Public Health Assessment for

PLYMOUTH AVENUE LANDFILL
DELAND, VOLUSIA COUNTY, FLORIDA
CERCLIS NO. FLD984167569
AUGUST 24, 1994

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

PUBLIC HEALTH ASSESSMENT

PLYMOUTH AVENUE LANDFILL

DELAND, VOLUSIA COUNTY, FLORIDA

CERCLIS NO. FLD984167569

Prepared by

The Florida Department of Health and Rehabilitative Services
Under Cooperative Agreement With
The Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations 42 C.F.R. Part 90). In preparing this document ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30 day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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ATSDR Public Health Assessment

ATSDR developed this fact sheet to provide information about its Public Health Assessments—a term that can be confusing. A Public Health Assessment is <u>not</u> the same thing as a medical exam or a community health study. It can sometimes lead to those things, as well as to other public health activities. ATSDR hopes this fact sheet is helpful to you in understanding what a Public Health Assessment is. You may have questions the fact sheet doesn't answer or need more information about ATSDR and its activities. A contact person is listed at the end of the fact sheet.

What is ATSDR?

ATSDR is the **Agency for Toxic Substances and Disease Registry**, a federal public health agency. ATSDR is part of the Public Health Service in the U.S. Department of Health and Human Services. ATSDR is not a regulatory agency like the U.S. Environmental Protection Agency. Created by Superfund legislation in 1980, ATSDR's mission is to **prevent exposure and adverse human health effects and diminished quality of life associated with exposure to hazardous substances from waste sites, unplanned releases, and other sources of pollution present in the environment.** Through its programs—including surveillance, registries, health studies, environmental health education, and applied substance-specific research—and by working with other federal, state, and local government agencies, ATSDR acts to protect public health.

What is a Public Health Assessment?

An ATSDR Public Health Assessment reviews available information about hazardous substances at a site and evaluates whether exposure to them might cause any harm to people. ATSDR conducts a Public Health Assessment for every site on or proposed for the National Priorities List (the NPL, also known as the Superfund list).

Public Health Assessments consider—

- what the levels (or "concentrations") of hazardous substances are
- whether people might be exposed to contamination and how (through "exposure pathways" such as breathing air, drinking or contacting water, contacting or eating soil, or eating food)
- what harm the substances might cause to people (or the contaminants' "toxicity")
- whether working or living nearby might affect people's health
- other dangers to people, such as unsafe buildings, abandoned mine shafts, or other physical hazards

To make those determinations, ATSDR looks at three primary sources of information—

- ***environmental data***, such as information about the contaminants and how people could come in contact with them
- ***health data***, including available information on communitywide rates of illness, disease, and death compared with national and state rates
- ***community concerns***, such as reports from the public about how the site affects their health or quality of life

How Are Public Health Assessments Used?

ATSDR's Public Health Assessments identify health studies or other public health actions—such as community environmental health education—that might be needed. They advise federal, state, and local agencies on actions to prevent or reduce people's exposure to hazardous substances.

How Is the Community Involved in a Public Health Assessment?

The community plays a key role in a Public Health Assessment and any activity that may follow. Throughout the Public Health Assessment, ATSDR talks with people living or working near the site—action groups, local leaders, and health professionals, among other community members—about what they know about the site and their site-related health concerns. Community health concerns are addressed in every Public Health Assessment for every site.

Two-way communication between the public and ATSDR is vital to every Public Health Assessment. For that reason, ATSDR has many ways to give and receive information and involve the community in its activities, such as—

- **Public Availability Sessions** where community members can meet individually with ATSDR staff.
- **Public Meetings** so community members can express ideas in a larger forum.
- **Community Assistance Panels**, or CAPs, which work to inform ATSDR about community concerns and health information and, in turn, to inform the community about ATSDR activities and the status of the Public Health Assessment.
- Other **communication channels**, such as contact with local community groups, political leaders, and health professionals, as well as articles in local newspapers and stories on television and radio.
- Before the Public Health Assessment is finished, it is available in the community during the **Public Comment Period.** The Public Comment Period lets the community tell ATSDR how well the Public Health Assessment addresses their concerns. ATSDR responds to the public's comments in the final Public Health Assessment.

Fact sheets are available on Public Health Advisories, Health Consultations, Community Assistance Panels, and other ATSDR activities. If you want to know more about ATSDR, or if you have health concerns or information to share about ways people might have been or might now be exposed to hazardous substances, please contact the person listed below.

For more information, call or write:

Community Involvement Specialist
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SUMMARY

The Plymouth Avenue Landfill is about 1.75 miles west of the City of DeLand in rural western Volusia County, Florida. Volusia County owns this landfill and operates it under its Department of Solid Waste Management. From 1971 to 1988 it was a Class I landfill and received all types of nonhazardous industrial and municipal solid waste. From June 1978 to October 1980, the landfill reportedly received 4,500 gallons per week of process waste slurry from the Brunswick Corporation. This waste contained nitrate up to 90,000 milligrams per liter. The Volusia County Department of Solid Waste Management found elevated levels of nitrate in on-site monitor wells. They also found elevated levels of nitrate in off-site private drinking-water wells. Some nearby residents are concerned that ingestion of contaminated ground water made them sick.

We selected the following contaminants of concern: barium, chromium, 1,2-dichloroethene, iron, nitrate, sulfate, and vinyl chloride. Ingestion of ground water is a past completed human exposure pathway. Concentrations of the contaminants of concern found so far are unlikely to have caused illnesses in the nearby residents. Analysis of water samples has been inadequate, however, to assess the public health threat from ingestion of sulfate, giardia, or vinyl chloride. There were no infants younger than six months old in homes with wells having nitrate concentrations greater than 10 milligrams per liter. Therefore, we do not expect there were any cases of methemoglobinemia or "blue baby syndrome."

Based on the information currently available, we classify the public health hazard at this landfill as indeterminate. Groundwater sampling is needed to determine the extent of vinyl chloride contamination. Wells contaminated with giardia or sulfate may have caused diarrhea and other digestive problems in nearby residents. We recommend the Volusia County Department of Solid Waste Management sample the nearby private drinking-water wells and analyze for nitrate and vinyl chloride. If nearby residents experience diarrhea again, we recommend the Volusia County Public Health Unit sample their wells and analyze for coliform bacteria and possibly giardia.

The ATSDR Health Activities Recommendation Panel (HARP) evaluated the data and information developed in this preliminary public health assessment. The Panel determined that no follow-up health activities are currently needed because there is no evidence that people have been exposed to contaminants from this landfill at concentrations likely to affect their health. If information becomes available indicating exposure at levels of concern, the ATSDR will evaluate that information to decide what actions, if any, are necessary.

BACKGROUND

In this public health assessment, the Florida Department of Health and Rehabilitative Services (Florida HRS), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), evaluates the public health significance of the Plymouth Avenue Landfill. Specifically, Florida HRS decides whether health effects are possible and recommend actions to reduce or prevent them. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) authorizes the ATSDR to conduct public health assessments at hazardous waste sites. The ATSDR, located in Atlanta, Georgia, is a federal agency within the U.S. Department of Health and Human Services.

A. Site Description and History

The Plymouth Avenue Landfill is on the north side of Plymouth Avenue just east of Grand Avenue in western Volusia County, Florida (Figure 1, Appendix A). This area, about 1.75 miles west of the City of DeLand, is sparsely populated. The Volusia County Department of Solid Waste Management (DSWM) operates a general permit landfill on this 131-acre site and currently receives only yard trimmings and construction debris. The landfill is bounded on the east by Ridgewood Drive, on the south by Plymouth Avenue. It is bounded on the west by Grand Avenue, and on the north by the Volusia County Humane Society and a fernery. The Environmental Protection Agency has proposed adding the three (3) sludge cells on the eastern edge of the landfill to the National Priorities List of Superfund hazardous waste sites. In this assessment we consider the entire 131-acre landfill. The landfill has considerable topographic variation dominated by a water-filled depression in the center (Figure 2, Appendix A).

Volusia County owns this landfill and operates it under its Department of Solid Waste Management (DSWM). Starting sometime in the early 1940s until 1971, the landfill was an open dump. We do not know what was disposed of in the landfill during this period. From 1971 to 1988 it was a Class I landfill and received all types of nonhazardous industrial and municipal solid waste. Between June 1978 and October 1980, the landfill reportedly received 4,500 gallons per week of Brunswick Corporation process waste slurry. Brunswick generated the waste from a nitric acid process for polishing steel. This waste contained nitrate up to 90,000 milligrams per liter (mg/L) (BWA 1992). The Volusia County DSWM spread the waste over an undisturbed area in the southeast corner of the landfill or deposited it into shallow trenches also in the southeast corner of the landfill. In 1980, Brunswick switched to a sulfuric acid process. From September 1980 through August 1988, Volusia County DSWM constructed three disposal cells on the east side of the landfill. These cells received about 900 pounds per day of the slurred sulfuric acid process waste (also known as iron sulfate/calcium sulfate waste). Both the nitric acid and sulfuric acid wastes contained nickel, chromium, and copper. In 1988, the Florida Department of Environmental Protection (DEP) (formerly the Florida Department of Environmental Regulation) reclassified this site as a Class-III landfill. In 1993, Florida DEP reclassified the site as a general permit landfill.

Since then, the Volusia County DSWM has only accepted yard trimmings and construction debris at this landfill.

In February 1987, Volusia County DSWM found concentrations of nitrate in monitor wells along the southeast landfill boundary that violated ground-water and drinking-water standards. In June 1987, Volusia County DSWM sampled water from 40 nearby private drinking-water wells and analyzed for nitrate. They found elevated nitrate concentrations in 20 wells, two of which violated the nitrate drinking-water standard. The Volusia County Public Health Unit (CPHU) warned residents at these two homes not to allow infants less than six months old to drink this water. Nearby residents formed the Environmental Civic Highland Organization (ECHO) and complained of illness from drinking contaminated ground water. Once a month from January 1988 to February 1989, the Volusia County DSWM sampled five to six nearby private wells and analyzed for nitrate.

