PRELIMINARY Public Health Assessment for

STAUFFER CHEMICAL COMPANY/TARPON SPRINGS
TARPON SPRINGS, PINELLAS COUNTY, FLORIDA
CERCLIS NO. FLD010596013
AUGUST 4, 1993

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

PRELIMINARY PUBLIC HEALTH ASSESSMENT

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TARPON SPRINGS, PINELLAS COUNTY, FLORIDA

CERCLIS NO. FLD010596013

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.

Agency for Toxic Substances
and Disease Registry................................William L. Roper, M.D., M.P.H. Administrator
Barry L. Johnson, Ph.D., Assistant Administrator

Division of Health Assessment
and Consultation..Robert C. Williams, P.E., Director
Juan J. Reyes, Deputy Director

Federal Programs Branch..Sally L. Shaver, Chief

Community Health Branch...Cynthia M. Harris, Ph.D., Chief

Remedial Programs Branch..........................Sharon Williams-Fleetwood, Ph.D., Chief

Records & Information Management Branch..........................Max M. Howie, Jr., Chief

Emergency Response & Consultation Branch....................C. Harold Emmett, P.E., Chief

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TABLE OF CONTENTS

SUMMARY

The Stauffer Chemical Co. (Tarpon Springs Plant) site is located northwest of the city of Tarpon Springs, Pinellas County, Florida. The site is in a mixed residential/light industrial area along the Anclote River. Elemental phosphorus was extracted from phosphate ore at the plant from 1947 to 1981.

Soil, sediment, groundwater and surface water are contaminated. When the plant was in operation there was community concern about noxious fumes coming from the site. The community is currently concerned about airborne dust transporting contaminants from the site. Contaminants of concern at the site are antimony, arsenic, beryllium, boron, cadmium, chromium, fluoride, lead, thallium, vanadium, radon, radium and sulfur dioxide.

Residents near the site are concerned that contaminants may have caused brain cancer, lung cancer or emphysema. Four of the contaminants of concern--arsenic, beryllium, cadmium and chromium--are known or suspected lung carcinogens. None of the contaminants of concern is known to cause brain cancer. Workers on the site and residents within about one-half mile may have been exposed to sulfur dioxide and phosphorus pentoxide from the plant while it was operating. However, we do not have any information to estimate the health risk from exposure to the sulfur dioxide and phosphorus pentoxide.

Based on the available information, we categorize the Stauffer Chemical Co. (Tarpon Springs Plant) site as a public health hazard. Exposure to contaminants at this site has occurred in the past and may still be occurring. Exposure to contaminants at this site for longer than a year may cause adverse health effects. Workers on-site are exposed to contaminants in the soil and dust, and nearby residents may be exposed to contaminated air-borne dust. Workers were exposed to arsenic while the plant was in operation. This exposure may result in a "low" to "moderate" increase in the risk of skin cancer. Contaminants in the groundwater on-site may migrate into wells south and west of the site.

We recommend private wells within one-half mile south and west of the site be monitored. We also recommend river water and sediment samples from the beach area near the site be analyzed to determine the potential exposure to people who swim there. On-site workers should be provided with appropriate protection from exposure to contaminants.

ATSDR's Health Activities Recommendation Panel (HARP) has evaluated the data and information developed in the Stauffer Chemical Co. (Tarpon Springs Plant) Public Health Assessment. The Panel has determined that health education is needed to assist local residents and workers in understanding their potential for exposure to contaminants and possible associated

health risks. In addition, health professions education is recommended to inform the local medical community about the health effects that may occur in individuals exposed to contaminants from the site.

Florida HRS in cooperation with ATSDR and the Pinellas County Health Unit will develop and distribute educational materials for residents who may be consuming contaminated water from private wells. Also, physician education materials will be developed to inform local doctors of the possibility that patients may experience adverse health effects from exposure to chemicals from the Stauffer site.

BACKGROUND

The Florida Department of Health and Rehabilitative Services (Florida HRS) has entered into a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) to evaluate the public health significance of this site. Specifically, Florida HRS is tasked with determining whether health effects are possible and recommending actions to reduce or prevent them. ATSDR, located in Atlanta, Georgia, is a federal agency within the U.S. Department of Health and Human Services and is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to conduct public health assessments at hazardous waste sites.

A. Site Description and History

The Stauffer Chemical Co. (Tarpon Springs Plant) site (Stauffer) is between Anclote Boulevard and the Anclote River, about one mile east of the Gulf of Mexico, in Tarpon Springs, Pinellas County, Florida (Figures 1 and 2, Appendix A). The plant, which extracted elemental phosphorus from phosphate ore, is currently inactive and many buildings and other structures have been dismantled and removed from the site. A skeleton crew, consisting of a manager, four operators and three security guards, is currently stockpiling slag and other processing debris for later disposal as well as providing 24-hour security and maintenance of the grounds and remaining equipment.

The 160-acre facility was operated by Victor Chemical Works from 1947 to 1960 when it was purchased by Stauffer Chemical Co. Stauffer operated the plant until it closed in 1981 (NUS Corp. 1989, 1991). The facility's ownership has changed several times since then and is currently the Stauffer Management Co., a subsidiary of Zeneca, Inc. (formerly ICI Americas) (McNeice 1993).

The main plant site, as shown in Figure 3, Appendix A, is south and west of Anclote Road. This area originally included the phosphate ore processing and phosphorus production facilities, waste disposal facilities, office and administration buildings, and several railroad spurs used for receipt of raw materials and shipment of products. The area to the north, between Anclote Road and Anclote Boulevard, contains production wells for process water and was also used for storage of crushed slag and other waste materials. The railroad lines, many of the buildings, and much of the waste slag were removed after the plant closed.

Prior to 1978, Stauffer is reported to have buried about 900 55-gal. drums of calcined phosphate sand on-site near the southernmost slag piles (Figure 4, Appendix A) (NUS 1987). Between 1975 and 1979, the Pinellas County Department of Environmental

Management (DEM) received numerous complaints from local citizens about air pollution from the Stauffer plant. Residents near the plant complained of choking fumes (probably sulfur dioxide) from the plant. One news article and several citizen complaints described white clouds (probably phosphorus pentoxide) emanating from the plant. Air sampling between 1977 and 1980 showed sulfur dioxide and suspended particulate emissions from the plant were in violation of Florida ambient air quality standards (Gibbs 1980). Sampling in 1985 of on-site shallow groundwater showed levels of fluoride, a by-product of the phosphorus extraction process, exceeded Florida's Maximum Contaminant Level (MCL) (McClellan 1986).

Because of concern over air emissions and groundwater contamination this site is being evaluated for possible inclusion in the National Priorities List (NPL) of Superfund cleanup sites. The NPL is maintained by the U.S. Environmental Protection Agency (EPA) and lists those hazardous waste sites that require cleanup action under the "Superfund" law, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). This Public Health Assessment is being prepared by Florida HRS for ATSDR as part of the evaluation process.

B. Site Visit

Mr. Bruce Tuovila, Florida HRS, Mr. Dave Hansen, Pinellas County Public Health Unit (CPHU), and a representative from the Stauffer Chemical Co. visited the site on September 21, 1992. Both the main plant site and the slag storage area are surrounded by chain link fences topped with barbed wire and posted with warning signs. A 24-hour guard provides additional security for the site. The main plant area south of Anclote Road is fairly flat, sloping slightly toward the river to the south. Two piles of slag, about 15 feet high, are on the east and west sides of the site. Two smaller piles are on the southern-most point of the property (Figure 4, Appendix A). Along the southeast border of the site are a series of 4 foot deep impoundments that were used to treat process waste water. We observed that they are currently filled with vegetation and contain no standing water. We also observed that the ground in this area contains crushed slag and is sparsely vegetated. The railroad spur lines and many of the buildings have been removed from the site. Only the administrative office, guard house, lunch room, shop, water tower, power substation, boiler building and clarifier remain. Foundations of the removed buildings are still present. There is no surface evidence in the areas where the drums of calcined phosphate sand are supposed to be buried. The remainder of the site is covered by well-maintained grass.

The slag storage area north of Anclote Road is surrounded on the west, north and east by pine forest (Figure 5, Appendix A). In the open central area, which contains little vegetation, are the foundation of a building and the remains of crushed slag. We did not observe any evidence of trespassing on the site.

During our drive-through tour of the neighborhood around the site, we observed a residential area with homes under construction bordering the site on the west. About 100 feet north of the site across Anclote Boulevard are more residences and an elementary school. Fifty feet east of the site across Anclote Road is a light industrial area containing a scrap yard, a concrete plant and an auto junk yard. Along the Anclote River from one-eighth to one mile upstream and downstream of the plant are private residences, fishing camps and a county park. We observed five private wells within one mile of the site.

C. Demographics, Land Use, and Natural Resource Use

Demographics

According to 1990 census data (BOC 1992), approximately 14,000 people live within a one mile radius of the site north of the Anclote River and about 4,700 people live within one mile south of the river. The neighborhoods north of the site are lower-middle income while the ones south of the site across the river are middle income. About 100 feet north of the site across Anclote Boulevard are an elementary school and day care center, and three-quarters of a mile southwest of the site across the Anclote River are a hospital and another day care center.

Land Use

The area within one mile of the site is mostly residential with a light industrial/commercial area across Anclote Road to the east. The Anclote River, which is used for recreation and by commercial fishing boats, borders the site on the southwest. Several fishing camps and marinas are within one mile upstream and downstream and a county park is about three-quarters of a mile downstream of the site.

A new residential development is under construction next to the site on the west. At least five private wells and three public supply wells are located within one mile of the site to the west, north, east and southeast.

Natural Resource Use

Groundwater in the area of the site occurs in a shallow sand aquifer underlain by the Floridan aquifer. Water is reached at an average depth of 8 feet and the Floridan aquifer begins at a depth of 17 to 37 feet. Groundwater flow in the surficial aquifer is to the southwest (NUS Corp. 1991). Groundwater flow velocity in the surficial aquifer ranges from 0.001 to 0.01 feet/day (Seaburn and Robertson 1987). Groundwater flow in the

Floridan aquifer is believed to be to the southwest. The flow rate has not been determined. A clay layer up to 25 feet thick separates the two aquifers (USGS undated). However, the composition of this layer is not uniform and there is communication between the aquifers. Private and public supply wells within one mile of the site draw water from the Floridan aquifer (NUS Corp. 1991).

The Anclote River runs from northwest to southeast on the southwest side of the site. The river is tidally influenced from at least one mile upstream from the site to its mouth at the Gulf of Mexico. Thus flow direction changes depending on the tides. An electric power plant draws cooling water from the river approximately one mile downstream of the site. The river is also used extensively by commercial fishing boats traveling from a docking area one mile upstream to the Gulf of Mexico. Recreational boaters using the river may swim at the county park downstream from the site and fish near the mouth of the river.

D. Health Outcome Data

Guided by community health concerns, HRS epidemiologists reviewed information contained in the Florida Cancer Data System (FCDS). FCDS is a program of Florida HRS operated by the University of Miami School of Medicine and covers all cancers reported in Florida between 1981 and 1990. Since cancer registry information was available only at the county level, we analyzed data for Pinellas and Pasco counties.

Although there have been no allegations or indications of elevated birth defect rates near this site, HRS epidemiologists also reviewed information from the Congenital Defects Surveillance Project (CDSP). CDSP is a data base containing birth defects reported from 1980 to 1982. We will discuss the results of these reviews in the Public Health Implications, Health Outcome Data Evaluation section.

COMMUNITY HEALTH CONCERNS

Residents of Tarpon Springs, which borders the site, have expressed a number of health concerns. We compiled these concerns from telephone conversations with community leaders, community newsletters, newspaper articles, and local health officials.

Community members have expressed the following health concerns:

1. Can contaminants from the site cause brain cancer in people living close to the site?

2. Are contaminants leaching into the groundwater from the site and entering nearby private and public wells?

3. Were radioactive materials produced when the plant was operating and do they continue to contaminate the site?

4. Can dust blowing from the site carry contamination into the community or the nearby river?

5. Have children at the elementary school north of the site been exposed to contamination from the site?

6. When the plant was in operation, people living near the plant or using the river frequently reported being exposed to clouds of white fumes which produced respiratory distress. What other adverse health effects could occur from this exposure?

7. What has happened to the 900 drums of calcined phosphate sand buried on the site and what hazard do they represent?

8. Can exposure to contaminants in the air produce emphysema or lung cancer in workers at the plant?

These concerns are addressed in the Public Health Implications Community Health Concerns Evaluation section.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

In this section, we review the environmental data collected at this site. We evaluate the adequacy of the sampling that has been conducted, select contaminants of concern, and list the maximum concentration and frequency of detection of the contaminants found in various media. The maximum concentrations found are then compared to background levels and to standard comparison values. The following comparison values are used in the data tables:

1. CREG--Cancer Risk Evaluation Guide--calculated from EPA's cancer slope factors, is the contaminant concentration that is estimated to result in no more than one excess cancer in a million persons exposed over a lifetime.

2. EMEG--Environmental Media Evaluation Guide--derived from ATSDR's Minimal Risk Level (MRL), which provides a measure of the toxicity of a chemical, is the estimate of daily human exposure to a chemical that is likely to be without an appreciable risk of non-cancerous adverse effects, generally for a period of a year or longer.

3. LTHA--Lifetime Health Advisory for Drinking Water--is

EPA's estimate of the concentration of a contaminant in drinking water at which adverse health effects would not be anticipated to occur over a lifetime of exposure. LTHAs provide a safety margin to protect sensitive members of the population.

4. MCL--Maximum Contaminant Level--is the contaminant concentration that EPA considers protective of public health over a 70-year lifetime at an exposure rate of 2 liters of water per day. MCLs are regulatory concentrations.

5. Chronic RfD--Reference Dose--is EPA's estimate of the daily exposure to a contaminant that is unlikely to cause non-cancerous adverse health effects.

We selected contaminants at this site 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 the health assessment to those contaminants most important to public health. When selected as a contaminant of concern in one medium, we have also reported that contaminant in all other media. We evaluate these contaminants in subsequent sections and determine whether exposure has public health significance.

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

Antimony	Chromium	Sulfur dioxide
Arsenic	Fluoride	Thallium
Beryllium	Lead	Vanadium
Boron	Radium	
Cadmium	Radon	

For chromium, the analysis reports did not specify whether chromium metal (chromium 0), trivalent chromium (chromium III) or hexavalent chromium (chromium IV) was detected. Since chromium VI is the most toxic form of the metal, we feel it is most protective of public health to assume the presence of chromium VI and have used the appropriate comparison values throughout this assessment.

