloride levels were in agricultural areas, but levels were not significantly elevated over background.

Overland runoff from agricultural lands enters surface water during the wet season and acts as a major transport agent of constituents such as heavy metals, pesticides and nutrients that bind to soils. Practices that decrease sediment transport, such as cover crop cultivation, will also decrease turbidity and the transport of these substances to surface water bodies.

Total dissolved solids were analyzed only once and ranged from 320 to 380 mg/l. These data are insufficient to determine if there is significant difference between background and agricultural areas.

Levels of conductivity (ability of a solution to conduct an electric current) averaged 536 micromhos per centimeter (µmhos/cm) and ranged from 486 to 610 µmhos/cm. There was no significant difference between the background and the agricultural areas along the L-31N canal.

Turbidity (water clarity) ranged from 1.3 to 10.5 nephelometric turbidity units (NTU) with a median level of 4.4 NTU. There was no difference between background and agricultural areas, but levels in the L-31N were significantly higher than in the other canals in Dade County. This may be a consequence of high natural organic content.

Heavy metals associated with agricultural land use include arsenic, copper, lead, mercury and zinc.

Arsenic may be used in herbicides, insecticides and rodenticides. Organic arsenicals are especially of concern because of their value as selective herbicides. Common forms of arsenic include orthoarsenic acid ($H_3AsO_4$), arsenious oxide ($As_2O_3$), copper arsenite ($CuHAsO_3$) and organic arsenicals. Arsenic is highly poisonous to all animals and detections of arsenic in surface water at any level is of concern. It was not detected in the L-31N canal above the 2 µg/l detection limit.

Copper is a micronutrient of growing plants. Compounds of copper may be utilized as fertilizers or pesticides. As a fertilizer, copper compounds such as copper sulfate, copper oxide and copper chelate are used to increase crop yields. Copper compounds also constitute a widely used group of fungicides, algicides and insecticides. Pesticides of inorganic copper salts include basic carbonates ($Cu(OH)2CuCO_3$), hydroxides ($Cu(OH)_2$), basic chlorides ($3Cu(OH)_2.CuCl_2$), oxides ($Cu_2O$ and CuO) and a variety of sulfates. Some organic copper pesticides are acetate, naphthenate, quinolinate and resinate. At concentrations of 1 mg/l and higher, copper may impart some taste to water, and in excessive amounts, it may be harmful to humans. Copper results were mostly below the detection limits for samples from agricultural areas.

Lead was used in agriculture primarily as a insecticide in the forms of acid lead arsenate ($PbHAsO_4$) and basic lead arsenate ($Pb_4(PbOH)(AsO_4)_3$). These lead compounds are considered lethal to humans, and have mostly been replaced by synthetic organic chemicals. Average levels of lead were less than 2 µg/l at all agricultural sites. The maximum lead level detected was 2.5 µg/l in a non-agricultural area (L-31N-2).

A variety of mercury compounds, both organic and inorganic, may be utilized in agriculture as pesticides. These include mercurous chloride ($Hg_2Cl_2$), mercuric lactate, mercan and mergamma. Some mercurials are no longer approved as fungicides and have been discontinued; however, there may be some residual effects. No mercury was found in the L-31N canal above the detection limit of 0.1 µg/l.

Zinc is a plant micronutrient and may be applied in the form of zinc ammonium nitrate, zinc nitrate ($Zn(NO_3)_2 \cdot 6H_2O$), zinc oxide ($ZnO$) and different hydrates of zinc sulfates. Zinc may also be used as a pesticide, the most common compounds being zinc phosphide and zinc arsenate. There was no zinc found in the L-31N canal study above the detection limit of 0.01 mg/l.

Pesticide may be applied to agricultural fields as a solid or a liquid. Once on the ground, they may undertake different pathways depending on their individual properties. They may undergo chemical or biological degradation; or be taken up by the plants; or be adsorbed to the soil particles and eroded or leached, resulting in the pollution of surface and groundwater resources. The occurrence of pesticides in water depends on soil properties (organic and microbial content, cation exchange capacity and moisture content), chemical properties of the pesticides (water solubility, soil mobility, persistence in the environment, and degree and strength of adsorption in soil), application techniques, quantity applied and amount of rainfall. The behavior of pesticides in surface water is difficult to ascertain for the group as a whole because reactions are complex and their persistence in the environment is highly variable. Persistent pesticides may remain active in the soil for several years while non-persistent ones disappear within a few months of application. Any detection of pesticides should be considered in the context of their particular associated health risks.

In addition to the traditional pesticides, pesticide residues were selected on the basis of their usage and reported occurrence in Dade County and their ability to leach from soils. Table 3 lists the pesticides analyzed and their utilization on crops, harmful effects and mobility in soil. Table 4 lists the traditional pesticides that were analyzed.

Of the pesticides analyzed, none were found to be above the method detection limit (as listed in the Appendix). However, the types of pesticides used on a particular crop varies as insects develop more resistant strains. Because of this, monitoring for pesticides in use along the L-31N and any other canal that abuts agricultural land should be continued on at least an annual basis. The pesticides used in Dade County for aquatic weed control (specifically Fluridone, Endothall and Glyphosate) were not analyzed. Future studies of the L-31N canal should include analyses for these pesticides.

Volatile organic compounds (VOCs) are carbon compounds with low boiling points and high vapor pressures (i.e., they volatilize readily). Under normal conditions of temperature and pressure, most VOCs are liquids which are denser than water. Natural

TABLE 3 ORGANOPHOSPHORUS AND CARBAMATE PESTICIDE RESIDUES

ANALYZED IN THE 1987 INTENSIVE CANAL STUDY

| PESTICIDE | CROP USAGE | HEALTH EFFECTS | COMMENTS |
|---|---|---|---|
| Alachlor | Soybean, peanuts & field corn | Classified as Group B2. 10 day H.A. = 100 μg/l. | Leaves no residue in soil & is rapidly metabolized by crops. Water solubility: 240 mg/l @ 25°C. |
| Aldicarb (Temik) | Orange, lemon, lime grapefruit, potato, ornamentals, dry beans, & sweet potato. | Classified as Group E. 1 day H.A. = 10 μg/l. | Systemic insecticide, acaricide & nematocide. Moderately persistent in soil. Water solubility: 6 g/l @ room temp. |
| Atrazine | Corn, sorghum, sugar cane & pineapple | Class C. 10 day H.A. = 100 μg/l. | Selective herbicide. Water solubility: 70 mg/l @ 22°C. |
| Benomyl | Fruits, vegetables & ornamentals. | Slightly toxic to fish. | Systemic fungicide. Used for wide range of diseases. Insoluble in water. |
| Carbofuran | Corn & sugar cane. | Group E. Toxic to fish. 1 day H.A. = 50 μg/l. | Broad spectrum insecticide, nematocide & miticide. Water solubility: 700 mg/l @ 25°C. |
| Chlorothalonil | Beans, potatoes, tomatoes, sweet corn & ornamentals. | Group B2. Toxic to fish. 10 day H.A. = 250 μg/l. | Fungicide. Water solubility: 0.6 mg/l @ 25°C. |
| Ethoprop (Mocap) | Sweet potatoes, white potatoes, sugar cane, melons & plantains. | Toxic to some fish (e.g. Bluegill). | Nematocide, soil insecticide. Water solubility: 750 mg/l @ 25°C. |
| Fenamiphos (Nemacur) | Bananas, cabbage & brussel sprouts. | Group D. 10 day H.A. = 9 μg/l | Systemic nematocide. Water solubility: 400 mg/l @ 25°C. |
| Fonofos (Dyfonate) | Corn. | Very toxic to fish. Group D. Lifetime H.A. = 14 μg/l. | Volatile from water. Practically insoluble in water @ 25°C. |
| Methamidophos | | Fatal if swallowed, inhaled or adsorbed through skin. | Insectide, acaricide. Readily soluble in water. |
| Methomyl | Vegetables, soy beans & ornamentals. | May be fatal if swallowed. Group D. Toxic to fish. Lifetime H.A. = 175 μg/l. | Insecticide. Water solubility: 10,000 mg/l @ 25°C. |