In January 1989, the Florida DEP reviewed the existing environmental data and recommended an Environmental Protection Agency (EPA) inspection (DEP 1989). Later that year, the Volusia CPHU found low levels of benzene and vinyl chloride in the Volusia County Humane Society drinking-water well north of the landfill. The Volusia CPHU also sampled 12 nearby private drinking-water wells and analyzed for gasoline components but did not find any contamination. In 1990, the EPA inspected the landfill and found elevated levels of nitrate and some metals in the ground water. The EPA then recommended ranking the landfill for inclusion on the Superfund hazardous waste site National Priorities List (NPL). In a November 1992 report, Volusia County DSWM consultants recommended recovery of the nitrate contaminated ground water for on-site use. The EPA proposed adding the three (3) sludge cells on the eastern side of the landfill to the Superfund NPL in May 1993. Also in May, the Volusia CPHU sampled 11 nearby private drinking-water wells and analyzed for gasoline components but did not find any contamination. In August 1993, the Volusia CPHU sampled six nearby private drinking-water wells and analyzed for metals. They found elevated nitrate concentrations in five of the samples, one above the drinking-water standard. The Volusia County DSWM plans to sign a consent agreement with the EPA and agree to collect and analyze additional soil and ground-water samples. The Volusia County DSWM also plans to prepare an engineering evaluation and cost analysis for EPA review. This report will detail the County's plan to extract nitrate contaminated ground water for on-site irrigation. The County plans to eventually build a golf course at this site.

On June 29, 1994 Florida HRS mailed fact sheets to 40 nearby residents. These fact sheets summarized this preliminary public health assessment and solicited their comments. We did not receive any comments by July 29, the end of the public comment period.

B. Site Visit

Randy Merchant of the Florida Department of Health and Rehabilitative Services (HRS) visited this landfill on July 30, 1993. He toured the landfill and the surrounding area with a representative of the Volusia County DSWM. Mr. Merchant noted that a chain-link fence

surrounds the landfill and an attendant checks incoming vehicles. He noted the Volusia County DSWM has covered the three disposal cells on the east side of the landfill with grass. Mr. Merchant also observed the location of the on-site monitor wells. Storm water run-off from the landfill appears to collect in a large depression in the middle of the landfill. Mr. Merchant noted houses bordering the east side of the landfill and a fernery and large excavation south of the landfill. He observed undeveloped land west of the landfill and the Volusia County Humane Society and a fernery north of the landfill. During his visit, Mr. Merchant did not collect any environmental samples.

Mr. Merchant visited the area around the landfill again on February 24, 1994. He was available at the County Administration Building between 3:00 and 8:00 p.m. to meet concerned citizens. The EPA project manager for this site and representatives from the Volusia County DSWM and the Volusia CPHU were also available to answer questions. Two concerned citizens attended the availability session to ask questions and/or voice their concerns about the landfill.

C. Demographics, Land Use, and Natural Resource Use

Demographics

We estimate that in 1990, about 1,400 people lived within 1.5 miles of this landfill. We base our estimate on 1990 census data for tract #902.01 in Volusia County (BOC 1990). This census tract extends about 1.5 miles east, south, and west of the landfill and about 7 miles north. Residents in this census tract are overwhelmingly white (94%) with small black (4%) and Hispanic (4%) minorities. The population is mostly middle aged: the median age is 41 and 79% are 18 years or older. Most of the 2,831 houses in this tract are occupied by their owners. Median yearly family income in this tract is about $35,046 (BOC 1990). We assume the population demographics near the landfill are similar to the rest of the census tract.

Land Use

Land use within the vicinity of this landfill is primarily agricultural and residential. There are several small fern nurseries and citrus groves in the area. To the north of the landfill are the Volusia County Humane Society, a fern nursery, and a few homes. One resident north of the landfill raises horses. To the east are residences and small citrus groves. One parcel of land on the northeast side of the landfill was used in the past for commercial chicken farming. To the south are a clay mine and a fern nursery. West of the landfill are an abandoned citrus grove and undeveloped woods. The Lake Woodruff National Wildlife Refuge is about 1.5 miles west of the landfill.

The nearest house is about 250 feet east of the landfill boundary. There are no commercial day-care centers, schools, or hospitals within one mile of the landfill.

Natural Resource Use

The Volusia County DSWM currently only accepts yard trimmings and construction debris at this general permit landfill. There is no evidence of trespassing or other activities (hunting, fishing, etc.) on the landfill.

Homes and businesses near this landfill all rely on ground water from the Floridan aquifer as a source of drinking water and other domestic uses. We estimate there are between 50 and 100 private drinking-water wells within 0.5 mile of the landfill. Most of these well are to the east and southeast. One and three-quarters miles southeast of the landfill is the nearest public water supply well. The Volusia County Humane Society's drinking-water well is within 50 feet of the landfill's northern boundary. In 1990, the Florida DEP installed a carbon filter on this well to remove low level solvent contamination.

D. Health Outcome Data

We did not evaluate health outcome data for this landfill. See the Public Health Implications, Community Health Concerns Evaluation section later in this report for details.

COMMUNITY HEALTH CONCERNS

In 1988, one nearby resident complained to the EPA of foul tasting well water and digestive problems. This resident said that other nearby residents had (unspecified) health problems that lasted until they ceased drinking water from their wells. Another nearby resident complained that although they have not become ill, their horses have failed to breed as expected.

On February 15, 1994, we mailed letters to 40 nearby residents soliciting their health concerns and inviting them to a February 25 availability session. The EPA advertised this availability session in the Daytona News-Journal on February 20 and 23. Two nearby residents attended this availability session. One resident, who lives about 0.1 mile east of the landfill, complained that she and her husband experienced diarrhea for over six months. She said that their physician was unable to diagnose the cause but their symptoms ceased when they switched to bottled water. The other nearby resident, who lives about 0.25 mile south of the landfill, mentioned that her husband had died of cancer (melanoma) and her doctor successfully treated her for breast cancer. She was unsure if the landfill caused her family's health problems.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

In this section, we review the environmental data collected at this landfill. Specifically, we evaluate the adequacy of the environmental data, select contaminants of concern, and list their maximum concentration and frequency of detection. We then compare the maximum concentrations found to background levels and to standard comparison values. In the data tables, we use the following comparison values:

1. EMEGs--Environmental Media Evaluation Guides--are derived from the ATSDR's Minimal Risk Levels (MRLs) and provide a measure of the toxicity of a chemical. They are the ATSDR's estimate of daily human exposure to a chemical that is likely to be without an appreciable risk of adverse effects. EMEGs are usually based on exposure for a year or longer.

2. LTHAs--Lifetime Health Advisories for Drinking Water--are the EPA's estimate of drinking water contaminant concentrations at which adverse health effects are unlikely over lifetime exposure. LTHAs provide a safety margin to protect sensitive members of the population.

3. MCLs--Maximum Contaminant Levels--are contaminant concentrations that the EPA considers protective of public health. They assume ingestion of 2 liters of water per day for 70-years. MCLs are regulatory concentrations.

4. RMEGs--Media Evaluation Guides--are derived from the EPA's reference dose. RMEGs are an estimate of daily human exposure to a chemical that is likely to be without an appreciable risk of adverse effects. They are usually based on exposure for a year or longer. RMEGS are similar to the EMEGs above.

5. SMCLs--Secondary Maximum Contaminant Levels--are the EPA's estimate of the concentration above which water is not aesthetically acceptable (primarily due to taste and/or odor). SMCLs are regulatory concentrations in Florida.

We reviewed the environmental sampling data collected at this landfill and selected the following chemicals as contaminants of concern:

barium	iron
chromium (total)	nitrate
1,2-dichloroethene	sulfate
(cis & trans isomers)	vinyl chloride

We selected these contaminants based on the following factors:

1. Concentrations of contaminants on and off the site.

2. Field data quality, laboratory data quality, and sample design.

3. Comparison of on-site and off-site concentrations with health assessment comparison values for (1) noncarcinogenic endpoints and (2) carcinogenic endpoints.

4. Community health concerns.

Identification of a contaminant of concern in this section does not necessarily mean that exposure will cause adverse health effects. Identification serves to narrow the focus of this health assessment to those contaminants most important to public health. When selected as a contaminant of concern in one medium, we also reported the concentration of that contaminant in all other media. We evaluate these contaminants in subsequent sections and decide whether exposure has public health significance.

To identify industrial facilities that could contribute to the contamination near this landfill, we searched the EPA Toxic Chemical Release Inventory (TRI) data base. The EPA developed TRI from the chemical release information (air, water, and soil) provided by certain industries. The TRI data base covers releases between 1987 and 1991. We found one industrial facility in the 32720 ZIP code that includes the Plymouth Avenue Landfill. Ardmore Farms estimates it released 20,000 pounds of ammonia into the air between 1987 and 1991. Ardmore Farms is an orange juice processing facility at 1915 N. Woodland Boulevard, about 2.5 miles northeast of the landfill. Because of the distance, we do not expect that ammonia from this facility has affected the health of people living near the landfill.

In this assessment, we discuss the contamination that exists on the landfill first, separately from the contamination that occurs off the landfill.

A. On-site Contamination

The Environmental Protection Agency has proposed adding the three (3) sludge cells on the eastern edge of the landfill to the National Priorities List of Superfund hazardous waste sites. In this assessment we consider the entire 131-acre landfill. We define "on-site" as the landfill property boundary as shown in Figure 2 (Appendix A). We compiled data in this subsection from the files of the Volusia County DSWM (VCDSWM 1994) and Florida Department of Environmental Protection (DEP 1994). We also compiled data in this subsection from reports by Briley, Wild and Associates (BWA 1981, 1992) and the NUS Corporation (NUS 1990).

On-Site Waste Material

From June 1978 to October 1980, the landfill reportedly received 4,500 gallons per week of nitric acid process waste slurry (pH 0-1) from the nearby Brunswick Corporation. This

waste contained up to 90,000 milligrams per liter (mg/L) of nitrate. The Volusia County DSWM spread the waste over an undisturbed area in the southeast corner of the landfill or deposited it into shallow trenches also in the southeast corner of the landfill (BWA 1992). Table 1, below, summarizes the contaminants-of-concern maximum concentrations in this waste.

Table 1. Maximum Concentrations in 1978 Nitric Acid Waste

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # positive---- ---- Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Barium	NA	---	---	None	---
Chromium (total)	1	1/1	---	None	---
c+t-1,2-Dichloroethene	NA	---	---	None	___
Iron	17,500	1/1	---	None	---
Nitrate	20,500	1/1	---	None	---
Sulfate	NA	---	---	None	---
Vinyl Chloride	NA	---	---	None	---

NA - oot analyzed mg/kg - milligrams per kilogram
EMEG - Environmental Media Evaluatioo Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
Source: Russell 1978

On-Site Surface Soil

There have been no surface soil samples (0-3 inches deep). We do not recommend the Volusia County DSWM collect any on-site surface soil samples since it is unlikely that cover soil is contaminated. In 1990, the NUS Corporation, under contract with the EPA, did collect one background surface soil sample (0-6 inches deep) from the northwest corner of the site (Figure 3, Appendix A). They found 0.034 milligrams per kilogram (mg/kg) of toluene, a component of gasoline. Toluene in this surface soil sample is likely due to runoff from nearby Grand Avenue. They did not find any significant concentrations of metals, other organic chemicals, or pesticides in this background sample (NUS 1990). Table 2, below,

summarizes the contaminants-of-concern maximum concentrations in the on-site surface soil (0-3 inches deep).