In addition to the contaminants listed above, there are several others of concern to the community. Phosphorus pentoxide may have been emitted from the plant while it was in operation. Citizen complaints and one news report of a fire at the plant describe white clouds of fumes coming from the site. Elemental phosphorus produced at Stauffer would have spontaneously ignited to form white-colored clouds upon exposure to the air. However, no environmental data is available upon which to base an assessment of the public health significance of phosphorus pentoxide.

Phosphorus has been detected in on-site surface soil (609-84,800 mg/kg), subsurface soil (ND-68,000 mg/kg), shallow groundwater (10-49,000 ug/L), off-site surface water (ND-40,000 ug/L) and sediment (31-4,600 mg/kg) (Boison 1987, McClellan 1987a and b, Harris 1988a-1991a, NUS 1989, Weston 1990). There is insufficient toxicological data available upon which to base an assessment of the public health significance of phosphorus.

The possible presence of uranium at the site is also of concern to the local community. Although no environmental samples have been analyzed specifically for uranium, the results of a gamma survey are consistent with the presence of phosphate ore and do not indicate unusual concentrations of radionuclides (Weston 1990).

Polonium^{210} is an additional community concern and has been detected in on-site shallow groundwater (ND-80 pCi/L) and off-site surface water (ND-62 pCi/L) (Boison 1987, McClellan 1987a and b, Harris 1988a-1991a). There is insufficient toxicological data available upon which to base an assessment of the public health significance of polonium^{210}.

To identify industrial facilities that could contribute to the contamination near this site, we searched the 1987, 1988, 1989 and 1990 EPA Toxic Chemical Release Inventory (TRI) data bases. EPA developed TRI from the chemical release information (air, water, and soil) provided by certain industries. The Stauffer plant is in the 34689 zip code area and adjacent to the 34691 zip code area. A TRI search of these two zip codes revealed no industries reporting releases of chemicals found at levels of concern at this site.

In this assessment, the contamination that exists **on** the site will be discussed first, separately from the contamination that occurs **off** the site.

A. On-site Contamination

For the purposes of this evaluation, "on-site" will be defined as the area within the fenced boundaries of the main processing plant and the slag storage area to the north (Figure 3, Appendix A).

We compiled data in this subsection from the following sources: the 1988 NUS Corp. groundwater radon data (Donaghue 1988), the 1989 NUS Corp. expanded site investigation (NUS Corp. 1989), the 1990 Weston, Inc. site soil characterization study (Roy F. Weston, Inc. 1990), the 1991 NUS Corp. listing site inspection (NUS Corp. 1991), and the Stauffer Chemical Co. groundwater monitoring plan results (Boison 1987, Harris 1988a-1991a, McClellan 1986-1987b).

Surface Soil

EPA and Stauffer Chemical Co. contractors collected a total of 57 surface soil samples (depth not specified) from various locations on the site between 1988 and 1989 (Donaghue 1988, NUS Corp. 1989, Roy F. Weston, Inc. 1990, NUS Corp. 1991) (Figure 6, Appendix A). A background sample was collected from the northeast corner of the slag disposal area. This area is relatively undisturbed and is considered representative of background conditions on site. Antimony, arsenic, beryllium, cadmium and fluoride were at levels above background and the corresponding comparison values (Table 1, Appendix B). A total of 29 surface samples were also analyzed for radium. The concentrations in 22 of these samples exceeded the background level. For this assessment, these samples were adequate to characterize the on-site surface soil quality.

Subsurface Soil

EPA and Stauffer Chemical Co. contractors collected a total of 45 subsurface soil samples (4 - 15 feet deep) from various locations on the site between 1988 and 1989 (Donaghue 1988, NUS Corp. 1989, Roy F. Weston, Inc. 1990, NUS Corp. 1991) (Figure 7, Appendix A). A background sample was collected from the northeast corner of the slag disposal area. This area is relatively undisturbed and is considered representative of background conditions on site. Antimony, arsenic, beryllium, cadmium and fluoride were at levels above background and the corresponding comparison values (Table 2, Appendix B). A total of 59 samples were also analyzed for radium. The concentrations in 32 of these samples exceeded the background level. For this assessment, these samples were adequate to characterize the on-site subsurface soil quality.

Sediments

EPA and Stauffer Chemical Co. contractors collected a total of 14 sediment samples from various locations on the site between 1988 and 1989 (Donaghue 1988, NUS Corp. 1989, Roy F. Weston, Inc. 1990, NUS Corp. 1991) (Figure 8, Appendix A). A background sample was collected from the eastern half of the slag disposal area. This area is relatively undisturbed and is considered representative of background conditions on site. Arsenic, cadmium, and chromium were at levels above background and the corresponding comparison values (Table 3, Appendix B). Nine sediment samples from the on-site lagoons were also analyzed for radium. The concentrations in all these samples exceeded the background level. For this assessment, these samples were adequate to characterize the on-site sediment quality.

Shallow Groundwater

Between 1985 and 1989, EPA and Stauffer Chemical Co. contractors collected a total of 158 shallow groundwater (less than 35 feet deep) samples from monitoring wells installed at various locations on the site (Boison 1987, Harris 1988a-1991a, McClellan 1986-1987b, Donaghue 1988, NUS Corp. 1989, NUS Corp. 1991) (Figure 9, Appendix A). Background samples were collected from the northeast corner of the slag disposal area. This area is relatively undisturbed and is considered representative of background conditions on site. Background samples were collected from both the upper and lower portions of the surficial aquifer. We consider the samples from the lower portion of the aquifer to represent undisturbed background conditions. Antimony, arsenic, boron, cadmium, chromium, fluoride, lead, thallium and vanadium were at levels above background and the corresponding comparison values (Table 4, Appendix B). A total of 149 samples were analyzed for radon. Of these, 73 contained concentrations above the proposed maximum contaminant level (MCL) of 300 picoCuries per liter (pCi/L). In addition, 131 samples were analyzed for radium. None of these samples exceeded the Florida MCL of 5 pCi/L. For this assessment, these samples were adequate to characterize the on-site shallow groundwater quality.

Deep Groundwater

EPA and Stauffer Chemical Co. contractors collected a total of 5 deep groundwater (greater than 35 feet deep) samples from monitoring wells on site between 1988 and 1989 (Donaghue 1988, NUS Corp. 1989, NUS Corp. 1991) (Figure 10, Appendix A). A background sample was collected from the northeast corner of the slag disposal area. This area is relatively undisturbed and is considered representative of background conditions on site. Arsenic, chromium and fluoride were at levels above background and the corresponding comparison values (Table 5, Appendix B). Ten samples were analyzed for radon. Of these, 8 were at levels above the proposed MCL of 300 pCi/L. In addition, two samples were analyzed for radium. None of these samples exceeded the Florida MCL of 5 pCi/L. For this assessment, these samples are not sufficient to adequately characterize the on-site deep groundwater quality. Only two deep groundwater monitoring wells have been developed on the site. This number is insufficient to assess deep groundwater quality at this site.

B. Off-site Contamination

For the purposes of this evaluation, "off-site" will be defined as the area outside the boundary fences of the Stauffer plant and slag storage area (Figure 3, Appendix A).

We compiled data in this subsection from the following sources: the 1983 report of air monitoring data to the Florida Department of Environmental Regulation (FDER) (Robbins 1983), the 1988 NUS Corp. groundwater radon data (Donaghue 1988), the 1989 NUS Corp. expanded site investigation (NUS Corp. 1989), the 1990 Pinellas county private well monitoring data (Wyatt 1990), the 1990 Weston, Inc. site soil characterization study (Roy F. Weston, Inc. 1990), the 1991 NUS Corp. listing site inspection (NUS Corp. 1991), and the Stauffer Chemical Co. groundwater monitoring plan results (Boison 1987, Harris 1988a-1991a, McClellan 1986-1987b).

Surface Soil

EPA and Stauffer Chemical Co. contractors collected a total of 12 surface soil samples (depth not specified) from various locations on undeveloped property off the site between 1988 and 1989 (Roy F. Weston, Inc. 1990, NUS Corp. 1991) (Figure 11, Appendix A). No background samples were collected. EPA average soil concentrations for arsenic, cadmium, chromium, fluoride and lead were used as background comparison values. An average soil radium concentration of 1.0 pCi/g published by the Florida Institute of Phosphate Research was also used. These values are listed in Table 6, but may not represent off-site background conditions at this site. Only the concentration of lead exceeded background (Table 6, Appendix B). In addition, two samples were analyzed for radium. The concentrations in both of these samples exceeded the background level. Because of the small number of sample locations and the absence of site-specific background samples, the off-site surface soil quality cannot be fully characterized.

Subsurface Soil

EPA and Stauffer Chemical Co. contractors collected a total of 3 subsurface soil samples (4 - 6 feet deep) from various locations on undeveloped property off the site between 1988 and 1989 (NUS Corp. 1989, Roy F. Weston, Inc. 1990) (Figure 12, Appendix A). No background samples were collected. EPA average soil concentrations for arsenic, cadmium, chromium, fluoride and lead were used as background comparison values. An average soil radium concentration of 1.0 pCi/g published by the Florida Institute of Phosphate Research was also used. These values are listed in Table 6, but may not represent off-site background conditions at this site. Although fluoride was at a level above background, its concentration did not exceed the corresponding comparison value (Table 7, Appendix B). In addition, five samples were analyzed for radium. None of these samples exceeded the background level. Because of the small number of samples and sample locations, and the absence of site-specific background samples, the off-site subsurface soil quality cannot be fully characterized.

Sediments

EPA contractors collected a total of 24 sediment samples from various locations off the site between 1988 and 1989 (NUS Corp. 1989, NUS Corp. 1991) (Figure 13, Appendix A). Background samples were collected from one location on undeveloped property just off the site and from another several miles away. These areas are relatively undisturbed and are considered representative of background conditions off the site. Although arsenic, chromium, fluoride, lead, thallium and vanadium concentrations exceeded the background levels, only fluoride exceeded its comparison value (Table 8, Appendix B). No off-site sediment samples were analyzed for radium. Except for radium and boron, these samples were adequate to characterize the off-site sediment quality.

Shallow Groundwater

EPA contractors collected a total of nine shallow groundwater samples (less than 35 feet deep) from three monitoring wells off the site between 1988 and 1989 (Donaghue 1988, NUS Corp. 1989, NUS Corp. 1991) (Figure 14, Appendix A). No background samples were collected for comparison. Arsenic, beryllium, cadmium, chromium, fluoride, lead and vanadium were found at levels above the corresponding comparison values (Table 9, Appendix B). Four samples were also analyzed for radon. Two of these samples exceeded the proposed MCL for radon of 300 pCi/L. No off-site shallow groundwater samples were analyzed for radium. Except for radium and boron, these samples were adequate to characterize the off-site shallow groundwater quality.

Deep Groundwater

EPA contractors and the Pinellas CPHU collected a total of 15 deep groundwater samples (greater than 35 feet deep) from five public supply wells, six private wells and two monitoring wells off the site between 1988 and 1990 (Donaghue 1988, Wyatt 1990, NUS Corp. 1989, NUS Corp. 1991) (Figure 15, Appendix A). No background samples were collected for comparison. Arsenic, beryllium, cadmium, chromium, fluoride, thallium and vanadium were found at levels exceeding the corresponding comparison values (Table 10, Appendix B). A total of 20 samples were also collected and analyzed for radon. All these samples contained radon concentrations exceeding the proposed MCL of 300 pCi/L. No off-site deep groundwater samples were analyzed for radium or boron. Because all contaminants of concern have not been analyzed for and the site-specific flow rate and direction of the Floridan aquifer have not been determined, we do not consider the off-site deep groundwater to have been adequately characterized.

Surface Water

EPA contractors and Stauffer Chemical Co. collected a total of 45 surface water samples from the Anclote River at various times between 1987 and 1990 (NUS Corp. 1989, NUS Corp. 1991, Harris 1988a-1991a, McClellan 1987a-b) (Figure 16, Appendix A). One background sample was collected at a point upstream from the site where there is little or no tidal influence. This sample is considered representative of background surface water conditions off the site. The remaining samples were collected in the tidal portion of the river where mixing of upstream and downstream water would occur. Antimony, arsenic, boron, chromium, fluoride, lead, thallium and vanadium were found at levels above the corresponding comparison values (Table 11, Appendix B). A total of 38 samples were also analyzed for radon and radium. No radon concentrations exceeded the proposed MCL of 300 pCi/L and no radium concentrations exceeded the Florida MCL of 5 pCi/L. For this assessment, these samples were adequate to characterize the off-site surface water quality.

Air

Pinellas County collected a total of 30 air samples from its off-site air monitoring station between July and December 1982 (Roabbins 1983) (Figure 17, Appendix A) and analyzed them for sulfur dioxide. Only one sample exceeded the Florida Air Toxics Working List no threat level for sulfur dioxide (Table 12, Appendix B). For this assessment, these samples were not adequate to characterize the air quality at this site. The lack of air monitoring data represents a significant data gap in evaluating the public health hazard of this site.

C. Quality Assurance and Quality Control

We requested but were unable to obtain a data review summary from EPA. In preparing this public health assessment, we relied on the referenced information and assumed that adequate quality assurance and quality control measures were followed with regard to chain-of-custody, laboratory procedures, and data reporting. The validity of the analysis and conclusions drawn for this public health assessment is determined by the completeness and reliability of the referenced information.

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

Although we observed numerous physical hazards during the site visit, access to the main plant site and the slag storage area is very closely controlled through fencing and active security patrols. Therefore, we consider the actual risk to trespassers from these physical hazards to be negligible.

PATHWAYS ANALYSES

To determine whether nearby residents are exposed to contaminants migrating from the site, 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.

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

A. Completed Exposure Pathways

For a summary of the completed exposure pathways at this site, refer to Table 13, Appendix B.

Surface Soil Pathway

Workers on the site have been in the past and are currently exposed to surface soil contamination through direct dermal contact, inhalation of dust, and incidental ingestion of soil. If the site is remediated, remediation workers may also be exposed. Since access to the site is restricted, other community members, including children, are not likely to be exposed through this pathway.

Deep Groundwater Pathway

About three individuals at a nearby business obtained their drinking water from a private deep water well. This business has recently closed. A mobile home park about 0.25 mile southeast of the site uses a private well for irrigation purposes. Casual ingestion of this water may have occurred and may still be occurring. Individuals at these two locations may have been exposed to arsenic in the well water. If the on-site deep water well was used for consumption, then workers and other individuals on the site may have been exposed to arsenic and other contaminants in the past.

Surface Water Pathway

Individuals swimming or coming in contact with water from the Anclote River may have been exposed in the past and may be exposed in the present and future to contaminants in the water. Children and other individuals using the beach/recreation area downstream from the site, as well as skiers and boaters on other parts of the river, may have also been exposed.