## TABLE 3(cont.) ORGANOPHOSPHORUS AND CARBAMATE PESTICIDE RESIDUES ANALYZED IN THE 1987 INTENSIVE CANAL STUDY

| PESTICIDE | CROP USAGE | HEALTH EFFECTS | COMMENTS |
|---|---|---|---|
| Metolachlor | Soybean, peanuts, corn, potatoes, grain sorghum, pod crops & woody ornamentals. | Classified as Group C. 10 day H.A. = 1400 μg/l. | Mobile in sandy clay & loam soil. Selective herbicide. Water solubility: 530 mg/l @ 20°C. |
| Metribuzin | Peas, potatoes, sugar cane, field corn & tomatoes. ornamentals, dry beans, & sweet potato. | Hazardous to some fish. Group D. 10 day H.A. = 4500 μg/l. | Water solubility: 1200 mg/l @ 25°C. |
| Oxamyl | Many field crops, vegetables, fruits & ornamentals. | Class E. Lifetime H.A. = 175 μg/l. | Rapidly degraded in soil. Water solubility: 280 g/l @ 25°C. |
| Paraquat | Ornamentals, soybeans, sugar cane, killing potato vines. | Slightly toxic to fish. May be fatal if ingested. Group C. 10 day H.A. = 100 μg/l. | Strongly absorbed & inactivated by soil. Water solubility: Dichloride salt is freely soluble. |
| Permethrin | Corn, broccoli, cabbage, celery, potatoes, bell peppers, pumpkins, spinach & cantaloupes. | Toxic to fish. | Water solubility: <1 ppm. |
| Simazine | Corn, citrus, berry fruits & weed control in orchards. | Group D. Non-toxic to fish. Harmful if swallowed. Lifetime H.A. = 35 μg/l. | Selective herbicide. Water solubility: 3.5 mg/l @ 20°C. |

H.A. = Health Advisory

Group B2: Probable human carcinogen. Have adequate evidence from human studies and sufficient evidence from animal studies.

Group C : Possible human carcinogen. Limited evidence of carcinogenicity in animals and absence of human data.

Group D : Not classified. Inadequate animal evidence of carcinogenicity.

Group E : No evidence of carcinogenicity.

# TABLE 4 PESTICIDES & PCBs ANALYZED IN THE 1987 INTENSIVE CANAL STUDY

UNITS: µg/l

alpha-BHC
beta-BHC
gamma-BHC
Aldrin
alpha-Chlordane
gamma-Chlordane
Chlordane
Dieldrin
o,p'-DDD
p,p'-DDD
o,p'-DDE
p,p'-DDE
o,p'-DDT
p,p'-DDT
Endosulfan I
Endosulfan II
Endosulfan cyclic sulfate
Endrin
Endrin aldehyde
Heptachlor
Heptachlor Epoxide
Methoxychlor
Mirex
Toxaphene
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262

occurrence of VOCs in the water is rare, so the presence of these compounds can be attributed to anthropomorphic sources.
VOCs associated with agriculture are: 1,2-dichloroethane, 1,2-dichloropropane, cis/trans-1,3-dichloropropane, 1,1,2,2-tetrachloroethane, and ortho/para-dichlorobenzenes. VOCs analyzed are listed in Table 5. There was no detection of any of these compounds in the L-31N canal.

**Airport Related Parameters**

The Homestead Airport is small, and its location in a predominantly agricultural area requires that an assessment of its impact on surface water quality include impacts from agricultural activities. Surface runoff from the airport into the canal could adversely affect water quality. Possible contaminants from the airport include heavy metals (lead, cadmium and chromium), phenols and certain volatile organic compounds from maintenance, service and fueling operations.

Lead detections at site L-31N-6 may be the result of a combination of impacts from agriculture and airport operations. The level of lead is extremely close to its detection limit, and the data does not conclusively indicate adverse impacts on water quality from either of these sources.

Cadmium levels downstream of the airport were not elevated above background values for any of the sampling events. Chromium was

## TABLE 5: VOLATILE ORGANIC COMPOUNDS ANALYZED IN 1987 ICS

| Compounds (detection limit = 1 µg/l) |
|---|
| Bromobenzene |
| Bromochloromethane |
| Bromodichloromethane |
| Bromoform |
| Bromomethane |
| Carbon Tetrachloride |
| Chlorobenzene |
| Chloroethane |
| 2-Chloroethylvinyl Ether |
| Chloroform |
| Chloromethane |
| o-Chlorotoluene |
| m-Chlorotoluene |
| p-Chlorotoluene |
| 1,2-Dibromoethane |
| Dibromomethane |
| Dibromochloromethane |
| Dichlorodifluoromethane |
| 1,1-Dichloroethane |
| 1,2-Dichloroethane |
| 1,1-Dichloroethene (Vinylidene chloride) |
| cis-1,2-Dichloroethene |
| trans-1,2-Dichloroethene |
| 1,2-Dichloropropane |
| 1,3-Dichloropropane |
| 2,2-Dichloropropane |
| 1,1-Dichloropropene |
| cis-1,3-Dichloropropene |
| trans-1,3-Dichloropropene |
| 1,1,1,2-Tetrachloroethane |
| 1,1,2,2-Tetrachloroethane |
| Tetrachloroethene |
| 1,1,1-Trichloroethane |
| 1,1,2-Trichloroethane |
| Trichloroethene (1,1,2-Trichloroethene) |
| Trichlorofluoromethane |
| 1,2,3-Trichloropropane |
| 1,1,2-Trichloro-1,2,2-trifluoroethane |
| Methylene chloride |
| Vinyl chloride |

analyzed in the last sampling event; all levels were below the detection limit of 1 μg/l.

Levels of phenols at site L-31N-6 were below the detection limit, indicating no phenol contamination from the airport at this time.

Volatile organic compounds that may be used as solvents in airport operations include chlorobenzene, vinylidene chloride, cis/trans-1,2-dichloroethene, o/m/p-dichlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, trichloroethylene, o/m/p-chlorotoluene, 1,1,1-trichloroethane and o/m-chlorotoluene. There was no detection of any of these solvents.

## Parameters Related to Cement Manufacturing

Although operations ceased in 1984, General Portland Cement Company was issued a Notice of Violation and Orders for Corrective Action in 1986, which required soil and groundwater testing for pollution. Contamination may have resulted from the long-term storage of coal and diesel fuel and chemicals from service and maintenance of heavy mobile equipment. Contaminants include heavy metals (copper, lead and zinc), phenols and volatile organic compounds.

No copper was found above detection limits during an on-site analysis at General Portland Cement for copper in 1987. However, these tests were performed using Flame Atomic Absorption Spectroscopy which has detection limits which sometimes exceed levels that impair drinking water quality.

L-31N, which runs north to south in this area, had low levels of all relevant parameters throughout the year with the exception of copper. On one sampling event, the copper level at L-31N-2 was 20 times greater than the background. Subsequent sampling at this site indicated low levels of copper. The higher result was possibly an anomaly. At this time, there seems to be no evidence of impact of General Portland Cement on surface water quality in the L-31N canal.