Table 2. Maximum Concentrations in On-Site Surface Soil (0-3 inches deep)

Contaminants of Concern	Maximum Concen-tration (mg/kg)	Total # positive---- ---- Total # samples	Back-ground* Concen-tration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Barium	NA	---	<10	50,000	RMEG
Chromium (total)	NA	---	3.3	4,000	RMEG
c+t-1,2-Di-chloroethene	NA	---	<0.005	10,000	RMEG
Iron	NA	---	690	None	None
Nitrate	NA	---	2.1	10^6	RMEG
Sulfate	NA	---	NA	---	---
Vinyl Chloride	NA	---	<0.011	10	EMEG

* - EPA background surface soil sample 0-6 inches deep
NA - not analyzed mg/kg - milligrams per kilogram
EMEG - Environmental Media Evaluation Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
Source: NUS 1990

On-Site Subsurface Soil (1-75 feet deep)

In 1989, NUS collected three subsurface soil samples (four to 5 feet deep) in and around the disposal cells on the east side of the site (Figure 3, Appendix A). They analyzed these samples for metals, volatile organic chemicals, nonvolatile organic chemicals, pesticides, nitrate, and cyanide. They found elevated concentrations of chromium, iron, and nitrate in the samples from the disposal cells (NUS 1990). We consider sample PL-SB-01 as representative of background subsurface soil quality.

In 1991, Briley, Wild and Associates, consultants for the Volusia County DSWM, collected 212 subsurface soil samples. They collected these samples (1 to 75 feet deep) from 22 spots near the disposal cells (Figure 4, Appendix A). They analyzed these samples for nitrate and

sulfate and found elevated concentrations around the southern most disposal cell (BWA 1992).

Table 3, below, summarizes the contaminants-of-concern maximum concentrations in on-site subsurface soils (1 to 75 feet deep). For this public health assessment, these samples are adequate to characterize the subsurface soil quality. This is especially true for nitrate on the east side of the landfill.

Table 3. Maximum Concentrations in On-Site Subsurface Soil (1 to 75 feet deep)

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # positive---- ---- Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Barium	<40	0/3	<5	50,000	RMEG
Chromium (total)	58	0/3	<1	4,000	RMEG
c+t-1,2-Dichloroethene	<0.006	0/3	<0.005	10,000	RMEG
Iron	5,900	3/3	510	None	---
Nitrate	180	83/215	4.2	10^6	RMEG
Sulfate	19,200	7/7	NA	None	---
Vinyl Chloride	<0.012	0/3	<0.011	10	EMEG

NA - not analyzed mg/kg - milligrams per kilogram
EMEG - Environmental Media Evaluation Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
Sources: NUS 1990, BWA 1992.

On-Site Surface Water

In 1987 and 1988, the Volusia County DSWM sampled and analyzed water from the large depression in the center of the landfill. They and found elevated concentrations of iron (maximum 13.9 mg/L). There is no other water body on or near the site with which to compare surface water concentrations. For this public health assessment, two samples are adequate to characterize the on-site surface water quality. Table 4, below, summarizes the contaminants-of-concern maximum concentrations in on-site surface water.

Table 4. Maximum Concentration in On-Site Surface Water

Contaminants of Concern	Maximum Concentration (mg/L)	Total # positive---- ---- Total # samples	Background Concentration (mg/L)	Comparison Value	
				(mg/L)	Source
Barium	NA	---	NA	0.7	RMEG
Chromium (total)	0.01	1/1	NA	0.1	LTHA
c+t-1,2-Di-chloroethene	<0.001	0/1	NA	0.1	LTHA
Iron	13.9	1/1	NA	0.03	SMCL
Nitrate	<0.5	0/1	NA	10	MCL
Sulfate	NA	---	NA	400	MCL
Vinyl Chloride	<0.001	0/1	NA	0.0002	EMEG

NA - not analyzed mg/L - milligrams per liter
MCL - Maximum Contaminant Level
EMEG - Environmental Media Evaluation Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
SMCL - Secondary Maximum Contaminant Level
Source: VCDSWM 1994

On-Site Sediments

In 1989, NUS collected one sediment grab sample from the large depression in the center of the landfill (Figure 3, Appendix A). They analyzed this sample for metals, volatile organic chemicals, nonvolatile organic chemicals, pesticides, nitrate, and cyanide. They found elevated concentrations of barium, chromium, iron, and nitrate (NUS 1990). There is no other water body on or near the site with which to compare sediment concentrations. For this public health assessment, one sample is adequate to characterize the on-site sediment quality. Table 5, below, summarizes the contaminants-of-concern maximum concentrations in on-site sediments.

Table 5. Maximum Concentration in On-Site Sediments

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # positive---- ---- Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Barium	330	1/1	NA	50,000	RMEG
Chromium (total)	71	1/1	NA	4,000	RMEG
c+t-1,2-Dichloroethene	<0.011	0/1	NA	10,000	RMEG
Iron	13,000	0/1	NA	None	---
Nitrate	6.7	1/1	NA	10^6	RMEG
Sulfate	NA	---	NA	---	---
Vinyl Chloride	<0.021	0/1	NA	10	EMEG

NA - not analyzed mg/kg - milligrams per kilogram
EMEG - Environmental Media Evaluation Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
Source: NUS 1990

On-Site Ground Water

For this assessment we have combined ground-water quality data from the surficial and Floridan aquifers. Three hydrogeological studies have documented a connection between the two aquifers at this site (USGS 1977, BWA 1981, BWA 1992).

The Volusia County DSWM has monitored ground-water quality at this landfill since 1981. In 1983, they noticed the concentrations of nitrate in monitor wells M05 and M11 along the east landfill (Figure 5, Appendix A) boundary began to rise. The concentration of nitrate in monitor well M11 peaked at 963 mg/L in March 1984. By 1992, the nitrate concentration in these wells had fallen to between 40 and 80 mg/L (VCDSWM).

The Volusia County DSWM also found that the concentration of barium in monitor wells M05 and M11 occasionally exceeded the drinking-water standard of 2 mg/L (VCDSWM 1994).

In 1990, the NUS Corporation sampled eight existing on-site monitor wells for the EPA (Figure 3, Appendix A). They found approximately 100 mg/L of nitrate in two wells along the east landfill boundary: PL-MW-02 and PL-MW-03 (NUS 1990). Previous reports referred to monitor wells PL-MW-02 and PL-MW-03 as "M05" and "M11."

From 1989 to 1991, Briley, Wild and Associates conducted a contamination assessment for the Volusia County DSWM. This assessment focused on the extent of nitrate ground-water contamination along the eastern landfill boundary. They found nitrate contamination in the ground water under the eastern part of the site and for a short distance off site. They found the surficial and the upper 30 feet of the Floridan aquifers were contaminated with nitrate at concentrations as high as 170 mg/L (BWA 1992).

We consider monitor well M14 (also called PL-MW-01) representative of background ground-water quality. For this public health assessment, the existing data adequately characterize the on-site ground-water quality. Table 6, below, summarizes the contaminants-of-concern maximum concentrations in the on-site monitor wells.

Table 6. Maximum Concentration in On-Site Monitor Wells

Contaminants of Concern	Maximum Concentration (mg/L)	Total # positive---- ---- Total # samples	Background Concentration (mg/L)	Comparison Value	
				(mg/L)	Source
Barium	2.9	54/72	<0.07	0.7	RMEG
Chromium (total)	0.09	28/101	<0.005	0.1	LTHA
c+t-1,2-Di-chloroethene	<0.005	0/7	<0.005	0.1	LTHA
Iron	18.5	42/51	1	0.3	SMCL
Nitrate	963	95/107	0.1	10	MCL
Sulfate	150	34/36	NA	400	MCL
Vinyl Chloride	<0.01	0/7	<0.01	0.0002	EMEG

Sources: VCDSWM 1994, NUS 1990, BWA 1992.

B. Off-site Contamination

For the purposes of this evaluation, we define "off-site" as the area outside the landfill property boundary as shown in Figure 2 (Appendix A). We compiled data in this subsection from the files of the Volusia County DSWM (VCDSWM 1994) and Volusia CPHU (VCPHU 1994). We also compiled data in this subsection from reports by Briley, Wild and Associates (BWA 1992) and the NUS Corporation (NUS 1990).

Off-Site Surface Soil (0-6 inches deep)

In 1990, the NUS Corporation, under contract with the EPA, collected two surface soil samples (0-6 inches deep) 200-300 feet east of the landfill (Figure 3, Appendix A). They did not find any significant concentrations of metals, solvents, organic chemicals, or pesticides (NUS 1990). Since there is little stormwater run-off from the site, we do not recommend any additional off-site surface soil sampling. Table 7, below, summarizes the maximum concentrations of contaminants of concern in off-site surface soil (0-6 inches deep) in 1990.

Table 7. Maximum Concentrations in Off-Site Surface Soil (0-6 inches deep)

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # positive---- ---- Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Barium	<9	0/2	NA	50,000	RMEG
Chromium (total)	<3	0/2	NA	4,000	RMEG
c+t-1,2-Dichloroethene	<0.005	0/2	NA	10,000	RMEG
Iron	540	2/2	NA	None	None
Nitrate	2.4	2/2	NA	10^6	RMEG
Sulfate	NA	---	NA	---	---
Vinyl Chloride	<0.011	0/2	NA	10	EMEG

NA - not analyzed mg/kg - milligrams per kilogram
EMEG - Environmental Media Evaluation Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
Source: NUS 1990

Off-Site Subsurface Soil (1-75 feet deep)

In 1989, the EPA collected two subsurface soil samples (four to 5 feet deep) 200-300 feet east of the landfill (Figure 3, Appendix A). They analyzed these samples for metals, volatile organic chemicals, nonvolatile organic chemicals, pesticides, nitrate, and cyanide but did not find any elevated concentrations (NUS 1990).

In 1991, Briley, Wild and Associates collected 88 subsurface soil samples (1 to 75 feet deep) from 13 locations east of the landfill (Figure 4, Appendix A). They analyzed these samples for nitrate and found elevated concentrations (maximum 11 mg/kg) in two samples (BWA 1992).

For this public health assessment, these samples are adequate to characterize the off-site subsurface soil quality. We consider sample PL-SB-01 (Figure 3, Appendix A) as representative of background subsurface soil quality. Table 8, below, summarizes the contaminants-of-concern maximum concentrations for off-site subsurface soil (1-75 feet deep).