Off-Site Sediment Pathway

Individuals coming in contact with sediment in the Anclote River during swimming may have been exposed in the past and may be exposed in the present and future to contaminants in the sediment. Children and other individuals using the beach/recreation area downstream from the site, and individuals who come in contact with sediments from other parts of the river may have been exposed.

Air Pathway

Individuals living within one mile of the site may have been exposed to sulfur dioxide and phosphorus pentoxide fumes emitted from the plant while it was in operation. Those individuals living or working close to the plant may have also been exposed to contaminated dust blowing from the site during periods of high winds.

B. Potential Exposure Pathways

For a summary of the potential exposure pathways at this site, refer to Table 14, Appendix B.

Subsurface Soil Pathway

While subsurface soil on the site is contaminated, this medium is currently inaccessible. However, if this soil is exposed during remediation work, those involved in the remediation could be exposed to this contamination.

Off-Site Surface Soil

Off-site surface soil does not contain any contaminants at a level of concern. However, the available environmental data is inadequate to fully characterize this source of contamination.

On-Site Sediment Pathway

Since the on-site lagoons are no longer filled with water, the sediments in them are accessible to workers on the site. Exposure to the contaminants in these sediments is currently possible and may occur during remediation work.

C. Eliminated Pathways

Shallow Groundwater

Shallow groundwater on and off the site is contaminated. However, the water from the surficial aquifer is not used for any purpose and currently poses no hazard.

Biota

Residents near the site have reported that fishing occurs at a pier about one-eighth mile downstream from the site. Although site-related contaminants are present in the river, none are known to biomagnify and are therefore not likely to occur at levels of concern in fish.

PUBLIC HEALTH IMPLICATIONS

In this section we discuss the health effects on persons exposed to specific contaminants, evaluate state and local health databases, and address specific community health concerns.

A. Toxicological Evaluation

Introduction

In this section, we used standard assumptions to estimate human exposure from incidental ingestion of contaminated soil, incidental ingestion of contaminated water and sediment (during swimming), and ingestion of contaminated groundwater used for domestic purposes.

To estimate exposure from incidental ingestion of contaminated soil, we made the following assumptions: 1) children between the ages of 6 and 18 ingest an average of 200 milligrams (mg) of soil per day, 2) these children weigh about 35 kilograms (kg), and 3) they ingested soil at the maximum concentration measured for each contaminant.

To estimate exposure from incidental ingestion of contaminated surface water during swimming, we made the following assumptions: 1) children between the ages of 6 and 18 swim in the river, 2) they ingest 0.05 liters of water per hour during swimming, 3) each swimming event lasts 1 hour, 4) they swim 72 times per year (3 times/week and 24 week/year), 5) the average weight is 35 kg, and 6) they were exposed to the maximum concentration measured for each contaminant.

To estimate exposure from ingestion of contaminated drinking water, we made the following assumptions: 1) children drink 1 liter (L) of water per day and weigh 10 kg, 2) adults drink 2 L of water per day and weigh 70 kg, and 3) they were exposed to the maximum concentration measured for each contaminant.

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

Antimony	Cadmium	Radium
Arsenic	Chromium	Radon
Beryllium	Fluoride	Thallium
Boron	Lead	Vanadium

To evaluate the increased risk of cancer from lifetime exposure to site-related contaminants, we use EPA's cancer slope factors. A slope factor is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical. We adjust for less than lifetime exposure and make a qualitative estimate of the increased cancer risk.

Antimony

Workers on the site may have been exposed to antimony via inhalation of dust and incidental ingestion of surface soil, and children swimming in the river may have been exposed to antimony via incidental ingestion of contaminated river water. Although ATSDR has not published an MRL for antimony, we estimate that exposure to on-site surface soil and off-site surface water is unlikely to cause adverse health effects.

Exposure to antimony may affect the liver, cardiovascular system and gastrointestinal tract (ATSDR 1990b). However, the maximum estimated dose from the above sources is about 100 times less than the dose at which no effects were found in animal studies. It is therefore unlikely that any adverse health effects would result from this exposure.

Arsenic

Workers on the site may have been exposed to arsenic via inhalation of dust, incidental ingestion of surface soil and sediments, and consumption of on-site deep groundwater. However, there is no air monitoring data to estimate worker exposure and we do not know the source of drinking water for these workers. There is no ATSDR oral MRL for arsenic (ATSDR 1991b). Our estimate of worker exposure via incidental ingestion of arsenic-contaminated soil and sediments equals the EPA chronic oral RfD. Therefore, we do not expect any non-cancerous health effects in workers from incidental ingestion of contaminated soil and sediments.

Arsenic is a known human carcinogen. Incidental ingestion of arsenic-contaminated soil and sediments by site workers since the 1950's could result in a "low" to "moderate" increase in skin cancer. ATSDR defines this level of increase to mean that after 70 years, at most, an additional five cancers may occur for every 10,000 persons exposed. This exposure would increase the number of expected cancers during the lifetime of these 10,000 persons from 2,500 to 2,505. Because the number of Stauffer employees is much lower than this, it is unlikely that they will develop cancer from their exposure. However, because of this theoretical increase in the rate of cancer, this exposure is considered unacceptable.

Individuals off-site may have been exposed to arsenic via incidental ingestion of surface water and consumption of deep groundwater. These exposures are unlikely to cause non-cancerous health effects. People who used water with similar arsenic concentrations in their houses for 10 years did not suffer any gastrointestinal, circulatory, dermal, or nervous system effects (Harrington et al 1978, Southwick et al 1981). There would also be no apparent increase in the risk of cancer from this exposure.

Arsenic has been found in off-site deep groundwater monitoring wells at concentrations higher than those in off-site private wells. It is therefore possible that arsenic may be found at higher concentrations in drinking water wells near the site in the future.

Beryllium

Workers on the site may have been exposed to beryllium via incidental ingestion of surface soil and by inhalation of dust. Adverse health effects are unlikely from incidental ingestion of beryllium in the surface soil.

The estimated daily dose of beryllium from ingestion of contaminated soil is less than the ATSDR chronic MRL. Dermal contact with beryllium may cause skin irritation, but beryllium is not readily absorbed through intact skin. Inhalation of beryllium can cause lung cancer and other respiratory illnesses (ATSDR 1988); however, no information is available to allow us to estimate the level of exposure by this route.

EPA detected beryllium in off-site shallow and deep groundwater monitoring wells indicating that beryllium could appear in drinking water wells in the future. EPA did not detect beryllium in off-site soil or in the river.

Boron

Children and other individuals swimming in the Anclote River may be exposed to boron via incidental ingestion of contaminated water. However, this exposure is unlikely to cause adverse health effects.

The estimated daily dose of boron from incidental ingestion of river water during swimming is less than the ATSDR intermediate MRL. A chronic MRL is not available. Boron may produce adverse effects on the nervous system, kidneys and liver. However, exposure to boron at the concentrations found in the river water is unlikely to cause adverse health effects. Boron is not readily absorbed through intact skin and is not known to cause cancer (ATSDR 1992a).

EPA did not analyze on- and off-site soil and sediment samples or off-site groundwater samples for boron.

Cadmium

On-site workers may have been exposed to cadmium via incidental ingestion of surface soil and sediment, and by inhalation of dust. However, incidental ingestion of soil and sediment is unlikely to have caused adverse health effects.

The estimated daily dose of cadmium from incidental ingestion of soil and sediment on site is less than the ATSDR chronic MRL. Ingestion of cadmium may produce kidney and liver damage. However, ingestion of cadmium is not known to cause cancer. Cadmium does cause cancer when inhaled (ATSDR 1991c). However, there is no information available for us to estimate the amount of exposure to cadmium that could occur from breathing contaminated dust.

Cadmium was not detected in drinking water wells off-site. However, it was found in shallow and deep groundwater monitoring wells indicating that it could appear in drinking water wells in the future. Cadmium was not detected in water from the river.

Chromium

On-site workers may have been exposed to chromium via incidental ingestion of sediments and consumption of drinking water from on-site wells. Individuals swimming in the Anclote River may be exposed to chromium via incidental ingestion of contaminated water. However, these exposures are unlikely to have caused adverse health effects.

The maximum estimated daily dose of chromium in children from ingestion of deep groundwater is at least 10 times less than the dose at which no effect has been found in animal studies. An ATSDR chronic MRL for chromium is not available. Exposure to chromium may cause liver and kidney damage (ATSDR 1991d). However, adverse health effects are unlikely since chromium has not been detected in off-site private wells.

Although chromium was detected in the Anclote River, it does not bioaccumulate in aquatic organisms.

Fluoride

On-site workers may have been exposed to fluoride via inhalation of dust, incidental ingestion of surface soil and consumption of drinking water from on-site wells. Individuals swimming in the

Anclote River may be exposed to fluoride via incidental ingestion of contaminated water and sediment. However, these exposures are unlikely to have caused adverse health effects.

Fluoride occurs in off-site deep groundwater at a level exceeding EPA's reference dose. An ATSDR chronic MRL for fluoride is not available. Consumption of this water over a lifetime could result in damage to teeth and bones (ATSDR 1991a). However, fluoride has not been detected in private wells near the site at a level of concern. Therefore, unless fluoride appears in private wells at increased concentrations in the future, no adverse health effects are likely.

Lead

Individuals swimming in the Anclote River may be exposed to lead via incidental ingestion of contaminated water. Although ATSDR and EPA have no lead exposure guidelines (MRLs or RfDs) for comparison (ATSDR 1990a), we estimate that this exposure is unlikely to have caused adverse health effects.

Although the maximum concentration of lead in the river water (0.15 mg/L) is ten times greater than the Florida drinking water standard (0.015 mg/L), we estimate the annual volume of water ingested during swimming in the river is 100 times less than the annual volume of water ingested from drinking water sources. Therefore, we estimate the dose of lead from incidental ingestion during swimming in the river is about ten times less than the dose from drinking water at the Florida standard.

Lead has not been detected in deep groundwater. However, it has been detected in shallow groundwater both on and off the site. Therefore, it is possible that lead may appear in deep groundwater drinking water wells in the future.

Radium

On-site workers may have been exposed to radium via incidental ingestion of soil and inhalation of dust. While adverse health effects are not likely from ingestion exposure, there is insufficient information available for us to determine if adverse health effects could result from inhalation exposure.

EPA has set occupational Annual Limits of Intake (ALI) for radium exposure by ingestion and inhalation. Long-term exposure to radium can result in anemia, necrosis of the jaw and bone cancer (ATSDR 1990c). Radium has been detected in on- and off-site surface soil at levels above background concentrations. These levels are at least 100 times less than the EPA ALI for ingestion of radium. However, no information is available to allow us to estimate the level of exposure by inhalation of dust.

EPA did not analyze off-site groundwater or river sediment for radium.

Radon

Workers on-site and individuals with private wells off-site may have been exposed to radon via consumption of contaminated deep groundwater. However, it is unlikely that exposure at the maximum concentration could cause adverse health effects.

Although ATSDR and EPA have no exposure guidelines (MRLs or RfDs) for radon in water, EPA has set a recommended exposure limit of 4.0 pCi/L of radon in air. The primary health risk from radon is an increase in the chance of lung cancer from inhalation exposure. There are no known health risks from consumption of radon in water (ATSDR 1990d). However, radon that outgasses from water will contribute to the radon level in indoor air. About 10,000 pCi/L of radon in water are required to increase the indoor air level by 1.0 pCi/L. Thus, the maximum contribution to indoor air levels from deep groundwater at this site would be less than 0.5 pCi/L. We estimate that this increase would not significantly increase the risk of cancer.

Sulfur Dioxide

Workers on the site and individuals off-site within about one-half mile may have been exposed to sulfur dioxide in the air. Since there are insufficient environmental data available to enable us to estimate the exposure to sulfur dioxide and very little toxicity information is available (Sittig 1985), we cannot determine the health risk to persons who may have been exposed.

Thallium

Individuals swimming in the Anclote River may be exposed to thallium via incidental ingestion of contaminated water. However, the maximum concentrations are unlikely to cause adverse health effects.

There is no ATSDR chronic MRL available for thallium. However, the estimated daily dose of thallium from incidental ingestion of contaminated river water is less than the dose at which no effect was found in animal studies. Although exposure to thallium can affect the nervous system, lungs, heart, liver and kidneys, the extent and severity of its effects at low concentrations are unknown. Thallium is not known to cause cancer (ATSDR 1992b). The maximum estimated dose from incidental ingestion during swimming is so low that adverse health effects are unlikely.

Thallium has not been detected in off-site private wells. However, it has been found in on-site shallow groundwater and off-site deep groundwater monitoring wells. Therefore, it is possible that thallium may appear in private wells in the future.

Vanadium

Individuals swimming in the Anclote River may be exposed to vanadium via incidental ingestion of contaminated water. However, the maximum concentrations are unlikely to cause adverse health effects.

The estimated daily dose of vanadium from incidental ingestion of contaminated water during swimming is less than the draft ATSDR intermediate MRL. A chronic MRL is unavailable. Vanadium has not been identified as causing cancer. Therefore, incidental ingestion of vanadium during swimming would be unlikely to cause adverse health effects. Since vanadium does not pass readily through the skin (ATSDR 1992c), adverse health effects from skin exposure are also unlikely.

B. Health Outcome Data Evaluation

Guided by community health concerns in the population living near the site, Florida HRS epidemiologists conducted an evaluation of cancer and birth defect incidence in this area. Since cancer and birth defect information was not available by zip code, an analysis was performed for the entire counties of Pasco and Pinellas. The site is in Pinellas county but borders Pasco county (Figure 2, Appendix A). The rates of birth defects and the incidence of cancer in these counties were compared with those for the state of Florida.

The number of birth defects in both counties was very small and was not elevated compared to the overall state rates. In addition, none of the contaminants at the Stauffer site is known to cause birth defects (Hurt 1993a). The rates of individual cancers, in particular lung and brain cancer, for the state and both counties are quite similar.

Because cancer and birth defect information for the zip code areas closest to the site are not available, we cannot determine the actual rates in the communities near the site. The available information, however, indicates that there is no unusual incidence of cancer or birth defects.

C. Community Health Concerns Evaluation

We have addressed each community health concern as follows:

1. **Can contamination from the site cause brain cancer in people living close to the site?**

   None of the contaminants of concern at this site are known to contribute to the incidence of brain cancer. Examination of the Florida cancer registry by HRS epidemiologists has not revealed any elevated rates of brain cancer in Pinellas or Pasco counties.

2. **Are contaminants leaching into the groundwater from the site and entering nearby private and public wells?**

   Contaminants occurring on the site also occur in shallow and deep groundwater monitoring wells and two private drinking water wells off-site. It is therefore possible that these contaminants may appear in private off-site drinking water wells in the future.