## Sediment Findings

Sediment samples were collected in the L-31N canal twice during the study (October 1987 and February 1988). Samples were collected with a petite ponar for metals, herbicides, pesticides and polychlorinated biphenyls (PCBs). Levels of arsenic, cadmium and chromium were below detection limits, whereas zinc and lead were detected at low levels.

Lead levels ranged from <0.01 - 0.02 g/kg with the higher values being detected in the dry season. Levels of lead were too close to the instrumental detection limit to be considered significant.

Zinc levels ranged from <0.01 - 0.06 g/kg in the late wet season, but stayed below detection limits in the dry season. The highest levels were at the background site.

## Other Water Quality Considerations

Although parameters analyzed on the L-31N canal were not in violation of the drinking water standards listed in Table 6, it should not be concluded that the canal's water is pristine. Dilution, diffusion and flow in canals can dissipate contaminants rapidly, especially after a rain event, and cause difficulties in contaminant tracking. From a practical viewpoint, levels of contaminants in surface waters rarely exceed standards, but the accumulated impact of slightly elevated levels may indicate overall water quality degradation.

A comparison of the water quality parameters for the L-31N canal with average levels for all other canals in Dade County (figure 7) allows the following observations:

1. Dissolved oxygen (D.O.) levels were significantly lower in the L-31N with an average of 2.8 mg/l. However, Class III standards (Table 7) require that dissolved oxygen should not be less than 5 mg/l at any time. This was violated at all sites on at least two occasions throughout the program.
2. Bacteria levels were significantly lower in the L-31N with medians values of: total coliform 40

TABLE 6: DRINKING WATER STANDARDS

| | PARAMETER | MAXIMUM CONTAMINANT LEVEL |
|---|---|---|
| INORGANICS | Arsenic | 50 μg/l |
| | Cadmium | 10 μg/l |
| | Lead | 50 μg/l |
| | Mercury | 2 μg/l |
| | Nitrate as N | 10 mg/l |
| | Sodium | 160 mg/l |
| ORGANICS | Endrin | 0.2 μg/l |
| | Lindane | 4 μg/l |
| | Methoxychlor | 100 μg/l |
| | Toxaphene | 5 μg/l |
| | 2,4-D | 100 μg/l |
| | 2,4,5-TP (Silvex) | 10 μg/l |
| VOLATILE ORGANICS | Trichloroethylene | 3 μg/l |
| | Carbon tetrachloride | 3 μg/l |
| | Vinyl chloride | 1 μg/l |
| | 1,2-Dichloroethane | 3 μg/l |
| | Benzene | 1 μg/l |
| | para-Dichlorobenzene | 75 μg/l |
| | 1,1-Dichloroethylene | 7 μg/l |
| | 1,1,1-Trichloroethane | 200 μg/l |
| | Tetrachloroethylene | 3 μg/l |
| | Ethylene dibromide | 0.02 μg/l |
| | Total trihalomethanes | 100 μg/l |
| μ BIO | Coliform Bacteria | 1 per 100 ml monthly average |
| PHYS | Turbidity | 1 Turbidity Unit |
| 2,STDS | Chloride | 250 mg/l |
| | Copper | 1 mg/l |
| | Foaming Agents | 500 μg/l |
| | pH | 6.5 minimum |
| | Total Dissolved Solids | 500 mg/l |
| | Zinc | 5 mg/l |

Unless otherwise noted, standards are Florida's Primary Drinking Water Standards.