Table 8. Maximum Concentrations in Off-Site Subsurface Soil (1-75 feet deep)

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # positive---- ---- Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Barium	<3	0/2	<5	50,000	RMEG
Chromium (total)	<2	0/2	<1	4,000	RMEG
c+t-1,2-Di-chloroethene	<0.005	0/2	<0.005	10,000	RMEG
Iron	250	2/2	510	None	---
Nitrate	11	9/90	4.2	10^6	RMEG
Sulfate	NA	---	NA	---	---
Vinyl Chloride	<0.01	0/2	<0.011	10	EMEG

NA - not analyzed mg/kg - milligrams per kilogram
EMEG - Environmental Media Evaluation Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
Sources: NUS 1990, BWA 1992.

Off-site Ground Water

In this section, we discuss the ground-water quality in the nearby private drinking-water wells and the ground-water quality in off-site monitor wells. The Volusia County DSWM and the Volusia CPHU sampled most of the nearby private drinking-water wells between 1987 and 1989 (Table 9). Between 1989 and 1992, the Volusia County DSWM installed and sampled the off-site monitor wells (Table 10). We used on-site monitor well M14 (also called PL-MW-01) as representative of background ground-water quality.

The predominate ground-water contaminant associated with this landfill is nitrate. Since 1987, the Volusia County DSWM, the Volusia CPHU, and the NUS Corporation together have sampled about 40 nearby private drinking-water wells. This includes about 20 private drinking-water wells within 0.25 mile of the landfill (Figure 6, Appendix A). They found elevated nitrate concentrations (>0.5 mg/L) in about half these wells (VCDSWM 1994, VCPHU 1994, NUS 1990). Monthly between 1987 and 1989, the Volusia County DSWM resampled six of these wells east and south of the landfill and found nitrate concentrations greater than 5 mg/L. Two had nitrate concentrations between 10 and 15 mg/L; a third had concentrations as high as 20 mg/L. Table 9, below, summarizes the contaminants-of-concern maximum concentrations for off-site private drinking-water wells.

Although over 40 nearby private drinking-water wells have been sampled, we do not know the past extent of the nitrate contamination. It is likely that before 1987, ground water nitrate concentrations were higher and contamination was more widespread. Most of the approximately 20 nearby private drinking-water wells that had less than 5 mg/L nitrate in 1987 have not been resampled. Due to the karst (cavernous) geology of the area, ground water concentrations can change rapidly. The lack of follow-up analysis for nitrate in these wells is a significant data gap. We recommend the Volusia County Department of Solid Waste Management resample these nearby private drinking-water wells and analyze for nitrate.

In 1989, the Volusia CPHU sampled and analyzed ten nearby private drinking-water wells as part of the underground petroleum storage tank program. They found low levels of 1,2-dichloroethene and vinyl chloride in the Volusia County Humane Society private drinking-water well (VCPHU 1994). Ground water sampling was inadequate, however, to determine the full area of contamination. We recommend the Volusia County Department of Solid Waste Management sample all of the nearby private drinking-water wells and analyze for vinyl chloride.

Table 9. Maximum Concentration in Off-Site Private Drinking-Water Wells

Contaminants of Concern	Maximum Concentration (mg/L)	Total # positive---- ---- Total # samples	Background Concentration (mg/L)	Comparison Value	
				(mg/L)	Source
Barium	<0.1	0/22	<0.07	0.7	RMEG
Chromium (total)	<0.005	0/10	<0.005	0.1	LTHA
c+t-1,2-Dichloroethene	0.006	3/10	<0.005	0.1	LTHA
Iron	0.74	4/10	1	None	---
Nitrate	20	118/147	0.1	10	MCL
Sulfate	7.3	1/1	NA	400	MCL
Vinyl Chloride	0.002	3/10	<0.01	0.0002	EMEG

NA - not analyzed mg/L - milligrams per liter
LTHA - Lifetime Health Advisory MCL - Maximum Contaminant Level
EMEG - Environmental Media Evaluation Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
SMCL - Secondary Maximum Contaminant Level
Sources: VCDSWM 1994, VCPHU 1994, NUS 1990.

Between 1989 and 1991, Briley, Wild and Associates installed and sampled five monitor wells east of the landfill (Figure 4, Appendix A). For these monitor wells, we have combined ground-water quality data from the surficial and Floridan aquifers. Hydrogeological studies have shown a connection between these two aquifers at this landfill (USGS 1977, BWA 1981, BWA 1992). They found elevated concentrations of nitrate, iron, and sulfate. Figure 7 (Appendix A) shows the current (1992) extent of ground water with more than 10 mg/L of nitrate. Ground water with more than 10 mg/L of nitrate extends about 200 feet east of the southeast side of the landfill (BWA 1992). We do not know how far ground water with more than 0.5 mg/L nitrate currently extends. Table 10, below, summarizes the contaminants-of-concern maximum concentrations for off-site monitor wells.

Only four off-site monitor wells and one private drinking-water well were tested for sulfate. Five samples are inadequate to characterize levels of sulfate in the off-site ground water. Sulfate concentrations in these five wells, however, were below state drinking water standards. Since the landfill stopped accepting the Brunswick Corporation sulfuric acid waste

in 1980, it is likely sulfate concentrations will continue to decline. Therefore, we do not recommend additional sampling for sulfate.

Table 10. Maximum Concentration in Off-Site Monitor Wells

Contaminants of Concern	Maximum Concentration (mg/L)	Total # positive---- ---- Total # samples	Background Concentration (mg/L)	Comparison Value	
				(mg/L)	Source
Barium	0.3	6/23	<0.07	0.7	RMEG
Chromium (total)	0.02	3/23	<0.005	0.1	LTHA
c+t-1,2-Dichloroethene	NA	---	<0.005	0.1	LTHA
Iron	6.4	7/23	1	0.3	SMCL
Nitrate	1.3	4/23	0.1	10	MCL
Sulfate	48	4/4	NA	400	MCL
Vinyl Chloride	NA	---	<0.01	0.0002	EMEG

NA - not analyzed mg/L - milligrams per liter
LTHA - Lifetime Health Advisory MCL - Maximum Contaminant Level
EMEG - Environmental Media Evaluation Guide based on the ATSDR minimal risk level.
RMEG - Media Evaluation Guide based on EPA reference dose.
SMCL - Secondary Maximum Contaminant Level
Source: BWA 1992

C. Quality Assurance and Quality Control

In preparing this public health assessment, we relied on the environmental data provided by the Volusia County DSWM, the Volusia CPHU, the Florida DEP and the EPA. We assume these agencies followed adequate quality assurance and quality control measures concerning chain-of-custody, laboratory procedures, and data reporting. The completeness and reliability of the referenced information determine the validity of the analysis and conclusions drawn for this public health assessment. We assume the data we reviewed for this assessment are valid since the environmental samples were collected and analyzed by governmental agencies or their contractors.

In each of the preceding On- and Off-Site Contamination subsections, we evaluated the adequacy of the data to estimate exposures. We assumed that estimated data (J) and presumptive data (N) were valid. This second assumption errs on the side of public health by assuming that a contaminant exists when actually it may not exist.

D. Physical and Other Hazards

The Volusia County DSWM has monitored the soil gases at the landfill borders but has not detected significant quantities of methane or other gases. Since the cover soil at this landfill is porous sand, accumulation of dangerous concentrations of gases is unlikely. The Volusia County DSWM is currently expanding its soil gas monitoring program (HRS 1994).

If the landfill were not secured, the water-filled depression in the center could be a drowning hazard for young children. The landfill is, however, surrounded by an 8-foot chain-link fence and supervised during the day. We did not see any other potential physical hazards during our visit.

PATHWAYS ANALYSES

In this section, we evaluated the environmental and human components of exposure pathways. Exposure pathways consist of five elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and an exposed population.

We eliminate exposure pathways if at least one of the five elements is missing and will never be present. We categorize exposure pathways that we can not eliminate as either completed or potential. For completed pathways, all five elements exist and exposure to a contaminant has occurred, is occurring, or will occur. At least one of the five elements is missing, but could exist in potential pathways. For potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

A. Completed Exposure Pathways

Ground Water Pathway

The hydrogeology underlying this landfill is complex. The uppermost 70 to 80 feet is mostly sand. This sand contains the unconfined surficial aquifer. Compared to the rest of the county, the unsaturated zone under this landfill is unusually thick. Depth to the top of the surficial aquifer is between 15 and 45 feet below the land surface. Below the sands of the surficial aquifer are discontinuous layers of clay of the Hawthorne formation. Although these clays slow the downward movement of water, they readily allow for recharge of the underlying semiconfined Floridan aquifer; the surficial and Floridan aquifers under this landfill are hydraulically connected. Water travels from the land surface to the Floridan

aquifer in as little as six years. Karst (cavernous) limestone of the Avon Park formation contains the Floridan aquifer (BWA 1992; NUS 1990).

Rainfall at this landfill seeps rapidly into the sand and percolates down to the top of the surficial aquifer. High porosity of these sands does not allow for significant surface water run-off. According to 1982 water level measurements, flow was to the southwest, south, and southeast. Measurements in 1986 showed flow was to the south and southeast (BWA 1988). Because of the complex topography and geology, the direction of ground-water flow in the surficial aquifer is largely undefined. The surficial aquifer serves as a source of recharge to the deeper Floridan aquifer.

Regionally, ground-water flow in the Floridan aquifer is west toward discharge to the St. Johns River and south toward discharge to Blue Springs. A 1977 U.S. Geological Survey investigation decided that ground-water flow in the Floridan aquifer under this landfill is to the east, south, and west (USGS 1977). A more recent investigation found flow in the Floridan aquifer under this landfill is predominantly to the southeast (BWA 1992).

Ingestion of contaminated ground water is a past completed exposure pathway (Table 10). Except for the Humane Society well, nitrate is the only contaminant to which we know people have been exposed. Analyses for sulfate have been inadequate. Solid or liquid waste disposed of at the landfill is a likely source of nitrate. Other possible sources of nitrate include: malfunctioning septic tanks, improper fertilizer disposal (ferneries), and improper animal waste disposal (commercial chicken farm). Although over 40 nearby private drinking-water wells have been sampled at one time or another, we do not know the past extent of the nitrate ground-water contamination. It is likely that in the past, ground-water nitrate concentrations were higher and contamination was more widespread. Between 1987 and 1989, elevated nitrate concentrations (<0.5 mg/L) were found in about 20 nearby private drinking-water wells. Although there are other possible sources of this nitrate contamination, we assume that at least some has migrated from the landfill. Ingestion is the route of exposure. Between 40 and 60 people may have been exposed in the past. More people may be exposed in the future if the appropriate agency does not clean-up the ground water.

B. Potential Exposure Pathways

Air Pathway

Inhalation of contaminated dust is a past potential exposure pathway (Table 11). Contaminated surface soil could have been the source. Air could have been the medium and nearby residents the points of exposure. Inhalation could have been the route of exposure. We categorize this exposure route as potential since there are insufficient data to confirm that either the surface soil or air was contaminated.