3. **Were radioactive materials produced when the plant was operating and do they continue to contaminate the site?**

   There is no evidence that radioactive materials were purposely extracted during the processing of phosphate ore for elemental phosphorus. Uranium and radium occur naturally in phosphate ores. Although no environmental samples have been analyzed for uranium, the results of the gamma survey of the site are consistent with the presence of phosphate ore and do not indicate unusual concentrations of radionuclides, including uranium. Radium has been found in on-site soil at levels above background but does not occur in on-site groundwater at a level of concern. However, no off-site groundwater samples have been analyzed for radium. Therefore, we cannot estimate the exposure from this source.

4. **Can dust blowing from the site carry contamination into the community or the nearby river?**

   No on-site surface soil contaminants occur at a level of concern in off-site surface soil. However, antimony, arsenic and fluoride occur in both on-site surface soil and the Anclote River. The source of this contamination may be dust from the site, stormwater runoff or other, unknown, sources.

5. **Have children at the elementary school north of the site been exposed to contamination from the site?**

   Since the school is supplied by public water, drinking water would not be a source of exposure to children. Of the contaminants of concern found at this site, only lead and chromium have been analyzed for in surface soil at the school. Neither was detected at a level of concern. However, we have no information about the other contaminants of concern in the soil or about any contaminants in the air or air-borne dust. Without this information, we cannot estimate the exposure from these sources.

6. **When the plant was in operation, people near the plant or using the river frequently reported being exposed to clouds of white fumes that produced respiratory distress. What other adverse health effects could occur from this exposure?**

   These clouds of white fumes are most likely phosphorus pentoxide emissions from the site. Local residents may also have been exposed to sulfur dioxide from the plant. However, there is no air monitoring data available to enable us to determine if exposure to these emissions represented a public health hazard.

7. **What has happened to the 900 drums of calcined phosphate sand buried on the site and what hazard do they represent?**

   In their current location, the material in these drums is not a hazard. If intact drums are recovered during remediation work, they are a possible fire hazard. Phosphorus migrating into the groundwater would be converted into a dilute phosphoric acid solution that is not a health hazard.

8. **Can exposure to contaminants in the air produce emphysema or lung cancer in workers at the plant?**

   Several contaminants detected in the soil above ATSDR comparison values may produce lung cancer. Workers at the plant may have been exposed to these contaminants in dust on the site. Evaluation of lung cancer incidence in Pinellas and Pasco counties by Florida HRS epidemiologists has not revealed any elevated rates of lung cancer. Without air sampling data, however, we cannot predict the health hazard resulting from breathing dust generated on the site.

CONCLUSIONS

Based on the information currently available, this site is classified as a public health hazard. Specific reasons for this classification are as follows:

1. Arsenic is present in surface soil, sediment and both shallow and deep groundwater on the site. On-site workers were exposed to arsenic in soil and dust when the plant was operational. Those currently working at the site are exposed to contaminants in soil, sediments and dust.

2. Arsenic, beryllium, cadmium and chromium have been detected in on-site soil and sediment, on- and off-site groundwater and off-site surface water at levels above ATSDR comparison values. Each of these contaminants is a known or suspected lung carcinogen.

3. Radium has been detected above background levels in on-site soil, sediment, and groundwater, and in off-site soil. No off-site groundwater or sediment samples have been analyzed for radium.

4. Only two deep groundwater wells have been monitored on the site and there is insufficient information about off-site surface and subsurface soils to allow us to determine the potential for exposure from these sources.

5. Arsenic, cadmium, chromium, fluoride, lead, thallium, and vanadium in shallow and/or deep groundwater on the site also appear in shallow and/or deep groundwater off the site. These contaminants may appear in private wells south and west of the site in the future.

6. Arsenic is present in one off-site drinking water well and one private well currently used for irrigation. It is also present in off-site shallow and deep groundwater and in the nearby river. Arsenic concentrations have been detected above the corresponding EPA reference dose (RfD).

Surface soil, groundwater, surface water, and sediment are considered to be completed exposure pathways for this site in the past, currently, and in the future. Ambient air is considered to be a completed exposure pathway in the past and could be in the future.

RECOMMENDATIONS

Cease/Reduce Exposure Recommendations

1. The Occupational Safety and Health Administration (OSHA) and National Institute of Occupational Safety and Health (NIOSH) should consider conducting medical monitoring on the workers at the site. Workers currently on the site should be provided with appropriate protective equipment while working around contaminated soil/sediment.

2. Future remediation workers should be provided with appropriate protective equipment while on site. During remediation work, adequate dust suppression measures should be employed to prevent contaminated dust from reaching the community around the site. Air monitoring should be conducted during remediation to ensure that air-borne contamination is not transported off the site.

Site Characterization Recommendations

1. Characterize off-site shallow and deep groundwater for radium. Areas to sample should include private and monitoring wells.

2. Characterize on-site deep groundwater, and off-site surface and subsurface soil for all contaminants of concern. Areas to sample should include the plant processing and slag storage areas, nearby residential property, and the elementary school.

3. Monitor private wells within one-half mile south and west of the site to ensure that any future contamination is detected as soon as possible.

Public Education Recommendations

1. Area residents who obtain their drinking water from private wells should be informed of the possibility of current and future contamination. A health education program should be conducted to help community members and on-site workers in understanding their potential for exposure and possible health risks.

Health Activities Recommendation Panel (HARP) Recommendations

The Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), as amended, requires ATSDR to perform public actions needed at hazardous waste sites. To determine if public health actions are needed, ATSDR's Health Activities Recommendation Panel (HARP) has evaluated the data and information developed in the Stauffer Chemical Co. (Tarpon Springs Plant) Public Health Assessment.

The Panel has determined that the following actions are needed at this site:

1. Local residents and workers on the site are being exposed to contaminants in private well drinking water and surface soil. Health education is needed to assist these groups in understanding their potential for exposure and possible health risks, and to inform them of measures they may take to reduce their exposure.

2. Physicians and other health professionals treating members of the community near the site may not be aware of the potential exposures to their patients. Health professions education is needed to inform the local medical community about the health effects that may occur in individuals exposed to contaminants from the site.

3. Available data about rates of cancers in the area need to be reviewed (health statistics review). This review was completed by Florida HRS in this public health assessment.

If information becomes available indicating additional exposures at levels of concern, ATSDR will evaluate that information to determine what additional actions, if any, are necessary.

PUBLIC HEALTH ACTIONS

This section describes what ATSDR and/or Florida HRS will do at the Stauffer Chemical Co. (Tarpon Springs Plant) site after the completion of this public health assessment report. The purpose of a Public Health Action Plan is to ensure that any existing health hazards are reduced and any future health hazards are prevented. ATSDR and/or Florida HRS will do the following:

1. The Pinellas County Public Health Unit (CPHU) will periodically monitor private wells near the site to detect increases in current contaminants or the appearance of new ones.

2. Florida HRS will develop educational materials to inform residents who may be consuming contaminated water from private wells of their potential for exposure and possible health risks. In particular, the material will discourage the use of this water for drinking, cooking or other domestic purposes.

3. The Pinellas CPHU will assist Florida HRS in distributing these educational materials to the affected residents and provide consultation to those individuals who require additional information or assistance.

4. Florida HRS will develop physician education materials to inform local doctors of the possibility that their patients may exhibit adverse health effects resulting from exposure to contaminants from the Stauffer site.

5. ATSDR will assist Florida HRS in the development of these educational materials to ensure that the information is accurate and reflects the most recent scientific findings and agency guidelines.

6. ATSDR in cooperation with Florida HRS will notify NIOSH about the need for medical monitoring of the workers at this site.

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

PREPARERS OF REPORT

Bruce J. Tuovila, M.S.
Environmental Specialist
Office of Toxicology and Hazard Assessment
Florida Department of Health and Rehabilitative Services

E. Randall Merchant, M.S.
Biological Administrator
Office of Toxicology and Hazard Assessment
Florida Department of Health and Rehabilitative Services

H. Joseph Sekerke, Jr., PhD.
Biological Scientist
Office of Toxicology and Hazard Assessment
Florida Department of Health and Rehabilitative Services

ATSDR Technical Project Officer:

Richard Kauffman
Remedial Programs Branch
Division of Health Assessment and Consultation

ATSDR Regional Representative:

Bob Safay
Regional Services
Office of the Assistant Administrator

CERTIFICATION

This Stauffer Chemical Co. (Tarpon Springs Plant) 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.

Richard R. Kauffman, M.S.
Technical Project Officer
Remedial Programs Branch
Division of Health Assessment and Consultation (DHAC)
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

REFERENCES

ATSDR. 1988. Toxicological Profile for Beryllium. Syracuse Research Corporation: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, ATSDR/TP-88/07.

ATSDR. 1990a. Toxicological Profile for Lead. Syracuse Research Corporation: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, ATSDR/TP-88/17.

ATSDR. 1990b. Draft Toxicological Profile for Antimony. Syracuse Research Corporation under subcontract to Clement Associates, Inc.: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry.

ATSDR. 1990c. Toxicological Profile for Radium. Life Systems, Inc. under subcontract to Clement Associates, Inc.: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, ATSDR/TP-90-22.

ATSDR. 1990d. Toxicological Profile for Radon. Clement International Corporation: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, ATSDR/TP-90-23.

ATSDR. 1991a. Draft Toxicological Profile for Fluorides, Hydrogen Fluoride, and Fluorine (F). Clement Associates, Inc.: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry.

ATSDR. 1991b. Draft Toxicological Profile for Arsenic. Life Systems, Inc. under subcontract to Clement International Corporation: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

ATSDR. 1991c. Draft Toxicological Profile for Cadmium. Life Systems, Inc. under subcontract to Clement International Corporation: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

ATSDR. 1991d. Draft Toxicological Profile for Chromium. Syracuse Research Corporation under subcontract to Clement International Corporation: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

ATSDR. 1992a. Toxicological Profile for Boron and Compounds. Life Systems, Inc. under subcontract to Clement International Corporation: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, ATSDR/TP-91/05.

ATSDR. 1992b. Toxicological Profile for Thallium. Life Systems, Inc. under subcontract to Clement International Corporation: U.S. Public Health Service, Agency for Toxic Substances and Disease registry, ATSDR/TP-91/26.

ATSDR. 1992c. Toxicological Profile for Vanadium and Compounds. Clement International Corporation: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, ATSDR/TP-91/29.

Beliles RP. 1981. Phosphorus, Selenium, and Tellurium. In: Clayton GD and Clayton FE. Patty's Industrial Hygiene and Toxicology, 3rd ed. rev., Vol 2A. John Wiley & Sons, 2124-2125.

BOC. 1992. Bureau of the Census, U.S. Department of Commerce, Washington, DC, 1990 Census Data Files.

Boison PJ. 1987. Letter (October 22) to Jerry Harris, Stauffer Chemical Company, regarding groundwater monitoring plan, Stauffer Chemical Co., Stauffer Chemical Company, Westport, CT.

Donaghue B. 1988. Letter (May 2) to Eric Nuzie, Florida Department of Environmental Regulation, regarding groundwater radon data at Stauffer Chemical Co., NUS Corporation.

Gibbs J. 1980. Memorandum (March 4) to Jacob Stowers, Pinellas County Department of Environmental Management, regarding complaints filed against Stauffer Chemical Co., EPA Air & Water Quality Division, Atlanta, GA.

Harrington JM, Middaugh JP, Morse DL, et al. 1978. A survey of a population exposed to high arsenic in well water in Fairbanks, Alaska. Am J Epidemiol 108:377-385.

Harris JF. 1988a. Letter (February 24) to Kirk Johnson, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Chemical Company, Tarpon Springs, FL.

Harris JF. 1988b. Letter (May 25) to Kirk Johnson, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Chemical Company, Tarpon Springs, FL.

Harris JF. 1988c. Letter (August 3) to Kirk Johnson, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Chemical Company, Tarpon Springs, FL.

Harris JF. 1988d. Letter (October 26) to Kirk Johnson, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Chemical Company, Tarpon Springs, FL.

Harris JF. 1989a. Letter (March 16) to Kirk Johnson, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Harris JF. 1989b. Letter (May 17) to Kirk Johnson, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Harris JF. 1989c. Letter (September 27) to Kirk Johnson, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Harris JF. 1989d. Letter (November 13) to Kirk Johnson, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Harris JF. 1990a. Letter (March 22) to Diane Trommer, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Harris JF. 1990b. Letter (July 11) to William Kelsey, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Harris JF. 1990c. Letter (October 3) to William Kelsey, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Harris JF. 1991a. Letter (March 6) to Division of Waste Management, Florida Department of Environmental Regulation, regarding groundwater monitoring, Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Harris JF. 1991b. Letter (April 19) to Tarpon Springs City Commissioners regarding future activities at Stauffer Chemical Co., Stauffer Management Co., Tarpon Springs, FL.

Hurt K. 1993a. Memorandum (February 1) to Randy Merchant, HRS Toxicology regarding birth defects in Pinellas and Pasco counties.

Hurt K. 1993b. Memorandum (February 9) to Randy Merchant, HRS Toxicology regarding cancer incidence in Pinellas and Pasco counties.

McClellan BS. 1986. Letter (April 21) to Jerry Harris, Stauffer Chemical Company, regarding groundwater monitoring plan, Stauffer Chemical Co., Stauffer Chemical Company, Westport, CT.

McClellan BS. 1987a. Letter (March 23) to Jerry Harris, Stauffer Chemical Company, regarding groundwater monitoring plan, Stauffer Chemical Co., Stauffer Chemical Company, Westport, CT.

McClellan BS. 1987b. Letter (September 16) to Jerry Harris, Stauffer Chemical Company, regarding groundwater monitoring plan, Stauffer Chemical Co., Stauffer Chemical Company, Westport, CT.

McNeice F. 1993. Fact sheet (March 12) Zeneca, Inc. describing site history, investigations, and current status of Stauffer Chemical Co., Zeneca, Inc., Wilmington, DE.

NUS Corporation. 1987. Final Study Plan, Expanded Site Investigation, Stauffer Chemical Company, Tarpon Springs, Florida.

NUS Corporation. 1989. Final Expanded Site Investigation Report, Stauffer Chemical Company, Tarpon Springs, Pinellas County, Florida.

NUS Corporation. 1991. Interim Final Listing Site Inspection Report, Stauffer Chemical Company Site, Tarpon Springs, Pinellas County, Florida.

Robbins G. 1983. Letter (January 27) to Doug Bromlett, Florida Department of Environmental Regulation, regarding sulfur dioxide levels at Stauffer Chemical Co., Pinellas Board of County Commissioners, Pinellas County, FL.

Roy F. Weston, Inc. 1990. Stauffer Management Company, Tarpon Springs, Florida Plant, Data Evaluation Report.

Seaburn and Robertson. 1987. Hydrogeologic Assessment, Stauffer Chemical Company, Tarpon Springs Plant, Tarpon Springs, Florida.