FIGURE 7 COMPARISON OF L—31N CANAL WITH OTHER CANALS IN DADE COUNTY

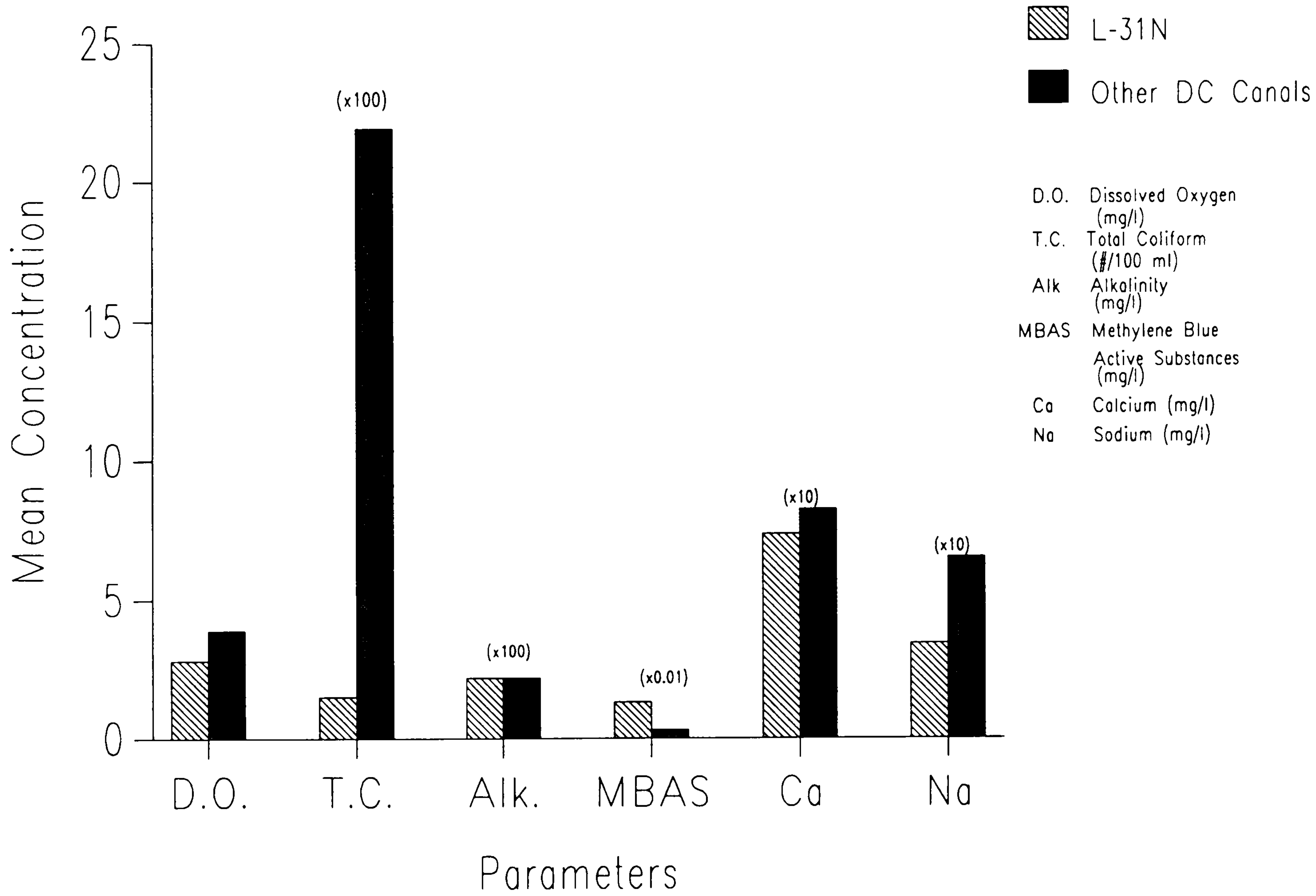


TABLE 7: CLASS III WATER QUALITY CRITERIA

| PARAMETER | CRITERIA |
|---|---|
| Alkalinity | Not below 20 mg/l as CaCO3 |
| Ammonia | 0.02 mg/l |
| Coliform Bacteria | 100 per 100 ml in 20% of the samples during any month; or 2,400 per 100 ml at any time. |
| Fecal Coliform | 400 per 100 ml in 10% of the samples; or 800 per 100 ml in any one day. |
| Cadmium | 0.8 μg/l in water with <150 mg/l CaCO3; or 1.2 μg/l in harder waters. |
| Copper | 30 μg/l |
| Cyanide | 5.0 μg/l |
| Dissolved Oxygen | Not less than 5 mg/l. |
| Lead | 30 μg/l |
| Mercury | 0.2 μg/l |
| Nutrients | Should not be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. |
| Zinc | 30 μg/l |
| Aldrin plus Dieldrin | 0.003 μg/l |
| Chlordane | 0.01 μg/l |
| DDT | 0.001 μg/l |
| Endosulfan | 0.003 μg/l |
| Endrin | 0.004 μg/l |
| Heptachlor | 0.001 μg/l |
| Lindane | 0.01 μg/l |
| Methoxychlor | 0.03 μg/l |
| Mirex | 0.001 μg/l |
| Parathion | 0.04 μg/l |
| Toxaphene | 0.005 μg/l |
| Phosphorus | 0.1 μg/l |
| Polychlorinated Biphenyls | 0.001 μg/l |

MPN/100 ml; fecal coliform <20 MPN/100 ml and fecal streptococci <20 MPN/100 ml. Levels were well below the standards.

3. Alkalinity levels in the L-31N were not significantly different from other canals. Levels ranged from 188 to 294 mg/l with a median value of 218 mg/l and were in compliance with Class III standards.
4. Methylene Blue Active Substances (MBAS) are, in general, foaming agents. Levels of MBAS in the L-31N canal averaged 0.1 mg/l, well below the 0.5 mg/l standard.
5. Calcium averaged 73.5 mg/l and ranged from 68.2 to 78.7 mg/l. Sodium levels were also significantly lower than those present in the other canals, with an average of 34 mg/l. The data is inconclusive, however, because these parameters were analyzed only once during the study.
6. Metal concentrations were similar to levels from other county canals and met Class III standards.
7. Overall, nutrient levels were lower than other canals within the County which are impacted by agriculture (e.g., C-102, C-103 and Goulds canals). Ammonia levels did exceed 0.02 mg/l Class III standard at all sites along the L-31N.
8. DER uses a rating scheme to characterize water quality along stream reaches in the State of

Florida. This rating scheme involves a determination of a 'Water Quality Index' which determines the overall water quality. Based on the average of six water quality index (WQI) categories (see Table 8), DER has designated the water quality in the L-31N canal 'Fair'. Some of the categories were not analyzed in this study (oxygen demanding substances and macroinvertebrate diversity), and therefore an overall water quality index cannot be accurately determined. However, individual categories were compared to cutoff values (0 to less than 45 for Good quality, 45 to less than 60 is Fair and 60 to less than 90 is Poor), and WQI's were determined for each category. As shown in Table 8, water clarity, nutrients and bacteria indicates Good water quality. However, the water quality in respect to the category of dissolved oxygen is Poor. This rating is fairly typical of Dade County canals because of the close interaction with groundwater which is naturally low in dissolved oxygen in the limestone strata. As a consequence, if D.O. data are removed as an evaluation criteria the water quality in the L-31N should be rated as 'Good'.

# TABLE 8 CALCULATION OF FLORIDA WATER QUALITY INDEX (WQI) FOR THE L-31N CANAL

| WATER QUALITY CATEGORY | WATER QUALITY PARAMETER | VALUE (1) | P.I. VALUE (2) | P.I. AVERAGE | WQI (3) ASSESSMENT |
|---|---|---|---|---|---|
| Water Clarity | Turbidity | 4.4 NTU | 30 | 30 | Good |
| | Total Suspended Solids | -1 | NA | | |
| Dissolved Oxygen | Dissolved Oxygen | 2.7 mg/l | 90 | 90 | Poor |
| Oxygen Demanding Substances | Biochemical Oxygen Demand | -1 | NA | | |
| | Chemical Oxygen Demand | -1 | NA | | |
| | Total Organic Carbon | -1 | NA | | |
| Nutrients | Total Nitrogen | -1 | | | |
| | Total Phosphorus | 0.01 mg/l | 10 | 10 | Good |
| Bacteria | Total Coliform | 74 MPN/100 ml | 10 | 15 | Good |
| | Fecal Coliform | <20 MPN/100 ml | 20 | | |
| Macroinvertebrate Diversity | Natural Substrate | -1 | NA | | |
| | Artificial Substrate | -1 | NA | | |
| | Beck's Biotic Index | -1 | NA | | |

Notes:

1. These are the average data values. A value of -1 means that the parameter was not sampled.
2. This is the parameter index which is the percentile distribution of STORET data in the 1988 Florida Water Quality Assessment 305(b) Technical Appendix (pp.4).
3. This assessment uses the following scale:

0 - <45 Good Quality

45 - <60 Fair Quality

60 - 90 Poor Quality

## Trihalomethane Formation Potential

Trihalomethanes (THMs) are trisubstituted halogenated methanes formed as a result of disinfection with chlorine. The THMs that bear directly on water quality are chloroform ($CHCl_3$), bromodichloromethane ($CHCl_2Br$), chlorodibromomethane ($CHClBr_2$) and bromoform ($CHBr_3$). Because THMs are detrimental to human health, the maximum contaminant level (MCL) allowed in finished drinking water is 100 µg/l. The Environmental Protection Agency (EPA) is currently contemplating a decrease in the MCL by 50-90%.