C. Eliminated Pathways

We eliminated incidental soil ingestion and surface water ingestion as exposure pathways. Although this landfill is open for use by the public during the day, it is fenced, access is monitored by Volusia County DSWM personnel, and there are no signs of trespass.

We eliminated inhalation of solvents released from gronnd water during showering and other domestic uses as an exposure pathway. This is not a significant exposure pathway at this site since the Humane Society Well was the only well with any solvents. The concentrations of solvents in the Humane Society well were low and the inhalation dose insignificant since this water was not used for showering.

Also, we eliminated inhalation of methane and other landfill gases as an exposure pathway. The Volusia County DSWM has monitored the soil gases at the landfill borders but has not detected significant quantities of methane or other gases. Since the cover soil at this landfill is porous sand, accumulation of dangerous gas concentrations is unlikely.

Table 10. Completed Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Ground Water	Landfill	Ground Water	Drinking-Water Wells	Ingestion	40-60 Nearby Residents	Past & Future

Table 11. Potential Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Contam-inated Dust	Landfill Surface Soil	Air	On and Off Site	Inhalation	Unknown	Past

PUBLIC HEALTH IMPLICATIONS

In this section we discuss potential health effects on persons exposed to specific contaminants and address specific community health concerns.

A. Toxicological Evaluation

Introduction

To evaluate health effects, the ATSDR developed a Minimal Risk Levels (MRLs) for contaminants commonly found at hazardous waste sites. An MRL is an estimate of daily human exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. The ATSDR developed MRLs for each route of exposure, such as ingestion and inhalation, and for the length of exposure. The ATSDR categorizes length of exposure as acute (less than 14 days), intermediate (15 to 364 days), or chronic (greater than 365 days). The ATSDR presents these MRLs in Toxicological Profiles. These chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status.

In this section, we use standard assumptions to estimate human exposure from ingestion of contaminated ground water. We assume the average adult ingests 2 liters of water per day and weighs 70 kilograms. Since there are no data for the concentrations of contaminants in on-site surface soil or air, we cannot evaluate the public health threat from these potential exposure pathways.

Barium

It is unlikely the concentrations of barium in the off-site ground water have caused illnesses. The various governmental agencies did not detect barium in any of the private drinking-water well samples. They detected barium in only 6 of the 23 off-site monitor well samples. The ATSDR has not established a Minimal Risk Level for barium. The estimated maximum dose from ingestion of the ground water in the monitor wells is less, however, than the lowest dose that did not cause an effect in laboratory animals (ATSDR 1992). Therefore, it is unlikely that barium in the ground water has caused any illnesses.

Chromium (total)

It is unlikely the concentrations of chromium (total) in the off-site ground water have caused illnesses. Since not all of the analyses for chromium differentiated between the different forms, we have considered the total of all of the forms. The various governmental agencies did not detect chromium in any of the private drinking-water well samples. They detected chromium in only 3 of the 23 off-site monitor well samples.

The ATSDR has not established a Minimal Risk Level for chromium. The estimated maximum dose from ingestion of ground water in the monitor wells is less, however, than the lowest dose that did not cause an effect in laboratory animals (ATSDR 1993a). Therefore, it is unlikely that chromium in the ground water has caused any illnesses.

cis and trans-1,2-Dichloroethene

It is unlikely the concentrations of 1,2-dichloroethene in the off-site ground water have caused illnesses. 1,2-Dichloroethene (total cis and trans isomers) was found in 3 out of 10 private drinking-water well samples. The estimated maximum dose from ingestion is less than both the acute and intermediate ATSDR MRLs. The ATSDR has not established a chronic MRL since scientists do not know the long-term human health effects of exposure to 1,2-dichloroethene. Scientists have not reported birth defects, reproductive effects, or cancer in humans or animals exposed to 1,2-dichloroethene (ATSDR 1990). The maximum concentration of 1,2-dichloroethene in these drinking-water wells was also less than the EPA Maximum Contaminant Level (MCL) for drinking water.

Iron

Concentrations of iron found in the ground water in both the drinking-water and off-site monitor wells are unlikely to cause illnesses. These concentrations, however, may give the water an astringent or metallic taste. In many places in Florida, natural ground water quality does not meet the secondary drinking water standard of 0.3 mg/L for iron. The EPA bases this secondary drinking water standard on iron's taste and staining threshold. There is no ATSDR toxicological profile for iron.

Nitrate

Maximum concentration of nitrate in the drinking-water wells could have caused methemoglobinemia in bottle fed infants less than six months old. These nitrate concentrations are unlikely, however, to cause any illnesses in infants older than six months, children, or adults. Methemoglobinemia is a condition where the blood is unable to transport oxygen to the tissues properly. We commonly refer to methemoglobinemia in infants as "blue baby syndrome."

When the Volusia CPHU found drinking-water wells with >10 mg/L nitrate, they advised the owner not to use this water to prepare infant formula. They also notified the Volusia CPHU medical director. Since there were no infants in these homes, we do not expect there were any cases of methemoglobinemia or "blue baby syndrome." There have been no reports of methemoglobinemia in this area.

Bacteria in the stomach, particularly of infants less than six months old, metabolize nitrate to nitrite. Nitrite reacts with hemoglobin, and markedly decreases the ability of blood to carry oxygen to the tissues. Bottle-fed infants less than six months old have a high stomach pH.

Bacteria that reduce nitrate to nitrite may proliferate in the stomach at a high pH, leading to an increased formation of nitrite. Nitrite then reacts with the hemoglobin (the molecule in the blood that transports oxygen) to form methemoglobin. Methemoglobin is unable to transport oxygen resulting in methemoglobinemia (NAS 1977a).

The EPA bases its Maximum Contaminant Level (MCL) for nitrate in drinking water (10 mg/L) on epidemiological studies of infants with methemoglobinemia. There is little margin of safety in this value, however (NAS 1977a). There is no ATSDR toxicological profile for nitrate.

Sulfate

Because of the lack of sampling data, we cannot assess the public health threat of sulfate in the ground water. As noted above, the various governmental agencies only tested one drinking-water well for sulfate. One sample is inadequate to characterize levels of sulfate in the drinking-water wells. Sulfate concentrations four to five times higher than found in the off-site monitor wells could have a laxative effect (cause diarrhea) in sensitive individuals (NAS 1977b). There is no ATSDR toxicological profile for sulfate.

Vinyl Chloride

Concentrations of vinyl chloride found in the private drinking-water wells are unlikely to cause illnesses. Ground water sampling was inadequate, however, to determine the full area of contamination. The estimated maximum dose of vinyl chloride in one drinking-water well was slightly above the chronic oral ATSDR Minimal Risk Level (MRL). This MRL, however, includes a one thousand fold safety factor. The ATSDR bases this MRL on changes in liver cells of rats fed vinyl chloride in their diet daily for almost three years (ATSDR 1993b).

The Department of Health and Human Services has decided that vinyl chloride is a known carcinogen. Similarly, the International Agency for Research on Cancer and EPA have decided that vinyl chloride is carcinogenic to humans. Rats fed high levels of vinyl chloride daily for one to two years developed liver cancer (ATSDR 1993b). Concentrations in drinking-water wells near this landfill are so low, however, there is no apparent increased risk of cancer to humans.

B. Health Outcome Data Evaluation

We did not evaluate community health outcome data. Although the concentrations of nitrate in a few nearby private drinking-water wells exceeded the standard, it is unlikely a search of state-wide health outcome data would detect an effect in such a small group. Therefore, there is little justification or community demand for an evaluation of health outcome data at this time. If future environmental investigations find other contaminants or more widespread contamination, we will evaluate health outcome data as appropriate.

C. Community Health Concerns Evaluation

We have addressed each community health concern as follows:

1. In 1988, one nearby resident complained of digestive problems. This resident said that other nearby residents had (unspecified) health problems that lasted until they ceased drinking water from their wells.

"Digestive problems" cover a wide range of medical conditions. Without a medical diagnosis or a more specific description of the symptoms, it is difficult to assess this concern. Diarrhea could be considered a "digestive problem." Although the environmental data are insufficient to establish a link to this landfill, ingestion of high concentrations of sulfate is one possible cause of diarrhea. The Brunswick Corporation disposed of high sulfur content waste at the landfill. Only four off-site monitor wells and one private drinking-water well were tested for sulfate. Sulfate concentrations in these five wells, however, were below state drinking water standards. Since the landfill stopped accepting the high sulfur content Brunswick Corporation waste in 1980, it is likely sulfate concentrations will continue to decline. Therefore, we do not recommend additional sampling for sulfate.

Without further information, we cannot assess other (unspecified) health problems.

2. In 1994, one nearby resident complained that although their health has not been affected, their horses have failed to breed as expected.

In 1989, the Volusia CPHU sampled the well that both this resident and their horses use. They analyzed for gasoline related contaminants but did not find any. We suggest this resident contact a county agricultural extension agent to discuss the failure of their horses to breed. Also, we suggest this resident have their well analyzed for nitrates. The enlarged cecum and colon of horses provide a location for the microbial reduction of nitrate to nitrite (NAS 1977).

3. In 1994, one nearby resident complained that she and her husband experienced diarrhea for over six months when drinking the water from their well. She said that their physician was unable to diagnose the cause but their symptoms ceased when they switched to bottled water.

Although the environmental data are insufficient to establish a link to this landfill, ingestion of high concentrations of sulfate is one possible cause of diarrhea. The Brunswick Corporation disposed of high sulfur content waste at the landfill. Only four off-site monitor wells and one private drinking-water well were tested for sulfate. Sulfate concentrations in these five wells, however, were below state drinking water

standards. Since the landfill stopped accepting the high sulfur content Brunswick Corporation waste in 1980, it is likely sulfate concentrations will continue to decline. Therefore, we do not recommend additional sampling for sulfate.

Another possible cause of diarrhea is giardia. Laboratories do not commonly analyze for this protozoan in drinking-water wells. It could have, however, traveled from the landfill to nearby drinking-water wells though the karst (cavernous) limestone. It could also have infiltrated from contaminated surface water to ground water along poorly constructed or deteriorated drinking-water wells. If nearby residents experience diarrhea again, we recommend the Volusia CPHU sample their wells and analyze for coliform bacteria and if funds are available, for giardia.

4. In 1994, one nearby resident mentioned that her husband had died of cancer (melanoma) and she had been treated successfully for breast cancer. She was unsure if the landfill caused her family's health problems.

Melanoma, a form of skin cancer, is associated with excessive sun exposure. The causes of breast cancer are less well known. None of the chemicals found at this landfill to date are associated with melanoma or breast cancer. Contaminated ground water from the landfill is not known to extend in the direction of this resident.