Sittig M. 1985. Sulfur Dioxide. In: Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2nd ed. Noyes Publications, 812-814.

Southwick JW, Western AE, Beck MM, et al. 1981. Community health associated with arsenic in drinking water in Millard County, Utah. Cincinnati, OH: U.S. Environmental Protection Agency, Health Effects Research Laboratory, EPA-600/1-81-064. NTIS no. PB82-108374.

USGS. Undated. The Surficial Aquifer in Pinellas County, Florida, Water-Resources Investigations Report 84-4289, by Causseaux KW.

Wyatt DW. 1990. Memorandum (July 18) to Tammy Stouter, Florida Department of Health and Rehabilitative Services Control Laboratory, regarding analysis of private well samples at Stauffer Chemical Co., Pinellas County Public Health Unit, Pinellas County, FL.

APPENDICES

A. Figures

Figure 1. State Map Showing Location of Pinellas County

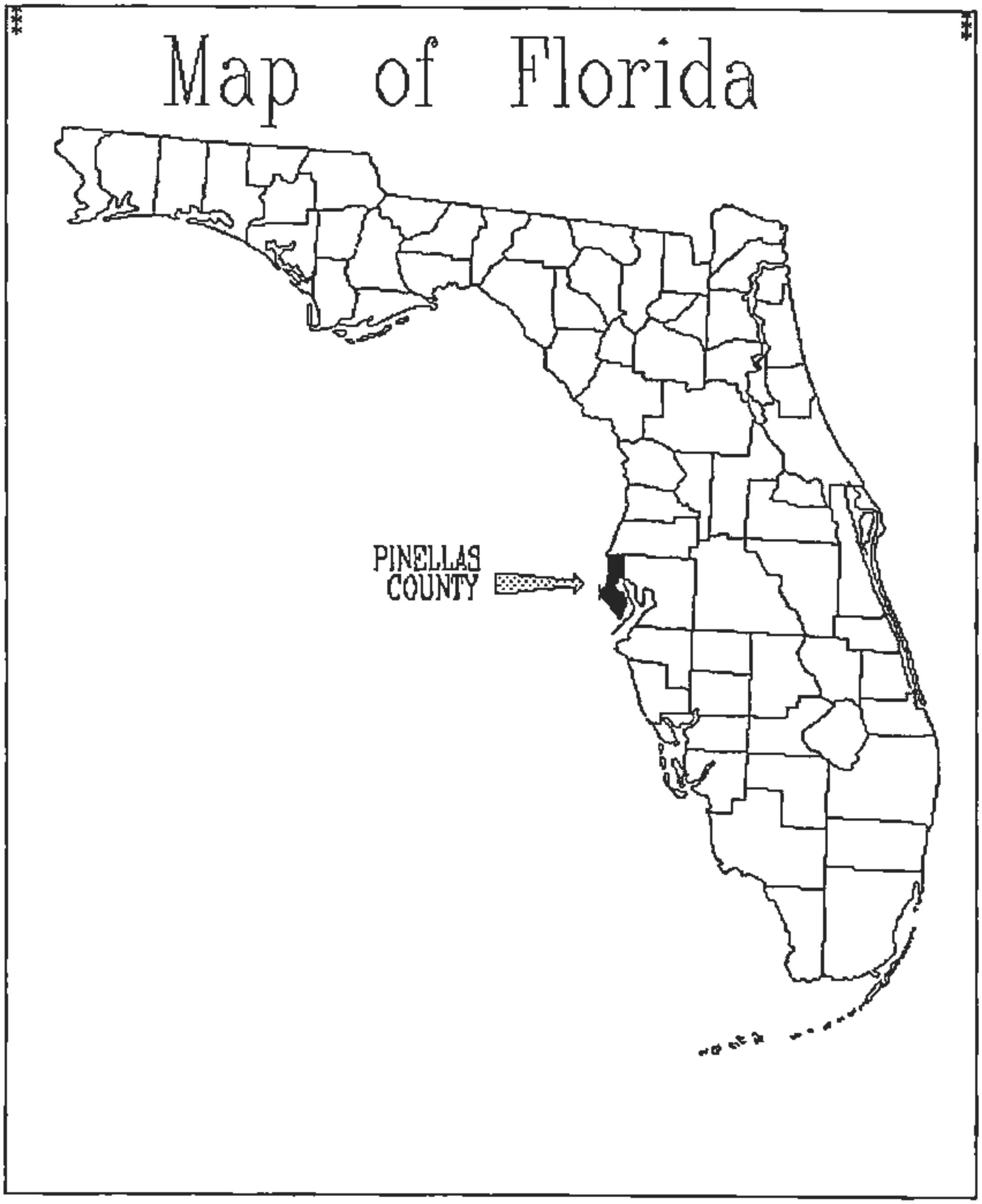


Figure 2. Location of Stauffer Chemical Co. in Tarpon Springs

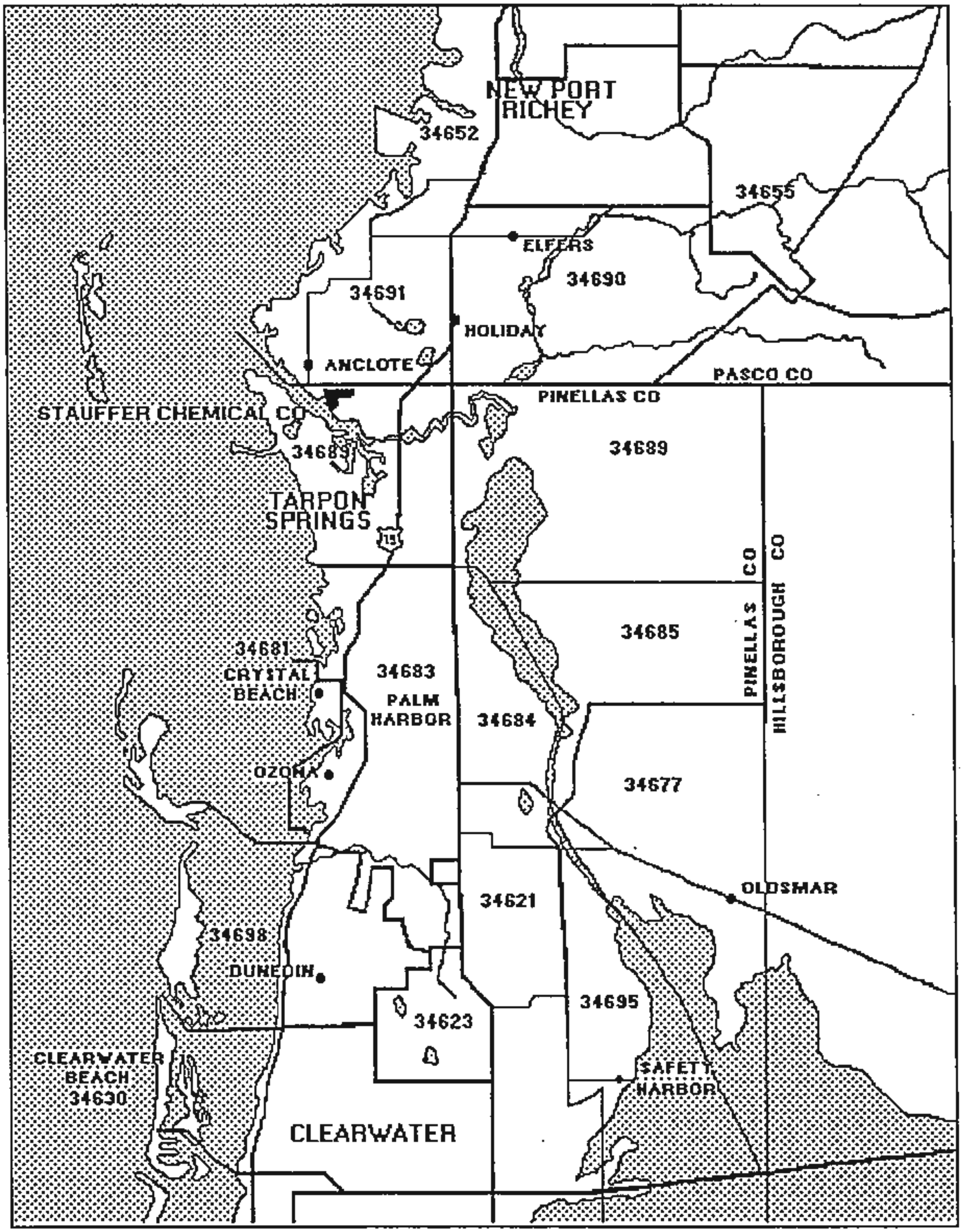


Figure 3. Layout of Stauffer Chemical Co. Site

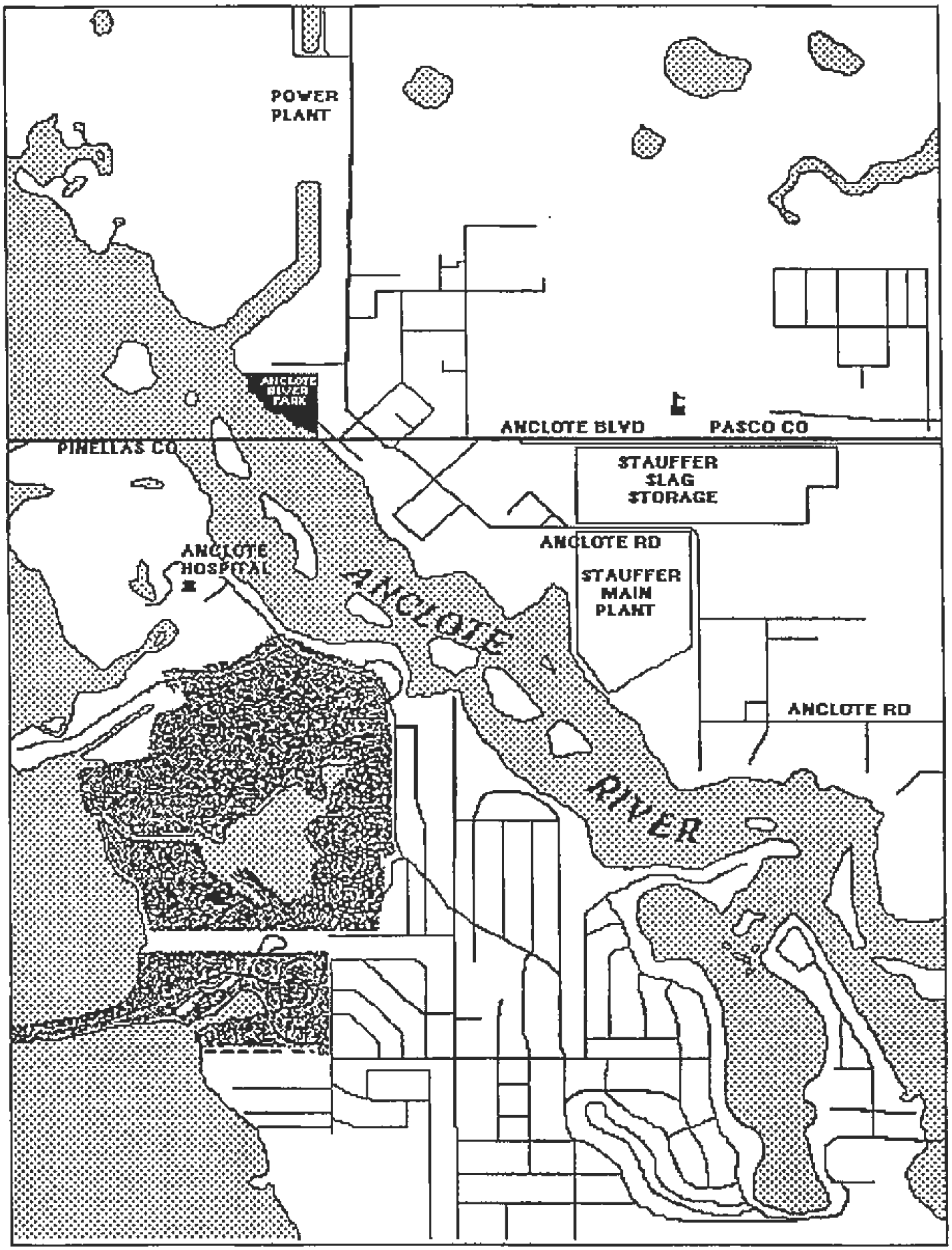
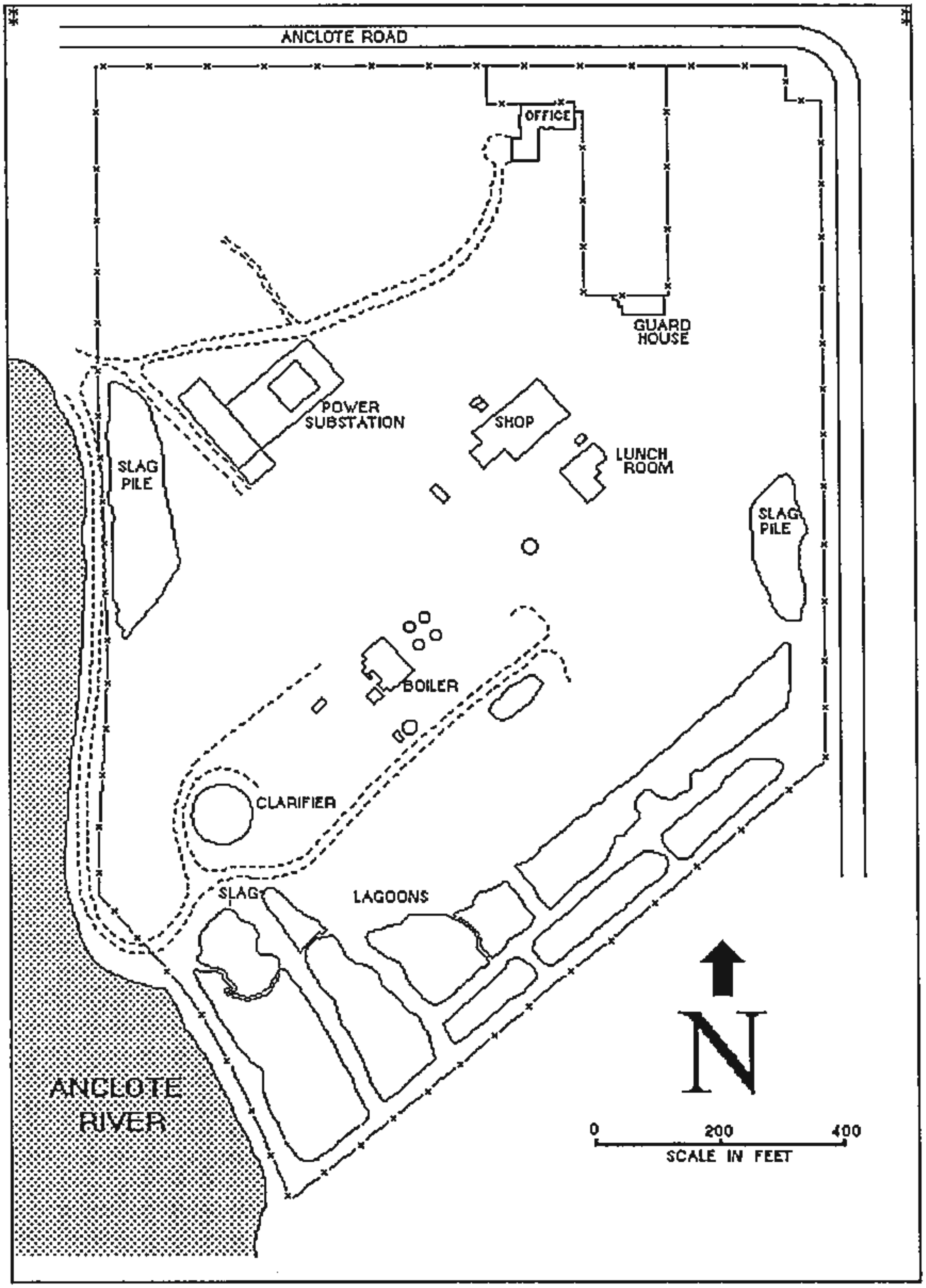