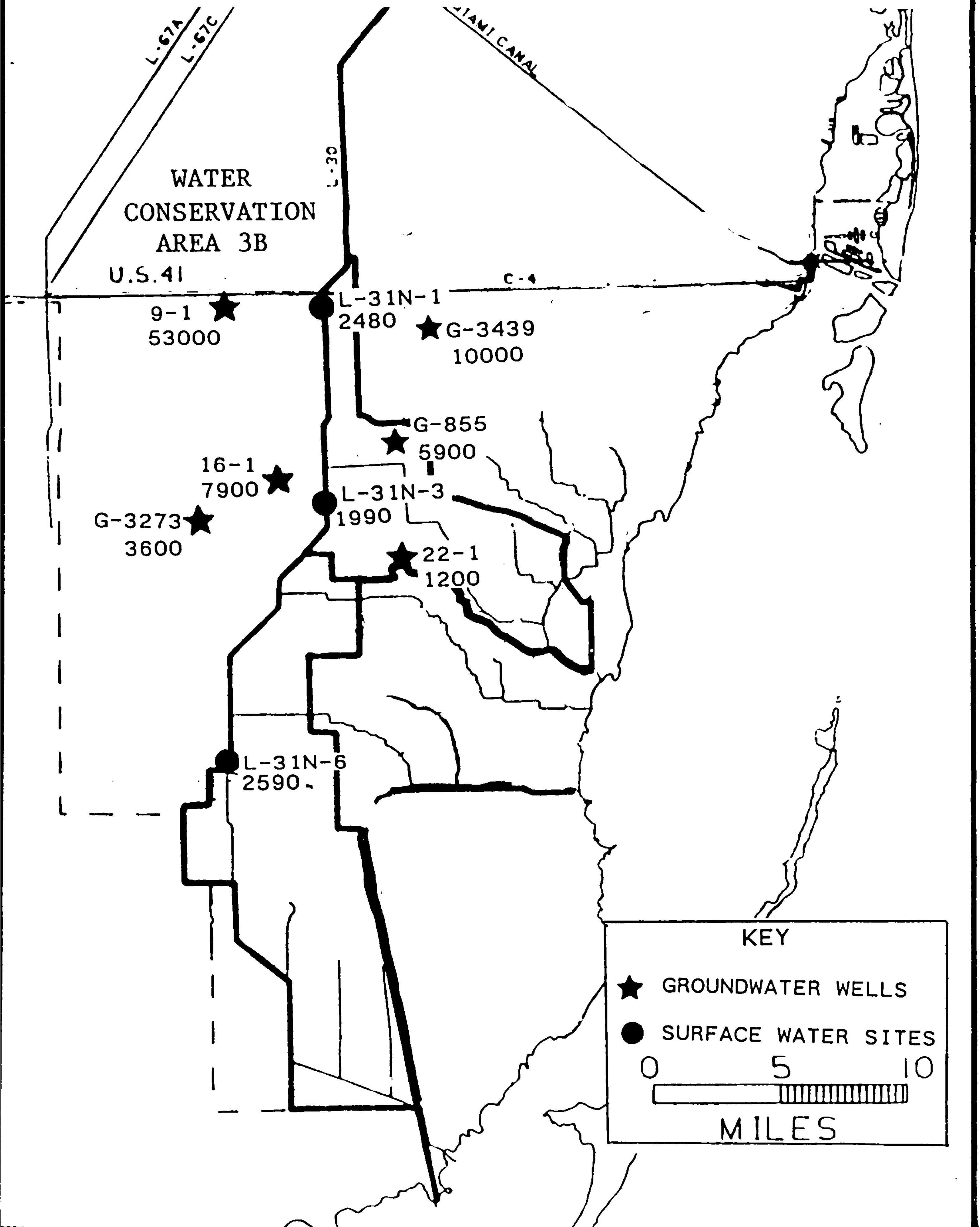
Analysis of THMs formation potential (THMFP) gives an indication of the potential of the organic compounds that are present in the water to form THMs during the disinfection process. THMFPs are important when evaluating the water quality in the L-31N because this canal will serve as a major recharge boundary for the proposed Dade County West Wellfield with a design capacity of 140 million gallons water pumpage per day.

There is no data available for other canals in the county; however, groundwater from Snapper Creek wellfield, which is closely linked with the Snapper Creek canal, had a THMFP level of 692 µg/l. Current disinfection practices at the treatment plant served by the Snapper Creek Wellfield limit the formation of THMs to 25-30 µg/l by treating the water with ammonia immediately after chlorine.

THMFP was analyzed at half of the sampling sites on the L-31N canal. THMFP averaged 2,353 µg/l with a range of 1,990 to 2,590 µg/l. THMFPs were examined in groundwater wells located in the vicinity of the L-31N and the proposed West Wellfield (figure 8). Groundwater concentrations ranged from 1,200 to 53,000 µg/l. Based on this limited data set, the levels in the canal were not significantly different from those in the groundwater.

If this is an indication of the levels of THMFPs for the southwestern Dade County area, it is unclear if current disinfectant practices will be sufficient to maintain low THMs in drinking water obtained from the West Wellfield. If not, removal of more organic material prior to chlorination or other treatment modifications may be required.

Figure 8: Trihalomethane Formation Potential Data



# APPENDIX I:
# Data Tables

1987 INTENSIVE CANAL SURVEY

| Site | Date | D.O. mg/l | Temp. C | Cond. umhos/cm | pH | Depth (ft) |
|---|---|---|---|---|---|---|
| L-31N-1 | 6/16/87 | 3.1 | 30.0 | 545 | 6.6 | |
| | 10/5/87 | 0.7 | 29.0 | 535 | 6.4 | |
| | 12/16/87 | | | 499 | 6.4 | |
| | 12/21/87 | 1.8 | 24.0 | | | |
| | 2/23/88 | 1.1 | 22.2 | 610 | 6.7 | 16.5 |
| L-31N-2 | 6/16/87 | 4.2 | 30.5 | 508 | 6.6 | |
| | 10/5/87 | 0.7 | 25.0 | 530 | 6.8 | |
| | 12/16/87 | | | 565 | 7.1 | |
| | 12/21/87 | 4.3 | 24.0 | | | |
| | 2/23/88 | 1.1 | 22.5 | 560 | 6.8 | 17.0 |
| L-31N-3 | 6/16/87 | 5.5 | 30.5 | 500 | 6.7 | |
| | 10/5/87 | 0.7 | 25.0 | 510 | 6.8 | |
| | 12/16/87 | | | 571 | 7.1 | |
| | 12/21/87 | 2.2 | 24.0 | | | |
| | 2/23/88 | 2.5 | 22.5 | 553 | 6.7 | 21.0 |
| L-31N-4 | 6/16/87 | 4.5 | 30.0 | 496 | 6.6 | |
| | 10/6/87 | 0.7 | 24.0 | 588 | 6.5 | |
| | 12/16/87 | | | 563 | 7.1 | |
| | 12/21/87 | 2.0 | 24.0 | | | |
| | 2/23/88 | 4.5 | 22.5 | 486 | 7.1 | 12.0 |
| L-31N-5 | 6/16/87 | 4.6 | 30.0 | 493 | 6.8 | |
| | 10/6/87 | 0.5 | 24.0 | 552 | 6.8 | |
| | 12/16/87 | | | 571 | 7.1 | |
| | 12/21/87 | 2.2 | 24.0 | | | |
| | 2/23/88 | 3.8 | 22.5 | 507 | 7.1 | 14.0 |
| L-31N-6 | 6/16/87 | 4.9 | 30.0 | 500 | 6.8 | |
| | 10/6/87 | 0.8 | 25.0 | 515 | 6.7 | |
| | 12/16/87 | | | 567 | 7.2 | |
| | 12/21/87 | 1.8 | 24.0 | | | |
| | 2/23/88 | 6.5 | 22.0 | 541 | 7.1 | 16.5 |

1987 INTENSIVE CANAL SURVEY

| | | NH3-N mg/l | NOx-N mg/l | O-PO4 mg/l | T-PO4 mg/l |
|---|---|---|---|---|---|
| L-31N-1 | 06/16/87 | 0.11 | 0.03 | 0.005 | 0.010 |
| | 10/05/87 | 0.85 | 0.03 | 0.004 | 0.014 |
| | 12/16/87 | 0.72 | 0.01 | 0.007 | 0.009 |
| | 02/24/88 | 0.83 | <0.01 | 0.004 | 0.022 |
| L-31N-2 | 06/16/87 | 0.15 | 0.02 | 0.004 | 0.011 |
| | 10/05/87 | 0.65 | 0.03 | 0.004 | 0.010 |
| | 12/16/87 | 0.59 | 0.01 | 0.006 | 0.008 |
| | 02/24/88 | 0.54 | <0.01 | 0.002 | 0.030 |
| L-31N-3 | 06/16/87 | 0.17 | 0.06 | 0.005 | 0.012 |
| | 06/16/87 | 0.17 | 0.02 | 0.004 | 0.012 |
| | 10/05/87 | 0.57 | 0.01 | 0.003 | 0.017 |
| | 10/05/87 | 0.63 | 0.01 | 0.003 | 0.014 |
| | 12/16/87 | 0.56 | 0.01 | 0.006 | 0.009 |
| | 12/16/87 | 0.59 | <0.01 | 0.006 | 0.007 |
| | 02/24/88 | 0.54 | <0.01 | 0.003 | 0.010 |
| L-31N-4 | 06/16/87 | 0.13 | 0.03 | 0.003 | 0.011 |
| | 10/05/87 | 0.55 | 0.11 | 0.002 | 0.010 |
| | 12/16/87 | 0.54 | <0.01 | 0.005 | 0.010 |
| | 02/24/88 | 0.43 | 0.02 | 0.003 | 0.010 |
| | 02/24/88 | 0.42 | 0.05 | 0.001 | 0.018 |
| L-31N-5 | 06/16/87 | 0.13 | 0.05 | 0.003 | 0.015 |
| | 10/05/87 | 0.57 | 0.01 | 0.002 | 0.014 |
| | 12/16/87 | 0.52 | 0.01 | 0.005 | 0.011 |
| L-31N-6 | 06/16/87 | 0.23 | 0.07 | 0.005 | 0.024 |
| | 10/05/87 | 0.62 | 0.02 | 0.001 | 0.014 |
| | 10/05/87 | 0.57 | 0.25 | 0.002 | 0.014 |
| | 12/16/87 | 0.52 | 0.01 | 0.005 | 0.011 |
| | 02/24/88 | 0.31 | 0.11 | <0.001 | 0.022 |