CONCLUSIONS

Based on the information currently available, we classify the public health hazard at this landfill as indeterminate. Additional environmental data is necessary to assess the public health threat to nearby residents. Conclusions supporting this classification are as follows:

1. Ingestion of contaminated ground water is a past completed human exposure pathway. The predominate ground-water contaminant associated with this landfill is nitrate. Concentrations of nitrate greater than 10 milligrams per liter (mg/L) in water used to make formula can cause methemoglobinemia in infants less than six months old. When the Volusia County Public Health Unit found >10 mg/L nitrate in a drinking-water well, they advised the owner not to use this water to prepare infant formula. Since there were no infants in these homes, we do not expect there were any cases of methemoglobinemia or "blue baby syndrome." There have been no reports of methemoglobinemia in this area.

2. In 1989, the Volusia CPHU sampled ten nearby private drinking-water wells and analyzed for gasoline components. They found low levels of 1,2-dichloroethene and vinyl chloride in the Volusia County Humane Society private drinking-water well. Ground water sampling was inadequate, however, to fully determine the area of contamination.

3. Most of the approximately 20 nearby private drinking-water wells that had less than 5 mg/L nitrate in 1987 have not been resampled. Due to the karst (cavernous) geology of the area, ground water concentrations can change rapidly. The lack of follow-up analysis for nitrate in these wells is a significant data gap.

4. Giardia is a possible cause of diarrhea experienced by one nearby resident. Laboratories do not commonly analyze for giardia in drinking-water wells. Giardia, from septic tank waste disposed of at the landfill, could have traveled to nearby drinking-water wells though the karst (cavernous) limestone. It could also have infiltrated from contaminated surface water to ground water along poorly constructed or deteriorated drinking-water wells. Coliform bacteria are also associated with animal or human waste from residential septic tanks. High levels of sulfate are another possible cause of diarrhea.

5. Between 1988 and 1990, four off-site monitor wells and one private drinking-water well were tested for sulfate. Sulfate concentrations in these five wells were below state drinking water standards. Since we do not know the sulfate concentrations prior to 1988, we cannot assess the public health threat of sulfate in the ground water prior to 1988. It is likely that the sulfate concentrations will continue to decline since the landfill stopped accepting the Brunswick Corporation sulfuric acid waste in 1980. Therefore, we do not recommend additional sampling for sulfate.

RECOMMENDATIONS

Cease/Reduce Exposure Recommendations

1. Avoid feeding water with greater than 10 mg/L nitrate to infants less than six months old. Owners of wells with nitrate concentrations greater than 10 mg/L should not use this water to prepare formula for infants less than six months old.

Site Characterization Recommendations

2. Sample all of the nearby private drinking-water wells and analyze for vinyl chloride. We recommend the Volusia County Department of Solid Waste Management sample all of the nearby private drinking-water wells and analyze for vinyl chloride.

3. Resample all these nearby private drinking-water wells and analyze for nitrate. We recommend the Volusia County Department of Solid Waste Management resample all of the private drinking-water wells within 0.25 mile of the landfill and analyze for nitrate.

4. Sample nearby wells and analyze for coliform bacteria and giardia. If nearby residents experience diarrhea again, we recommend the Volusia County Public Health Unit sample their wells and analyze for coliform bacteria and if funds are available, for giardia.

Health Activities Recommendation Panel (HARP) Recommendations

The Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), as amended, requires the ATSDR to take necessary public actions at hazardous waste sites. To determine necessary public health actions, the ATSDR's Health Activities Recommendation Panel (HARP) evaluated the data and information developed in this preliminary public health assessment.

The Panel determined that no follow-up health activities are currently needed because there is no evidence that people have been exposed to contaminants from this landfill at concentrations likely to affect their health. If information becomes available indicating exposure at levels of concern, the ATSDR will evaluate that information to decide what actions, if any, are necessary.

PUBLIC HEALTH ACTIONS

This section describes what the ATSDR and/or the Florida HRS will do at the Plymouth Avenue Landfill after the completion of this public health assessment report. The purpose of a Public Health Action Plan is to ensure that the appropriate agency or party reduce any existing health hazards and prevent future health hazards. The ATSDR and/or the Florida HRS will do the following:

1. If diarrhea recurs in nearby residents, the Volusia County Public Health Unit will sample their private drinking-water wells and analyze for coliform bacteria. If funds are available, they will also analyze for giardia.

The ATSDR and/or the Florida HRS will reevaluate the Public Health Action Plan when new environmental, toxicological, or health outcome data are available.

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Regional Services
Office of the Assistant Administrator

CERTIFICATION

This Plymouth Avenue Landfill Public Health Assessment was prepared by the Florida Department of Health and Rehabilitative Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun.

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ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment, and concurs with its findings.

Robert C. Williams, P.E., DEE
Director, DHAC, ATSDR

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APPENDIX A: Figures

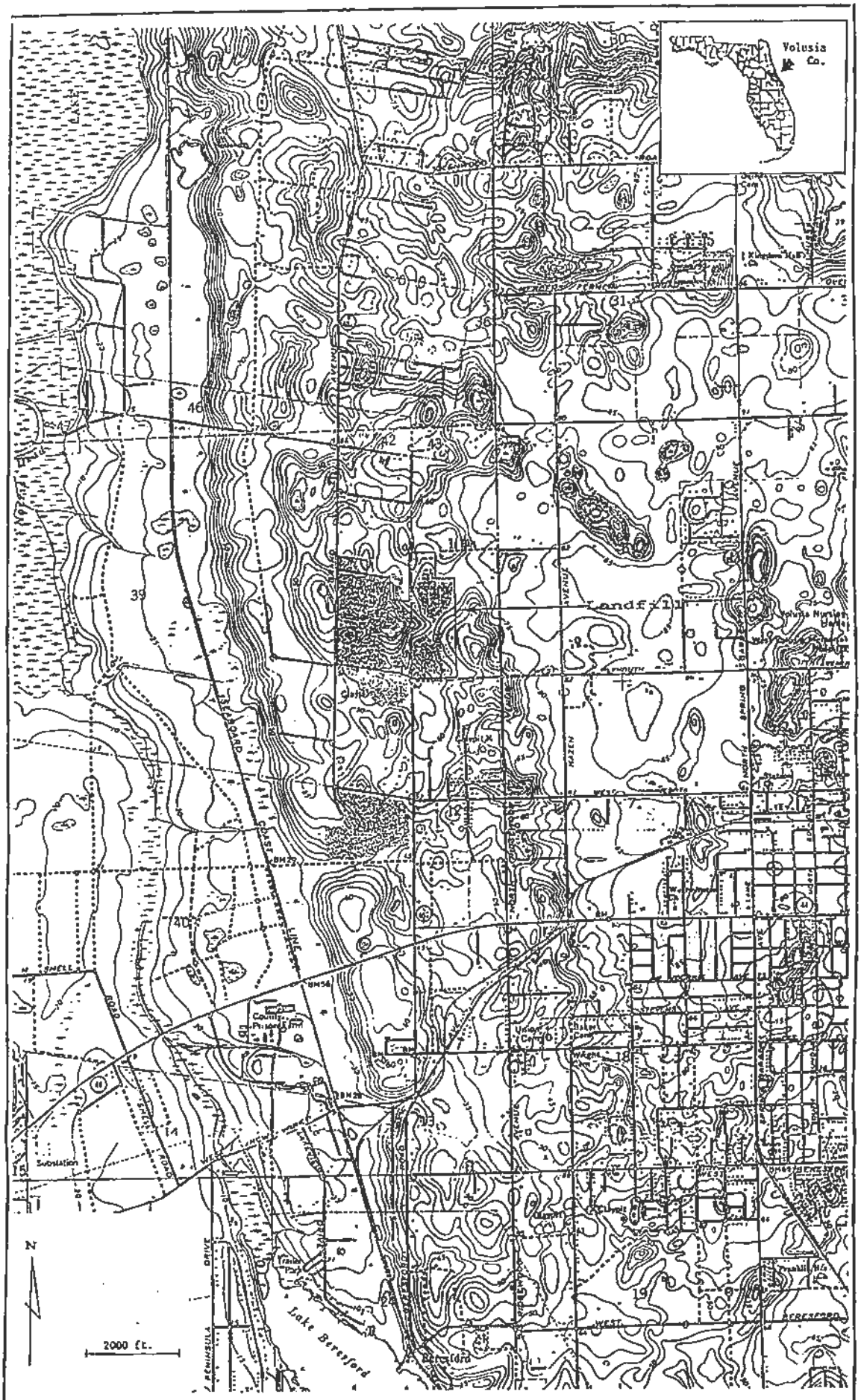
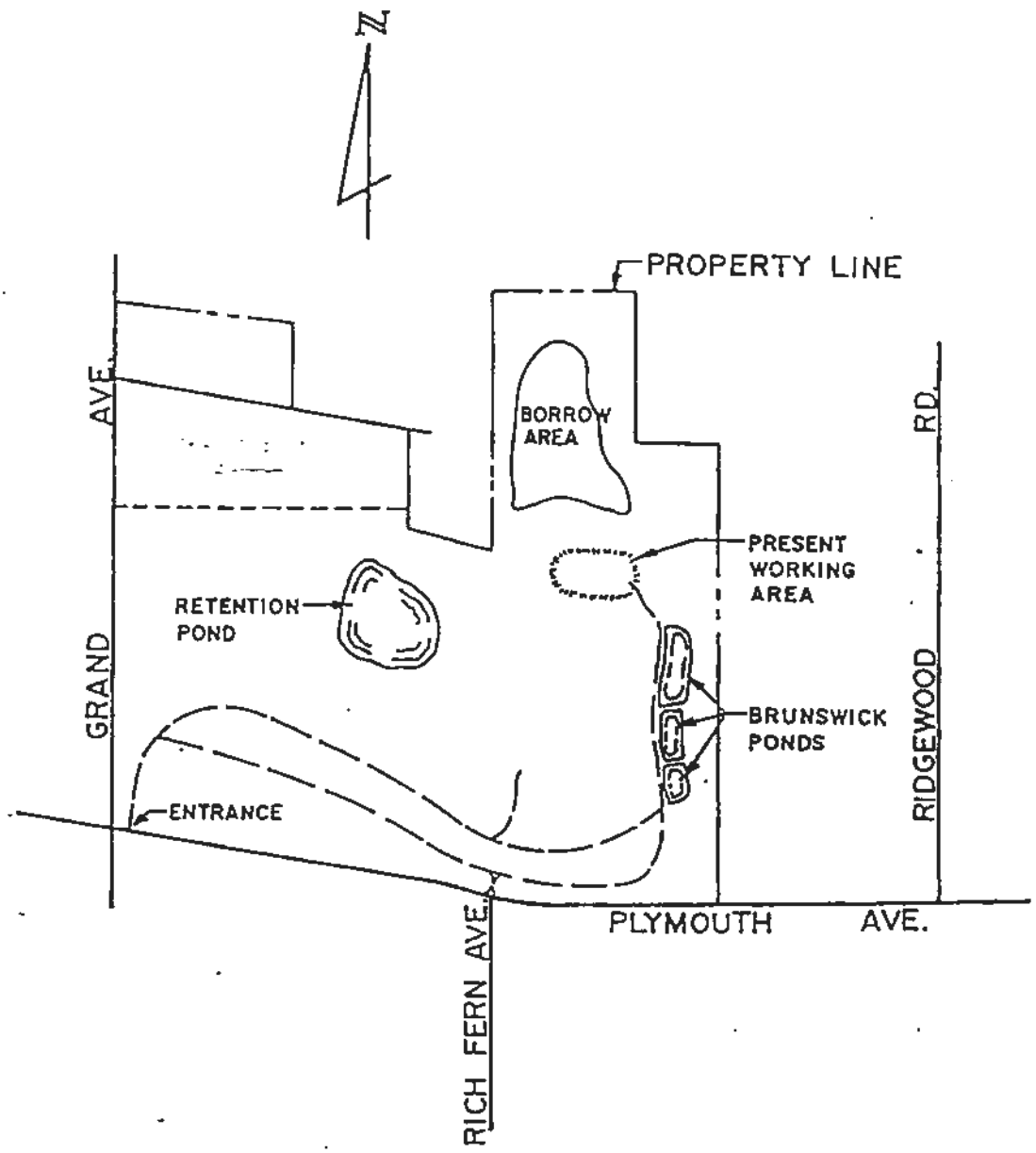