Figure 4. Detail--Stauffer Chemical Co. Main Plant Area



Stauffer Chemical Co. (Tarpon Springs Plant)

Figure 5. Detail--Stauffer Chemical Co. Slag Storage Area

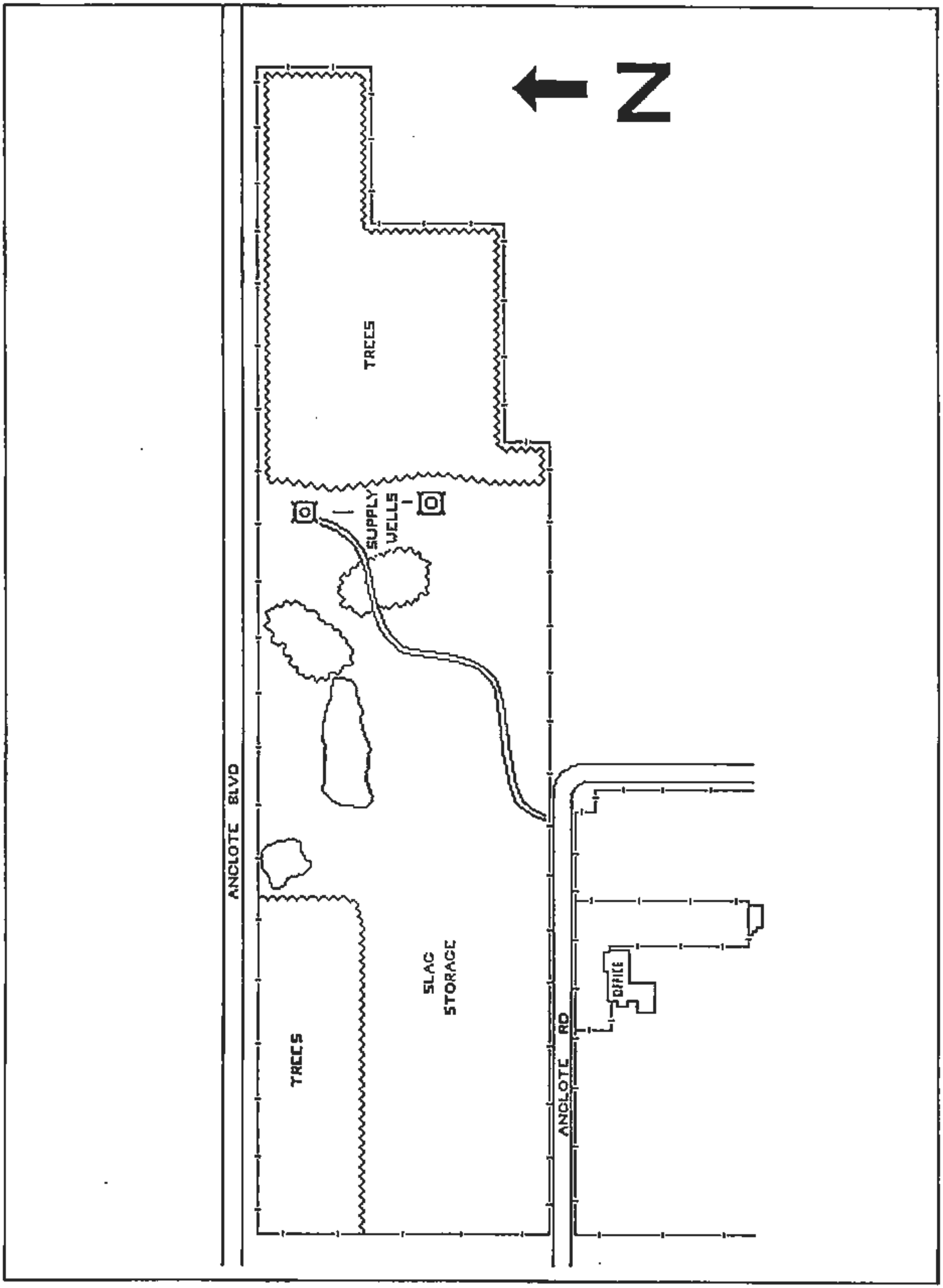


Figure 6. On-site Surface Soil Sample Locations

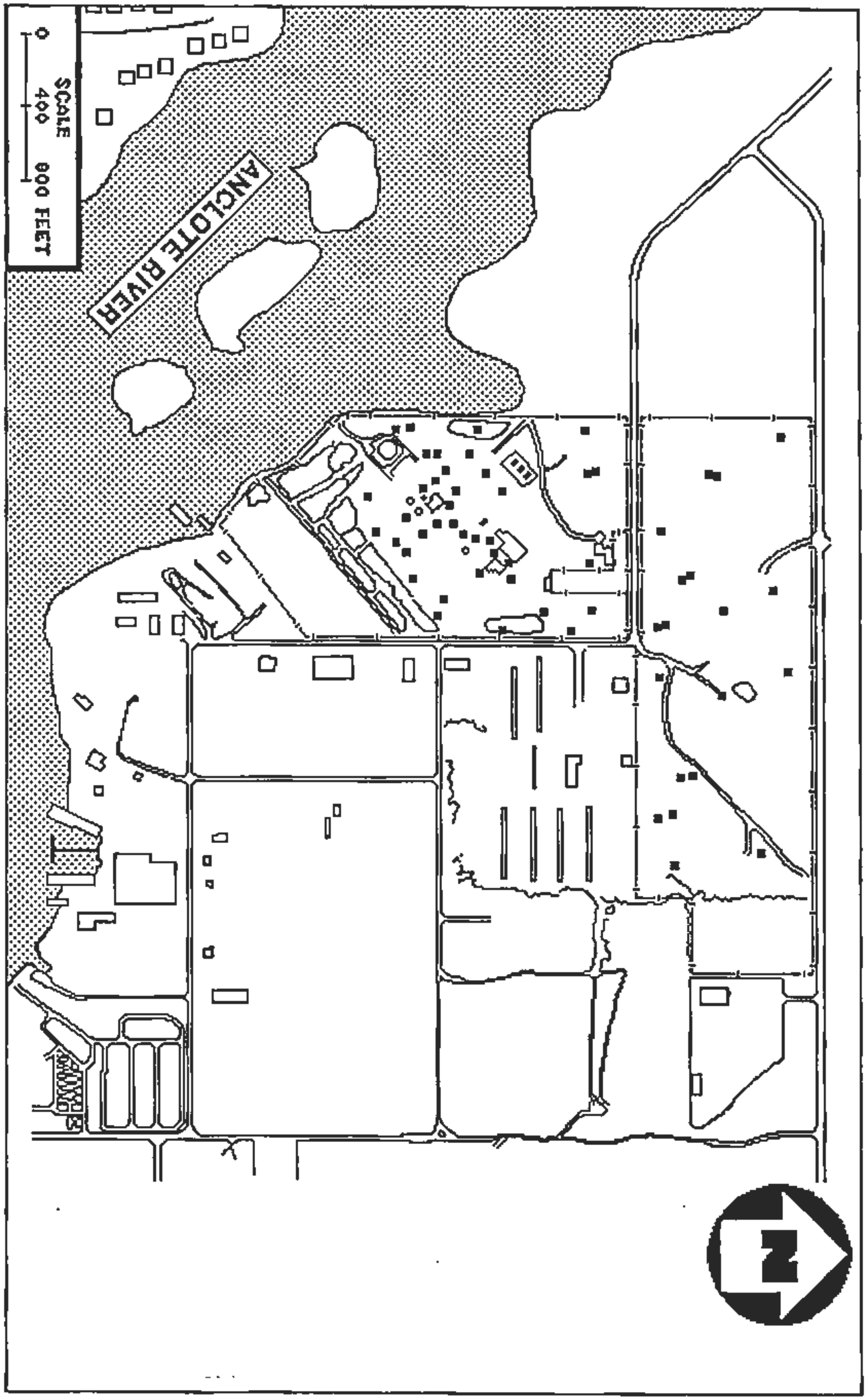


Figure 7. On-site Subsurface Soil Sample Locations

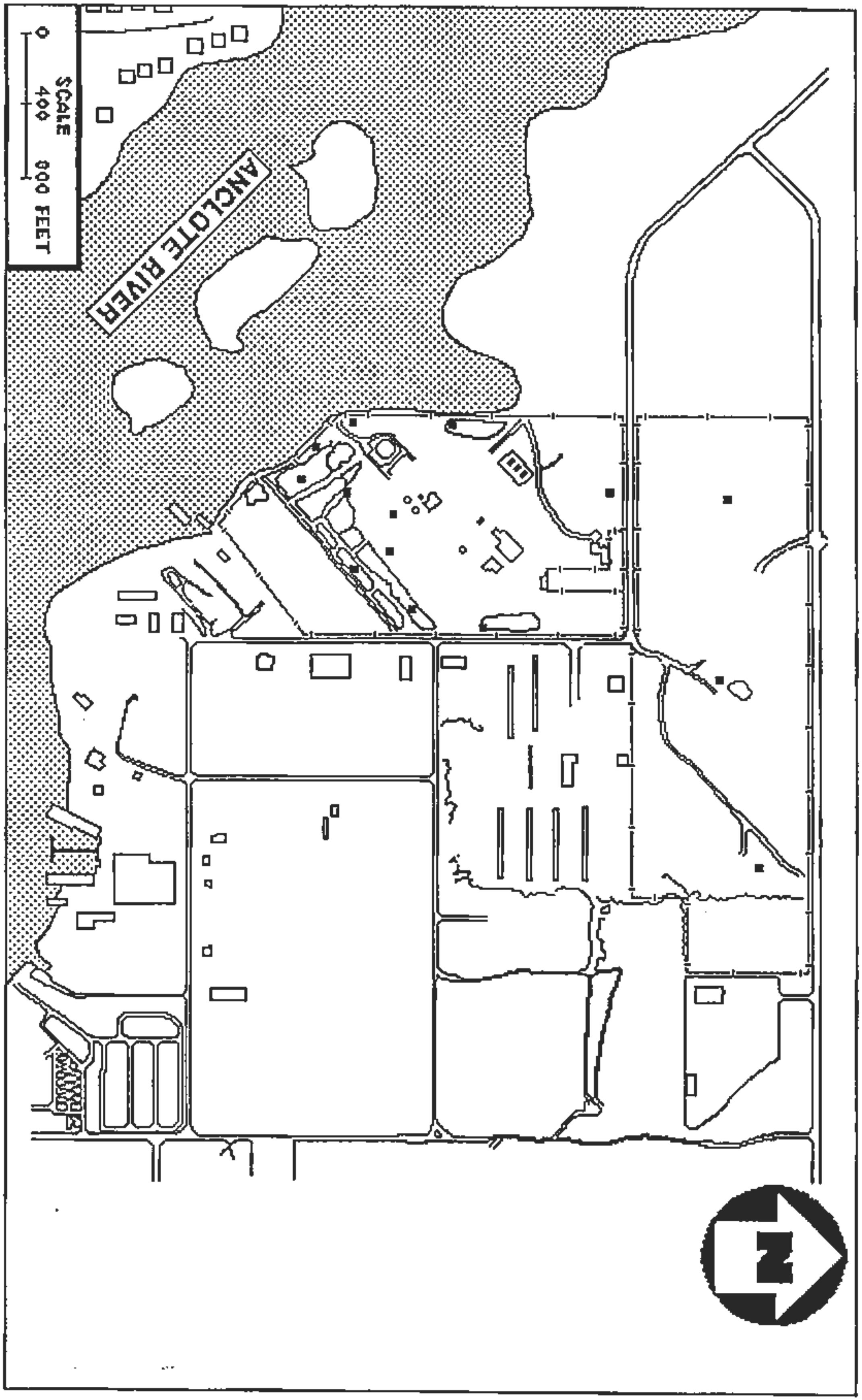
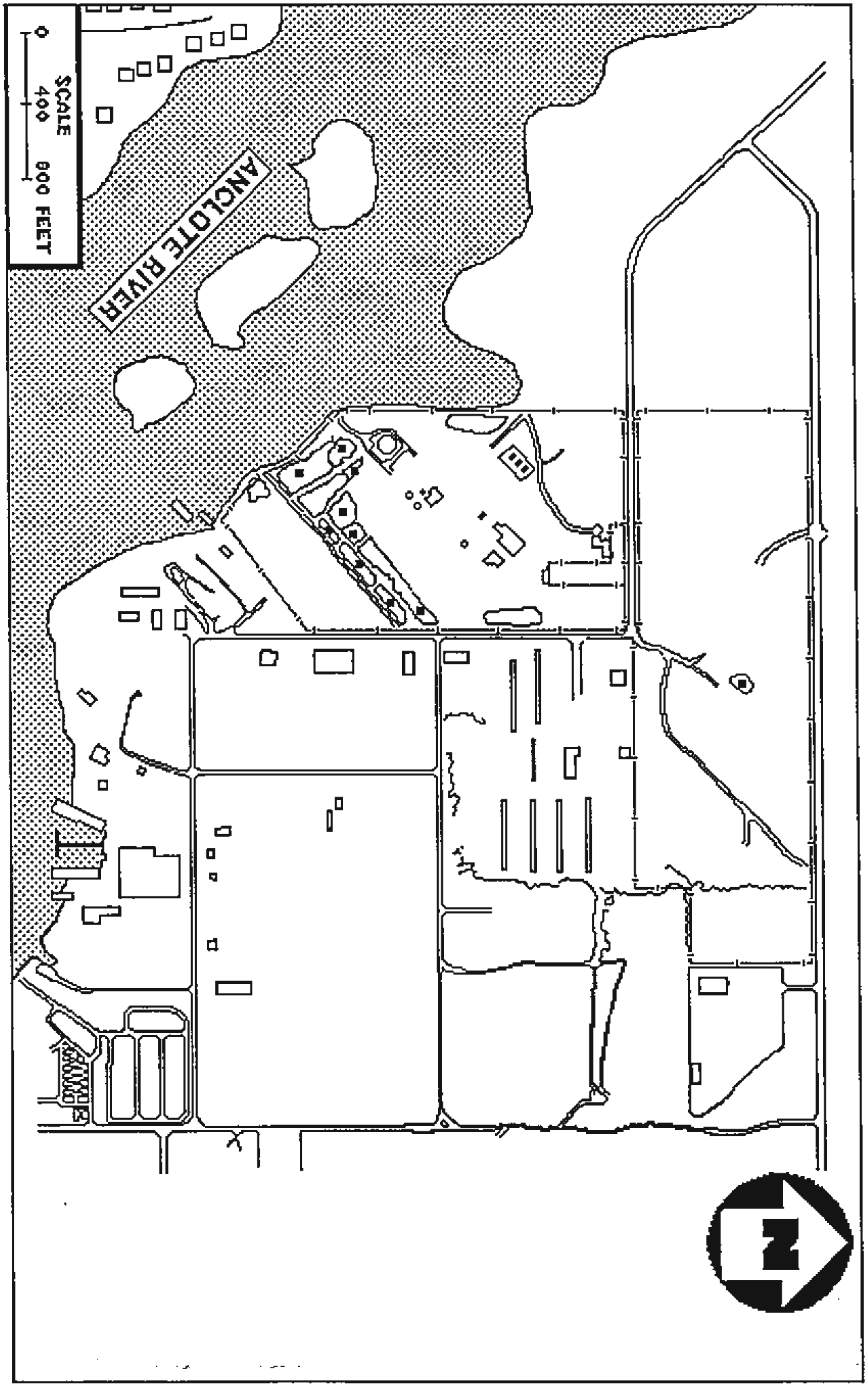