# 1987 INTENSIVE CANAL SURVEY

| | | As ug/l | Cd ug/l | Cu ug/l | Pb ug/l | Hg ug/l | Zn mg/l |
|---|---|---|---|---|---|---|---|
| L-31N-1 | 06/16/87 | <2 | <0.1 | <1 | 1.1 | <0.1 | <0.01 |
| | 10/05/87 | <2 | <0.1 | <1 | <1 | <0.1 | <0.01 |
| | 12/16/87 | <2 | <0.1 | <1 | <2 | <0.1 | <0.01 |
| | 02/24/88 | <2 | 1.7 | <1 | <2 | <0.1 | |
| L-31N-2 | 06/16/87 | <2 | <0.1 | 20.4 | 0.9 | <0.1 | <0.01 |
| | 10/05/87 | <2 | <0.1 | <1 | <1 | <0.1 | <0.01 |
| | 12/16/87 | <2 | <0.1 | <1 | <2 | <0.1 | <0.01 |
| | 02/24/88 | <2 | 1.9 | <1 | 2.5 | <0.1 | |
| L-31N-3 | 06/16/87 | <2 | <0.1 | <1 | 1.1 | <0.1 | <0.01 |
| | 06/16/87 | <2 | <0.1 | <1 | 0.7 | <0.1 | <0.01 |
| | 10/05/87 | <2 | <0.1 | <1 | <1 | <0.1 | <0.01 |
| | 10/05/87 | <2 | <0.1 | <1 | <1 | <0.1 | <0.01 |
| | 12/16/87 | <2 | <0.1 | <1 | <2 | <0.1 | <0.01 |
| | 12/16/87 | <2 | <0.1 | <1 | <2 | <0.1 | <0.01 |
| | 02/24/88 | <2 | 2.0 | 1.3 | <2 | <0.1 | |
| L-31N-4 | 06/16/87 | <2 | <0.1 | <1 | 0.6 | <0.1 | <0.01 |
| | 10/05/87 | <2 | <0.1 | <1 | <1 | <0.1 | <0.01 |
| | 12/16/87 | <2 | <0.1 | <1 | <2 | <0.1 | <0.01 |
| | 02/24/88 | <2 | 1.9 | <1 | <2 | <0.1 | |
| | 02/24/88 | <2 | 1.8 | <1 | <2 | <0.1 | <0.01 |
| L-31N-5 | 06/16/87 | <2 | <0.1 | <1 | 1.5 | <0.1 | <0.01 |
| | 10/05/87 | <2 | <0.1 | <1 | <1 | <0.1 | <0.01 |
| | 12/16/87 | <2 | <0.1 | <1 | <2 | <0.1 | <0.01 |
| | 02/24/88 | <2 | 1.9 | <1 | <2 | <0.1 | |
| L-31N-6 | 06/16/87 | <2 | <0.1 | <1 | 0.6 | <0.1 | <0.01 |
| | 10/05/87 | <2 | <0.1 | <1 | <1 | <0.1 | <0.01 |
| | 10/05/87 | <2 | <0.1 | <1 | <1 | <0.1 | <0.01 |
| | 12/16/87 | <2 | <0.1 | <1 | <2 | <0.1 | <0.01 |
| | 02/24/88 | <2 | 1.9 | <1 | 2.1 | <0.1 | |

| Site | Date | Cl mg/l | Alk mg/l | Turb NTU | MBAS mg/l | Phenols ug/l |
|---|---|---|---|---|---|---|
| L-31N-1 | 06/10/87 | 78.0 | 195.1 | 3.8 | 0.2 | 8 |
| | 10/05/87 | 64.2 | 240.0 | 6.4 | < 0.1 | <2 |
| | 12/16/87 | 47.5 | 193.8 | 1.3 | 0.1 | <4 |
| | 02/24/88 | 53.1 | 188.0 | 6.3 | N.D. | 6 |
| L-31N-2 | 06/10/87 | 80.5 | 209.9 | 10.5 | 0.2 | 4 |
| | 10/05/87 | 67.3 | 234.0 | 5.3 | < 0.1 | <2 |
| | 12/16/87 | 73.0 | 212.4 | 3.1 | 0.2 | <4 |
| | 02/24/88 | 70.2 | 215.0 | 4.6 | N.D. | 8 |
| L-31N-3 | 06/10/87 | 86.5 | 220.0 | 4.4 | < 0.1 | 3 |
| | 06/10/87 | 85.0 | 217.2 | 3.2 | | 3 |
| | 10/05/87 | 63.0 | 232.0 | 5.0 | < 0.1 | <2 |
| | 10/05/87 | 62.9 | | | N.D. | <2 |
| | 12/16/87 | 78.0 | 208.0 | 3.2 | N.D. | <4 |
| | 12/16/87 | 78.0 | 210.0 | 2.6 | 0.1 | <4 |
| | 02/24/88 | 66.3 | 204.0 | 3.4 | N.D. | 8 |
| L-31N-4 | 06/10/87 | 91.2 | 228.0 | 4.0 | 0.2 | <2 |
| | 10/06/87 | 67.5 | 235.0 | 7.6 | < 0.1 | <2 |
| | 12/16/87 | 79.5 | 196.0 | 4.5 | 0.1 | <4 |
| | 02/23/88 | 62.4 | 213.0 | 1.9 | N.D. | 6 |
| | 02/23/88 | 63.8 | 212.0 | 1.9 | N.D. | 6 |
| L-31N-5 | 06/10/87 | 91.0 | 236.0 | 3.6 | 0.2 | <2 |
| | 10/06/87 | 67.7 | 231.0 | 6.5 | < 0.1 | <2 |
| | 12/16/87 | 82.8 | 210.0 | 5.2 | 0.1 | <4 |
| | 02/23/88 | 61.8 | 190.0 | 2.3 | N.D. | N.D. |
| L-31N-6 | 06/10/87 | 94.0 | 243.2 | 2.6 | 0.2 | <2 |
| | 10/06/87 | 67.5 | 231.0 | 9.3 | N.D. | <2 |
| | 10/06/87 | 68.5 | 294.3 | ** | < 0.1 | <2 |
| | 12/16/87 | 90.0 | 211.0 | 2.8 | 0.1 | <4 |
| | 02/23/88 | 62.0 | 200.0 | 2.4 | N.D. | 6 |