Figure 1. Location of Plymouth Landfill

VC 86131-6 CE



SITE PLAN

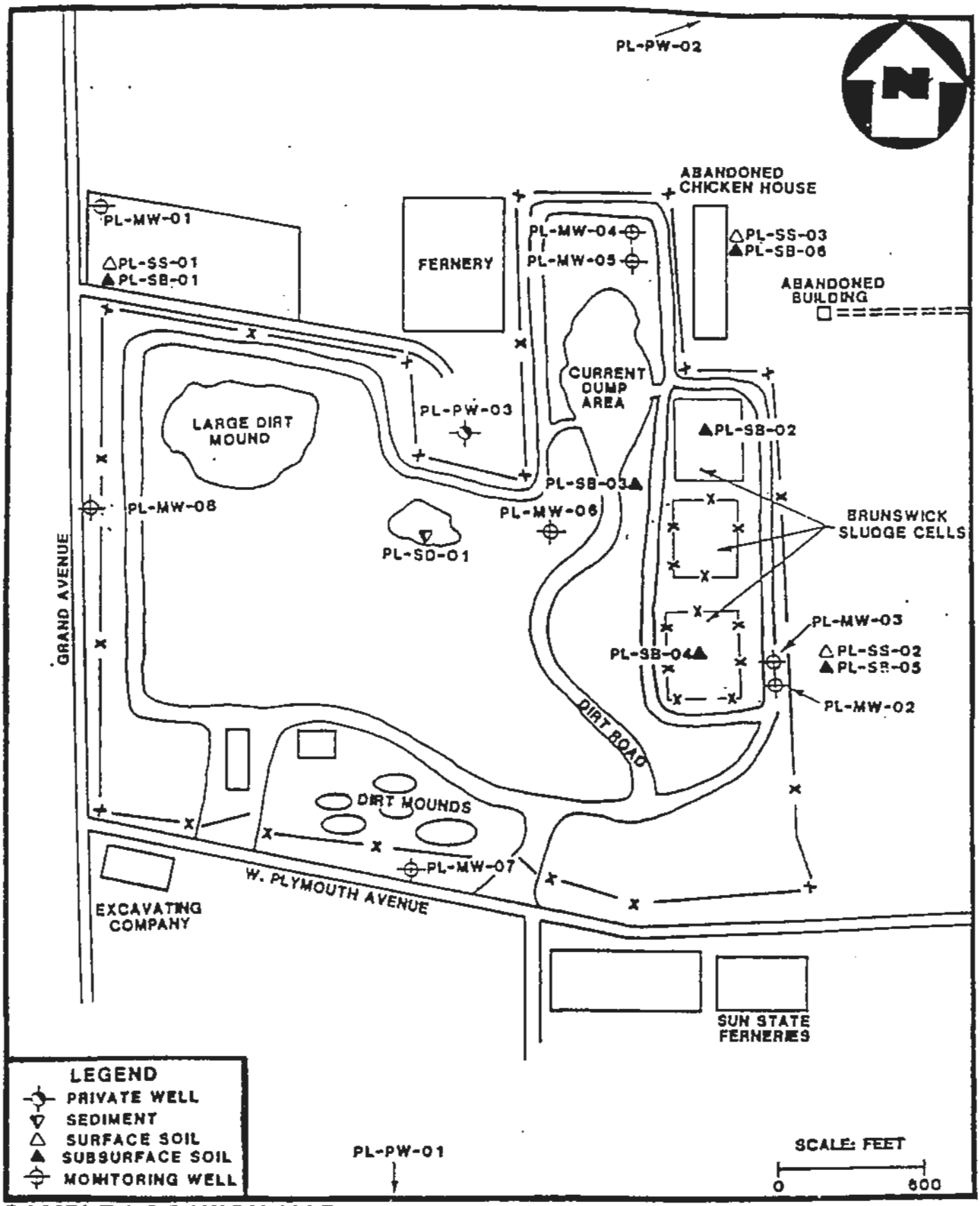
0 400 800

SCALE IN FEET

R-834

Prepared by
Briley, Wild & Associates, Inc.
Consulting Engineers & Planners

FIGURE 2



SAMPLE LOCATION MAP
PLYMOUTH AVENUE LANDFILL
DELAND, VOLUSIA COUNTY, FLORIDA

FIGURE 3

NUS CORPORATION

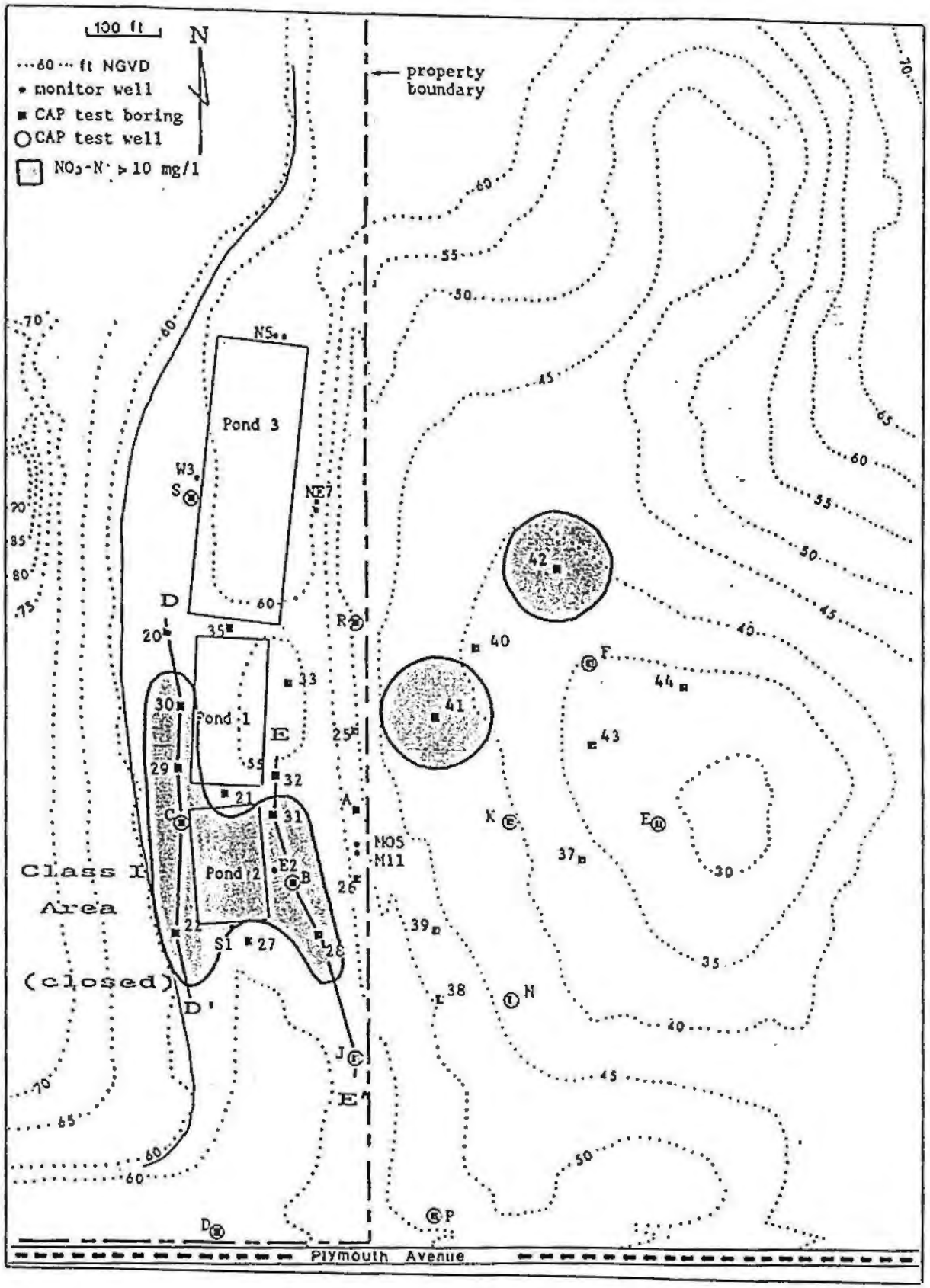


Figure 4. Soil Boring and Monitor Well Locations.