Figure 8. On-site Sediment Sample Locations



Stauffer Chemical Co. (Tarpon Springs Plant)

Figure 9. On-site Shallow Groundwater Sample Locations

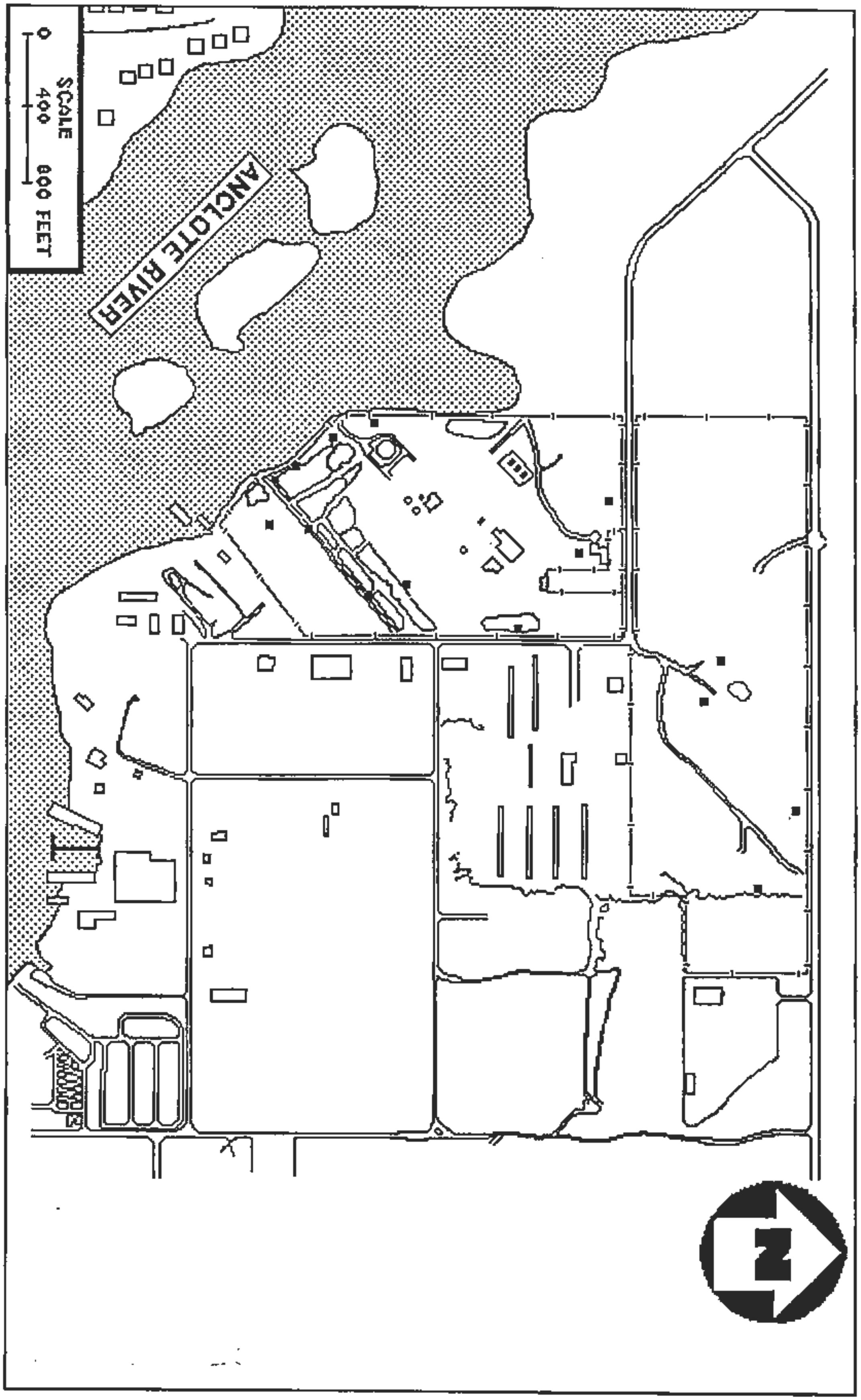


Figure 10. On-site Deep Groundwater Sample Locations

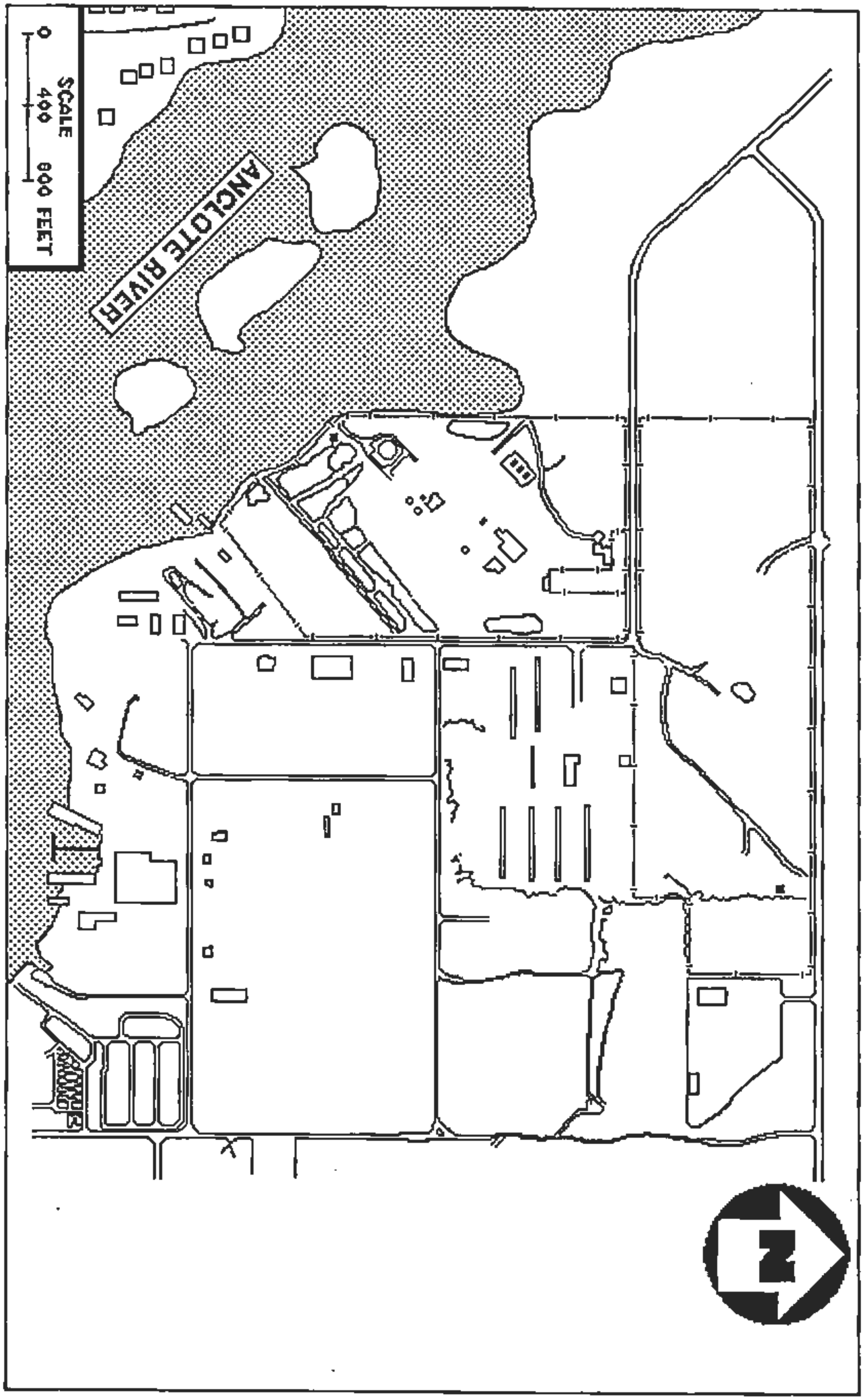


Figure 11. Off-site Surface Soil Sample Locations

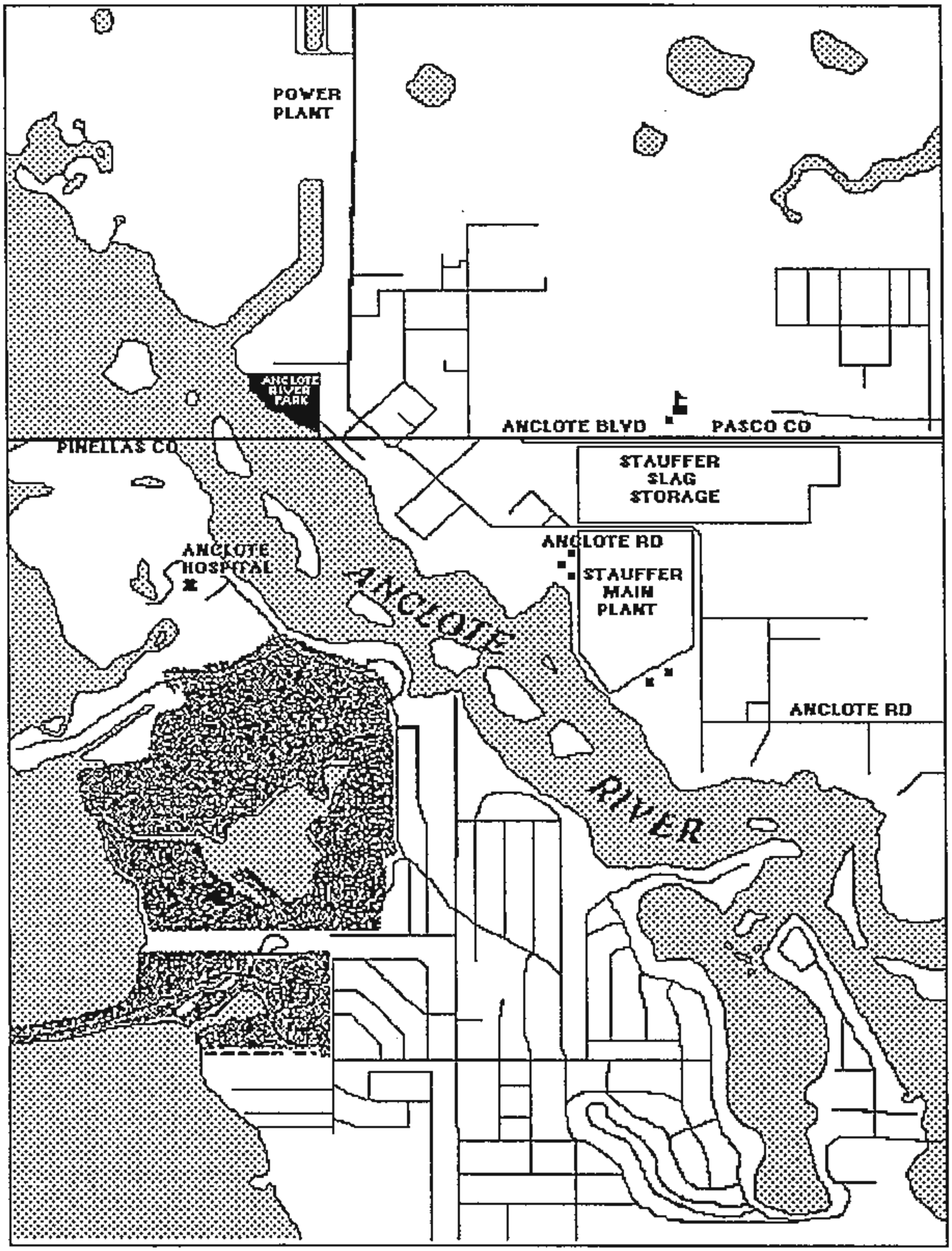


Figure 12. Off-site Subsurface Soil Sample Locations