** = value reported 64 NTU, but not confirmed.

BACTERIA
(Units: Counts per 100 ml)

| Site | Date | MPN Total Coliform | Fecal Coliform | Fecal Streptococcus |
|---|---|---|---|---|
| L-31N-1 | 06/10/87 | <20 | <20 | <20 |
| | 10/05/87 | 80 | 20 | N.D. |
| | 12/16/87 | <20 | <20 | N.D. |
| | 02/22/88 | <20 | <20 | N.D. |
| L-31N-2 | 06/10/87 | <20 | <20 | <20 |
| | 10/05/87 | 170 | 20 | N.D. |
| | 12/16/87 | <20 | <20 | N.D. |
| | 02/22/88 | 20 | <20 | N.D. |
| L-31N-3 | 06/10/87 | <20 | <20 | <20 |
| | 10/05/87 | 300 | <20 | N.D. |
| | 12/16/87 | <20 | <20 | N.D. |
| | 02/22/88 | <20 | <20 | N.D. |
| L-31N-4 | 06/10/87 | 80 | 40 | <20 |
| | 10/06/87 | 40 | 20 | N.D. |
| | 12/16/87 | <20 | <20 | N.D. |
| | 02/22/88 | 500 | 20 | N.D. |
| L-31N-5 | 06/10/87 | 40 | <20 | <20 |
| | 10/06/87 | 80 | <20 | N.D. |
| | 12/16/87 | <20 | <20 | N.D. |
| | 02/22/88 | 130 | 20 | N.D. |
| L-31N-6 | 06/10/87 | 80 | <20 | <20 |
| | 10/06/87 | <20 | <20 | N.D. |
| | 12/16/87 | <20 | <20 | N.D. |
| | 02/22/88 | 270 | 20 | N.D. |

N.D. = No Data

# 1987 INTENSIVE CANAL STUDY PESTICIDES DATA

| SITE | DATE | CHLORINATED INSECTICIDES (µg/l) (1) | HERBICIDES (µg/l) (2) |
|---|---|---|---|
| L-31N-1 | 6/10/87 | BDL | BDL |
| | 10/5/87 | BDL | BDL |
| | 12/16/87 | BDL | BDL |
| L-31N-2 | 6/10/87 | BDL | BDL |
| | 10/5/87 | BDL | BDL |
| | 12/16/87 | BDL | BDL |
| L-31N-3 | 6/10/87 | BDL | BDL |
| | 6/10/87 | BDL | BDL |
| | 10/5/87 | BDL | BDL |
| | 10/5/87 | BDL | BDL |
| | 12/16/87 | BDL | BDL |
| | 12/16/87 | BDL | BDL |
| L-31N-4 | 6/10/87 | BDL | BDL |
| | 10/5/87 | BDL | BDL |
| | 12/16/87 | BDL | BDL |
| L-31N-5 | 6/10/87 | BDL | BDL |
| | 10/5/87 | BDL | BDL |
| | 12/16/87 | BDL | BDL |
| L-31N-6 | 6/10/87 | BDL | BDL |
| | 10/5/87 | BDL | BDL |
| | 10/5/87 | BDL | BDL |
| | 12/16/87 | BDL | BDL |

BDL = Below Dectection Limit

(1) Detection Limit: See APPENDIX pp.7.

(2) Detection limit: 2,4-D 0.02 µg/l

2,4,5-T 0.002 µg/l

# DETECTION LIMITS OF PESTICIDES & PCBs ANALYZED IN 1987 INTENSIVE CANAL STUDY

| COMPOUNDS | June 87 | Oct. 87 | Dec. 87 | Feb 88 |
|---|---|---|---|---|
| alpha-BHC | 0.002 | 0.002 | 0.002 | 0.006 |
| beta-BHC | 0.003 | 0.003 | 0.003 | 0.015 |
| gamma-BHC | 0.002 | 0.002 | 0.002 | 0.007 |
| Aldrin | 0.002 | 0.002 | 0.002 | 0.010 |
| alpha-Chlordane | 0.003 | 0.003 | 0.003 | 0.013 |
| gamma-Chlordane | 0.003 | 0.003 | 0.003 | 0.014 |
| Chlordane | 0.012 | 0.012 | 0.012 | 0.104 |
| Dieldrin | 0.004 | 0.004 | 0.004 | 0.020 |
| o,p'-DDD | 0.009 | 0.009 | 0.009 | 0.040 |
| p,p'-DDD | 0.009 | 0.009 | 0.009 | 0.042 |
| o,p'-DDE | 0.005 | 0.005 | 0.005 | 0.023 |
| p,p'-DDE | 0.004 | 0.004 | 0.004 | 0.018 |
| o,p'-DDT | 0.010 | 0.010 | 0.010 | 0.048 |
| p,p'-DDT | 0.005 | 0.005 | 0.005 | 0.050 |
| Endosulfan I | 0.004 | 0.004 | 0.004 | 0.018 |
| Endosulfan II | 0.007 | 0.007 | 0.007 | 0.034 |
| Endosulfan cyclic sulfate | 0.007 | 0.007 | 0.007 | 0.105 |
| Endrin | 0.003 | 0.003 | 0.003 | 0.033 |
| Endrin aldehyde | 0.01 | 0.01 | 0.01 | 0.057 |
| Heptachlor | 0.002 | 0.002 | 0.002 | 0.010 |
| Heptachlor Epoxide | 0.002 | 0.002 | 0.002 | 0.014 |
| Methoxychlor | 0.012 | 0.012 | 0.012 | 0.150 |
| Mirex | 0.050 | 0.050 | 0.050 | 0.053 |
| Toxaphene | 0.100 | 0.100 | 0.100 | 0.527 |
| Aroclor 1016 | 0.033 | 0.033 | 0.033 | 0.142 |
| Aroclor 1221 | 0.028 | 0.028 | 0.028 | 0.264 |
| Aroclor 1232 | 0.030 | 0.030 | 0.030 | 0.313 |
| Aroclor 1242 | 0.030 | 0.030 | 0.030 | 0.186 |
| Aroclor 1248 | 0.042 | 0.042 | 0.042 | 0.251 |
| Aroclor 1254 | 0.028 | 0.028 | 0.028 | 0.190 |
| Aroclor 1260 | 0.038 | 0.038 | 0.038 | 0.221 |
| Aroclor 1262 | 0.048 | 0.048 | 0.048 | 0.261 |

| | | ALACHLOR | ALDICARB | ATRAZINE | BENOMYL | CARBOFURAN |
|---|---|---|---|---|---|---|
| L-31N-1 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-2 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-3 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-4 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-5 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-6 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |

N.D. = None Detected

| | | CHLOROTHALONIL | ETHOPROP | FENAMIPHOS | FONOPHOS | METOLACHLOR |
|---|---|---|---|---|---|---|
| L-31N-1 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-2 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-3 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-4 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-5 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-6 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |

N.D. = None Detected

| | | METHAMIDOPHOS | METHOMYL | METRIBUZIN | OXAMYL | PARAQUAT |
|---|---|---|---|---|---|---|
| L-31N-1 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-2 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-3 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-4 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-5 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |
| L-31N-6 | 06/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. | N.D. | N.D. | N.D. |