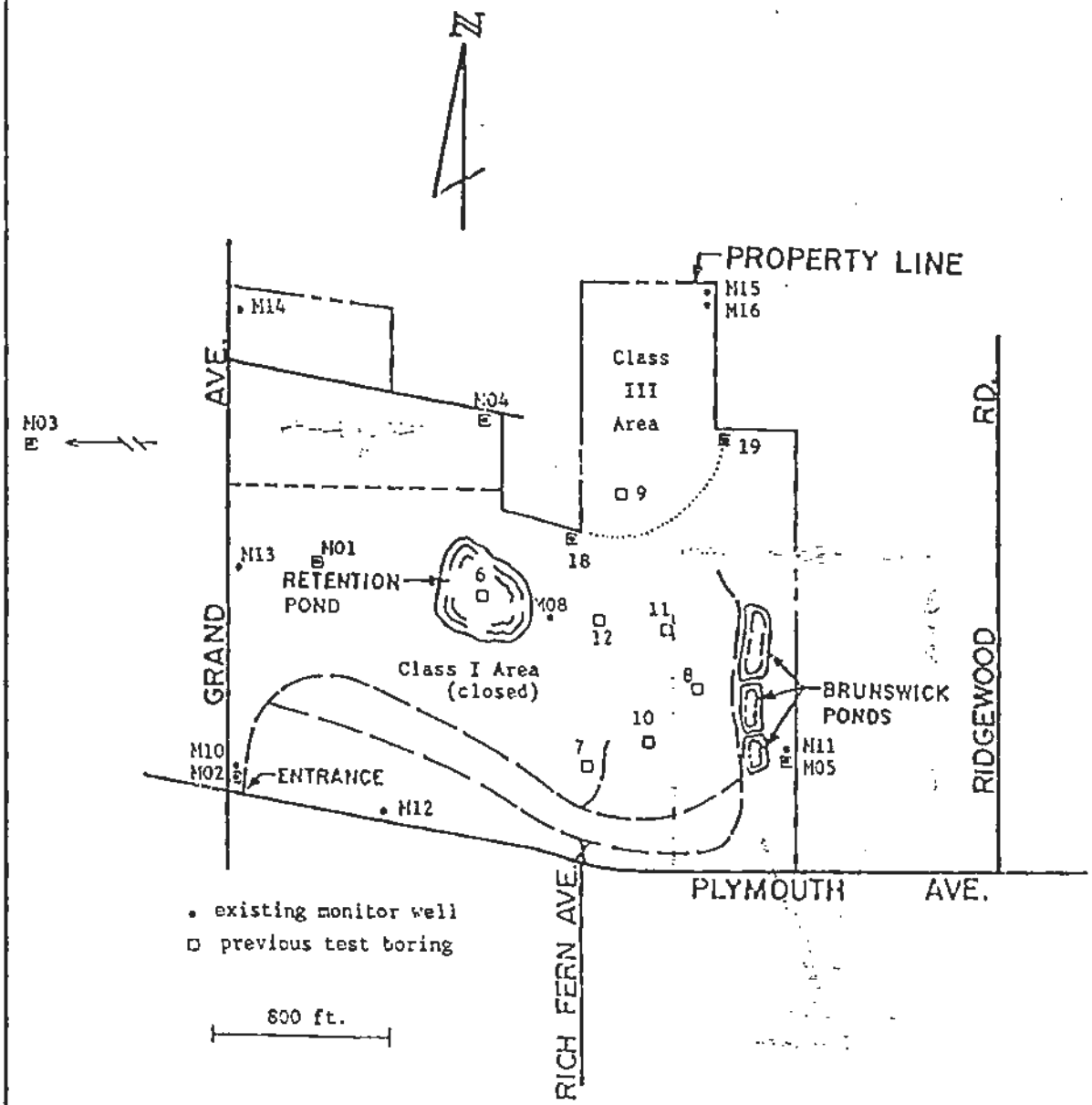


Figure 5. Monitor Well Locations.

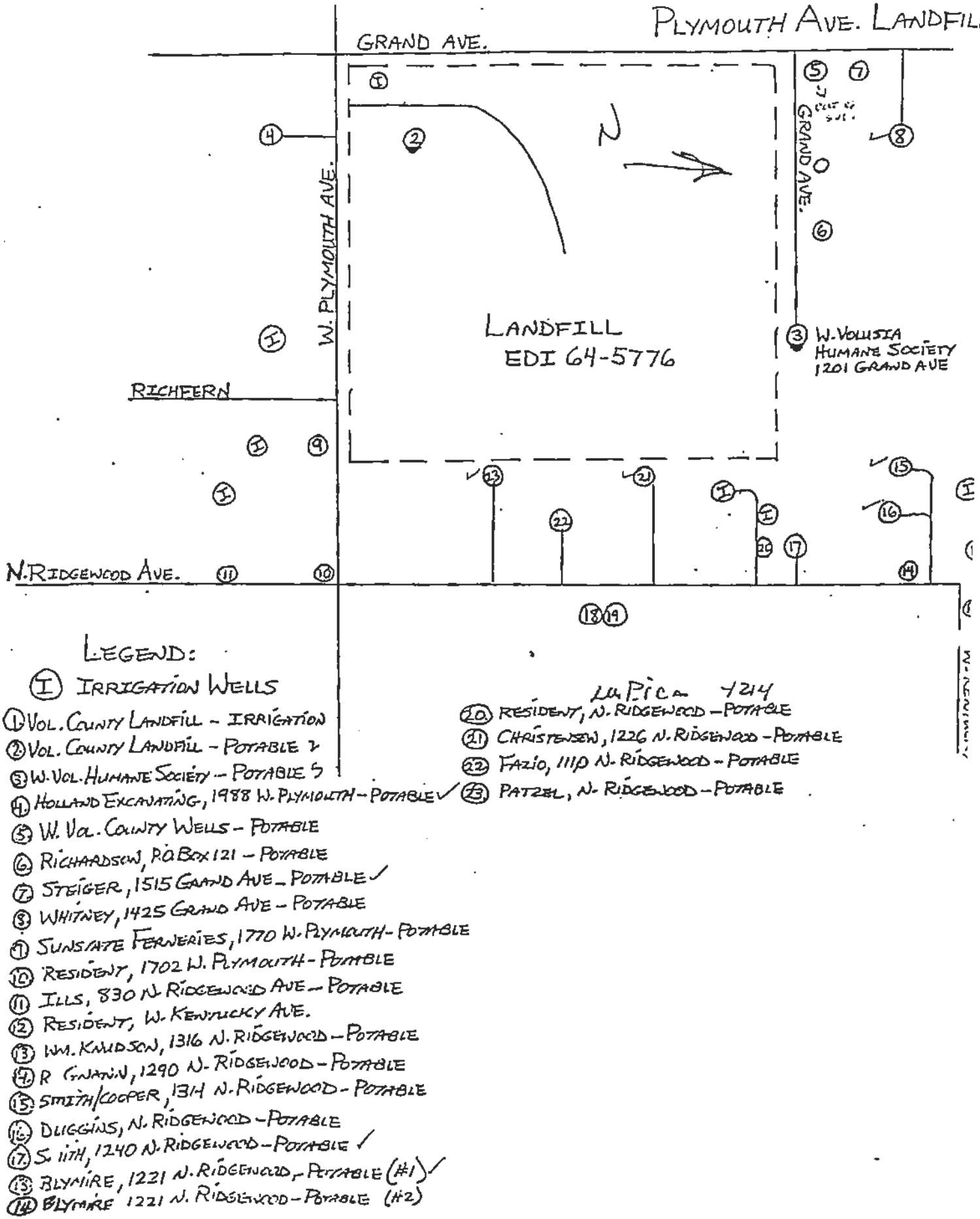


Figure 6. Nearby Private Drinking-Water Wells.

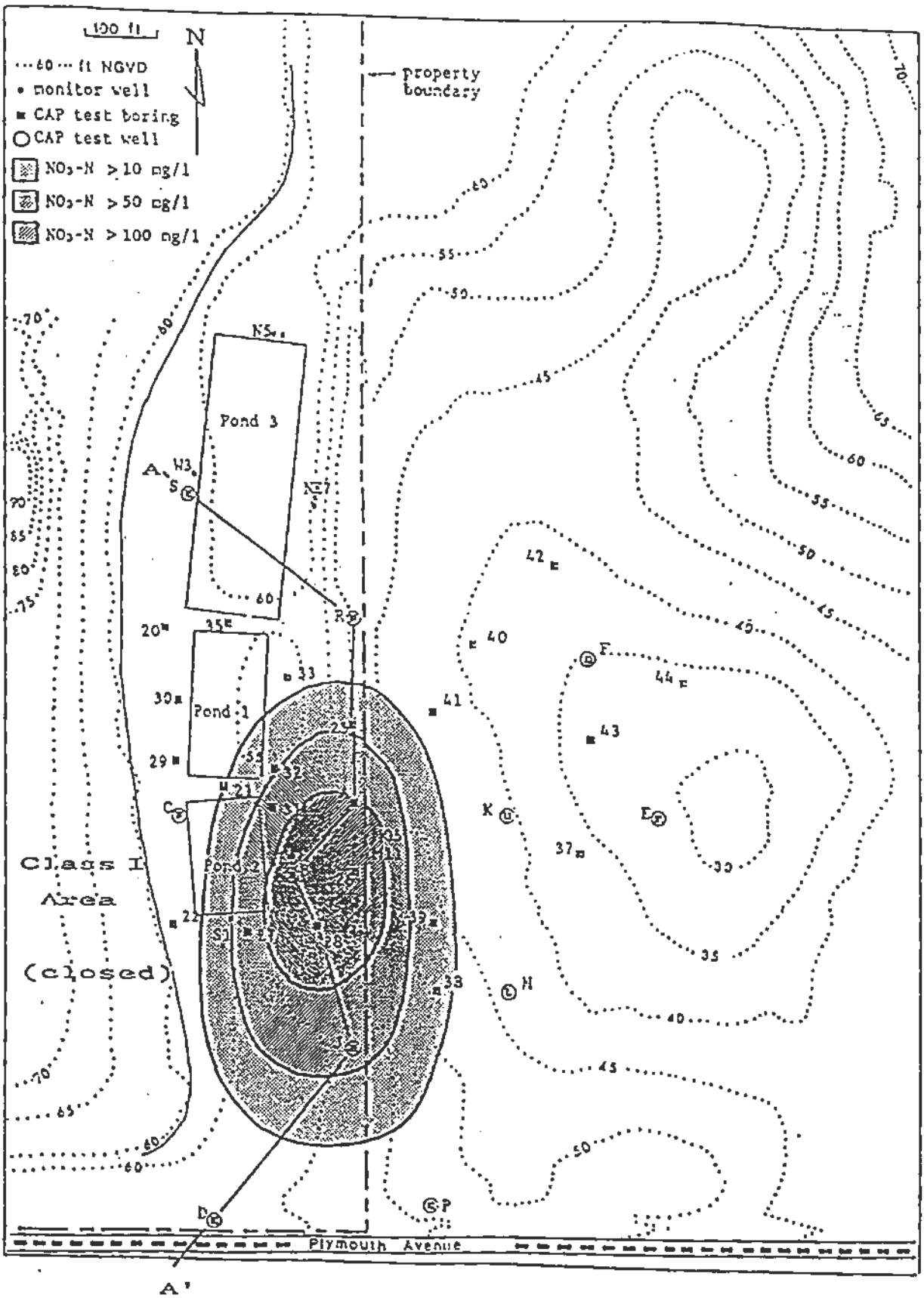


Figure 7. Area In Floridan Aquifer With Elevated Nitrates: 1992