N.D. = None Detected

| | | PERMETHRIN | SIMAZINE |
|---|---|---|---|
| L-31N-1 | 06/16/87 | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. |
| L-31N-2 | 06/16/87 | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. |
| L-31N-3 | 06/16/87 | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. |
| L-31N-4 | 06/16/87 | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. |
| L-31N-5 | 06/16/87 | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. |
| L-31N-6 | 06/16/87 | N.D. | N.D. |
| | 10/05/87 | N.D. | N.D. |
| | 12/16/87 | N.D. | N.D. |
| | 02/24/88 | N.D. | N.D. |

N.D. = None Detected

# DETECTION LIMITS OF PESTICIDES ANALYZED IN 1987 INTENSIVE CANAL STUDY

| COMPOUNDS | METHOD DETECTION LIMIT | | | |
|---|---|---|---|---|
| | June 87 | Oct. 87 | Dec. 87 | Feb 88 |
| Alachlor | 0.02 | 0.02 | 0.02 | 0.04 |
| Aldicarb | 2.0 | 2.0 | 2.0 | 2.0 |
| Atrazine | 0.20 | 0.10 | 0.10 | 0.10 |
| Benomyl | 20.0 | 20.0 | 20.0 | 20.0 |
| Carbofuran | 10.0 | 10.0 | 10.0 | 10.0 |
| Chlorothalonil | 0.004 | 0.004 | 0.004 | 0.01 |
| Ethoprop | 0.06 | 0.06 | 0.06 | 0.06 |
| Fenamiphos | 0.2 | 1.0 | 0.20 | 0.06 |
| Fonophos | 0.06 | 0.06 | 0.06 | 0.06 |
| Metolachlor | 0.02 | 0.02 | 0.02 | 0.02 |
| Methamidophos | 0.2 | 0.20 | 0.20 | 0.20 |
| Methomyl | 20.0 | 20.0 | 20.0 | 20.0 |
| Metribuzin | 0.004 | 0.004 | 0.004 | 0.004 |
| Oxamyl | 2.0 | 2.0 | 2.0 | 2.0 |
| Paraquat | 3.0 | 5.0 | 3.0 | 3.0 |
| Permethrin | 0.50 | 0.10 | 0.50 | 1.0 |
| Simazine | 0.20 | 0.10 | 0.10 | 0.10 |

1987 INTENSIVE CANAL STUDY 602s DATA

| SITE | DATE | BENZENE | TOLUENE | E-BENZENE | p-XYLENE | m-XYLENE | o-XYLENE | p-m-DCBENZENE | o-DCBENZENE |
|---|---|---|---|---|---|---|---|---|---|
| L-31N-1 | 6/10/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 10/5/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 12/16/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 2/24/88 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| L-31N-2 | 6/10/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 10/5/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 12/16/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 2/24/88 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| L-31N-3 | 6/10/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 10/5/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 12/16/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 12/16/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 2/24/88 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| L-31N-4 | 6/10/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 10/5/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 12/16/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 2/24/88 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 2/24/88 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| L-31N-5 | 6/10/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 10/5/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 12/16/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 2/24/88 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| L-31N-6 | 6/10/87 | BDL | Interference | BDL | BDL | BDL | BDL | BDL | BDL |
| | 6/26/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 10/5/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 12/16/87 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| | 2/24/88 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

# 1987 INTENSIVE CANAL SEDIMENT DATA

## Metals Data (Units: g/kg)

| SITE | DATE | As | Cd | Cr | Cu | Pb | Zn |
|---|---|---|---|---|---|---|---|
| L-31N-1 | 10/5/87 | 0.0024 | <0.01 | ND | <0.01 | 0.01 | 0.06 |
| | 2/24/88 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| L-31N-2 | 10/5/87 | ND | ND | ND | ND | ND | ND |
| | 2/24/88 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| L-31N-3 | 10/5/87 | 0.0034 | <0.01 | ND | <0.01 | <0.01 | <0.01 |
| | 10/5/87 | 0.0036 | <0.01 | ND | <0.01 | <0.01 | <0.01 |
| | 2/24/88 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| L-31N-4 | 10/5/87 | ND | ND | ND | ND | ND | ND |
| | 2/24/88 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 |
| | 2/24/88 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 |
| L-31N-5 | 10/5/87 | 0.0048 | <0.01 | ND | <0.01 | <0.01 | 0.02 |
| | 2/24/88 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| L-31N-6 | 10/5/87 | 0.0031 | <0.01 | ND | <0.01 | <0.01 | 0.02 |
| | 10/5/87 | 0.0039 | <0.01 | ND | <0.01 | <0.01 | 0.02 |
| | 2/24/88 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |

## Herbicides Data (Units: mg/kg)

| SITE | DATE | 2,4-D | 2,4,5-TP SILVEX |
|---|---|---|---|
| L-31N-1 | 10/6/87 | <0.0003 | <0.00003 |
| L-31N-3 | 10/6/87 | <0.0003 | <0.00003 |
| L-31N-5 | 10/6/87 | <0.0003 | <0.00003 |
| L-31N-6 | 10/6/87 | <0.0003 | <0.00003 |

ND = No Data

# 1987 INTENSIVE CANAL STUDY

## TRIHALOMETHANES & FORMATION POTENTIAL DATA

UNITS: µg/l

| SITE | TOTAL TRIHALOMETHANE FORMATION POTENTIAL | CHLOROFORM | DICHLORO-BROMOFORM | CHLORODI-BROMOFORM | BROMOFORM |
|---|---|---|---|---|---|
| L-31N-1 | 2480 | 2400 | 80 | <10 | <10 |
| L-31N-3 | 1990 | 1990 | 90 | <10 | <10 |
| L-31N-6 | 2590 | 2500 | 90 | <10 | <10 |

# STATISTICAL RESULTS OF THE KRUSKAL WALLIS

## ONE-WAY ANALYSIS OF VARIANCE

| PARAMETERS | BKS L31NBKS | BKS L31NAGS | AGS L31NAGS | L31NBKS L31NAGS | L31NALL CANALL | L31NALL AGS | BKS L31NALL | BKS AGS |
|---|---|---|---|---|---|---|---|---|
| NH3-N | SV | SV | SV | NSV | SV | SV | SV | NSV |
| NOx-N | SV | SV | SV | NSV | - | SV | SV | SV |
| O-P | SV | SV | SV | NSV | SV | SV | SV | NSV |
| T-P | SV | SV | SV | NSV | SV | SV | SV | NSV |
| COND. | NSV | NSV | NSV | NSV | - | NSV | SV | SV |
| TURB. | SV | SV | SV | NSV | SV | SV | SV | NSV |
| ALK. | - | - | - | - | NSV | - | - | - |
| D.O. | - | - | - | - | SV | - | - | - |
| Pb | - | - | - | - | SV | - | - | - |
| Ca | - | - | - | - | SV | - | - | - |
| Na | - | - | - | - | SV | - | - | - |
| MBAS | - | - | - | - | SV | - | - | - |
| CL | NSV | NSV | SV | NSV | NSV | SV | NSV | SV |
| TOT. COLIFORM | - | - | - | - | SV | - | - | - |
| FECAL COLIF. | - | - | - | - | NSV | - | - | - |

BKS = BACKGROUND SURFACE WATER SITES

AGS = AGRICULTURAL SURFACE WATER SITES

L31NBKS = L31-N BACKGROUND SITES (Not in agricultural areas)

L31NAGS = L31-N AGRICULTURAL SITES

L31NALL = L31-N SITES (Agricultural and background)

CANALL = ALL SURFACE WATER SITES EXCEPT THE L31-N

SV = SIGNIFICANT VARIATION

NSV = NO SIGNIFICANT VARIATION

# APPENDIX II:
# References

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