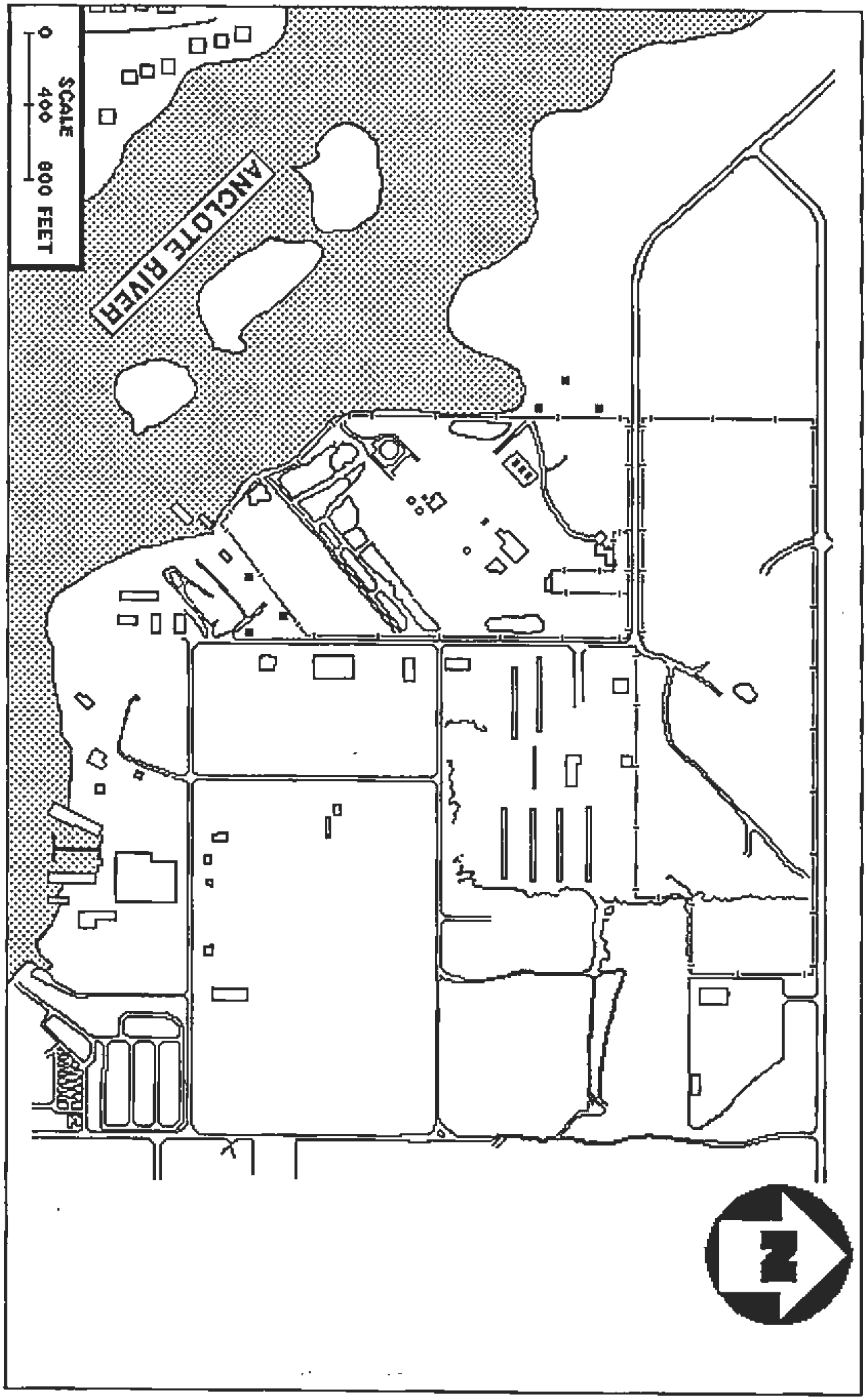


Figure 13. Off-site Sediment Sample Locations

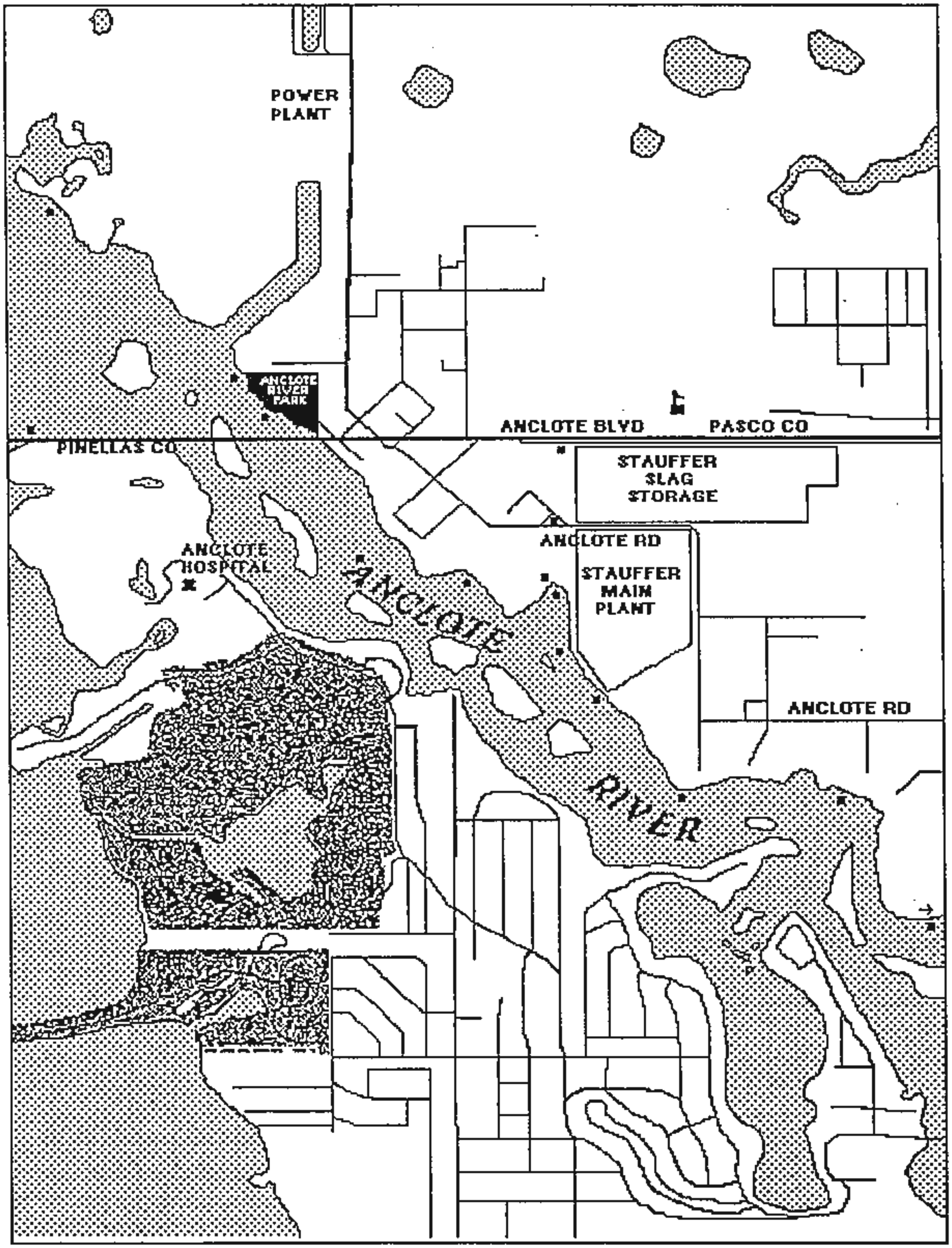


Figure 14. Off-site Shallow Groundwater Sample Locations

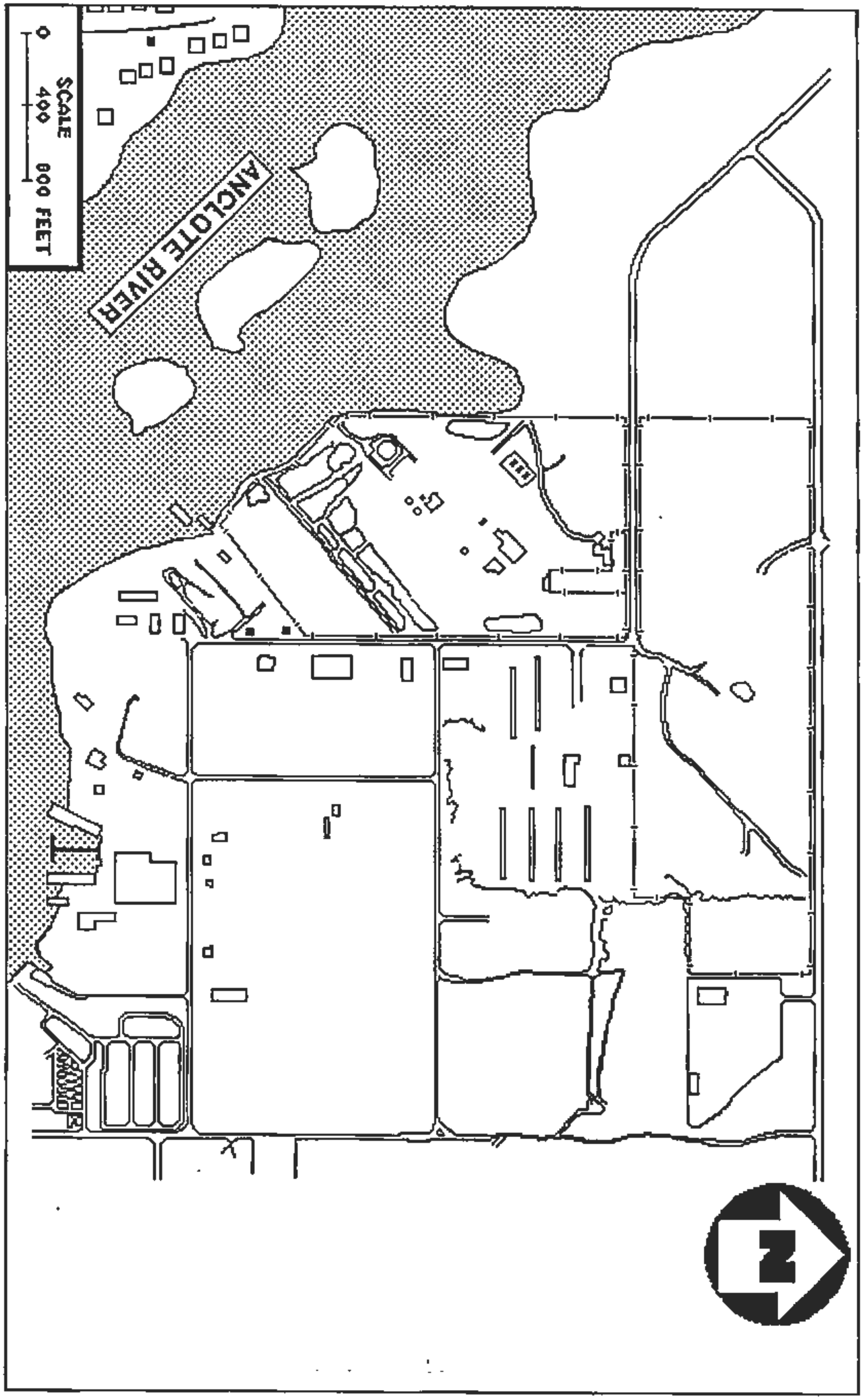


Figure 15. Off-site Deep Groundwater Sample Locations

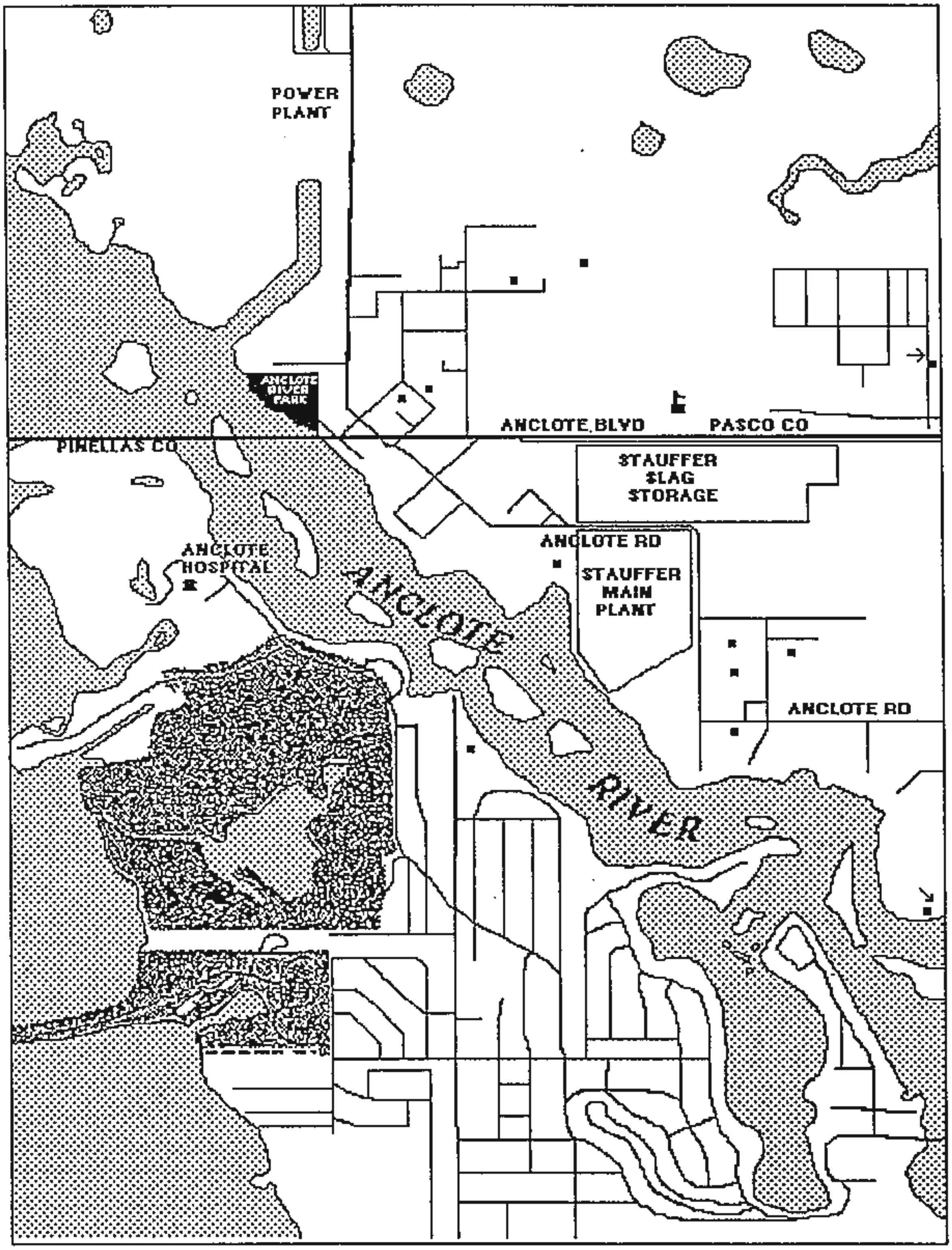


Figure 16. Off-site Surface Water Sample Locations

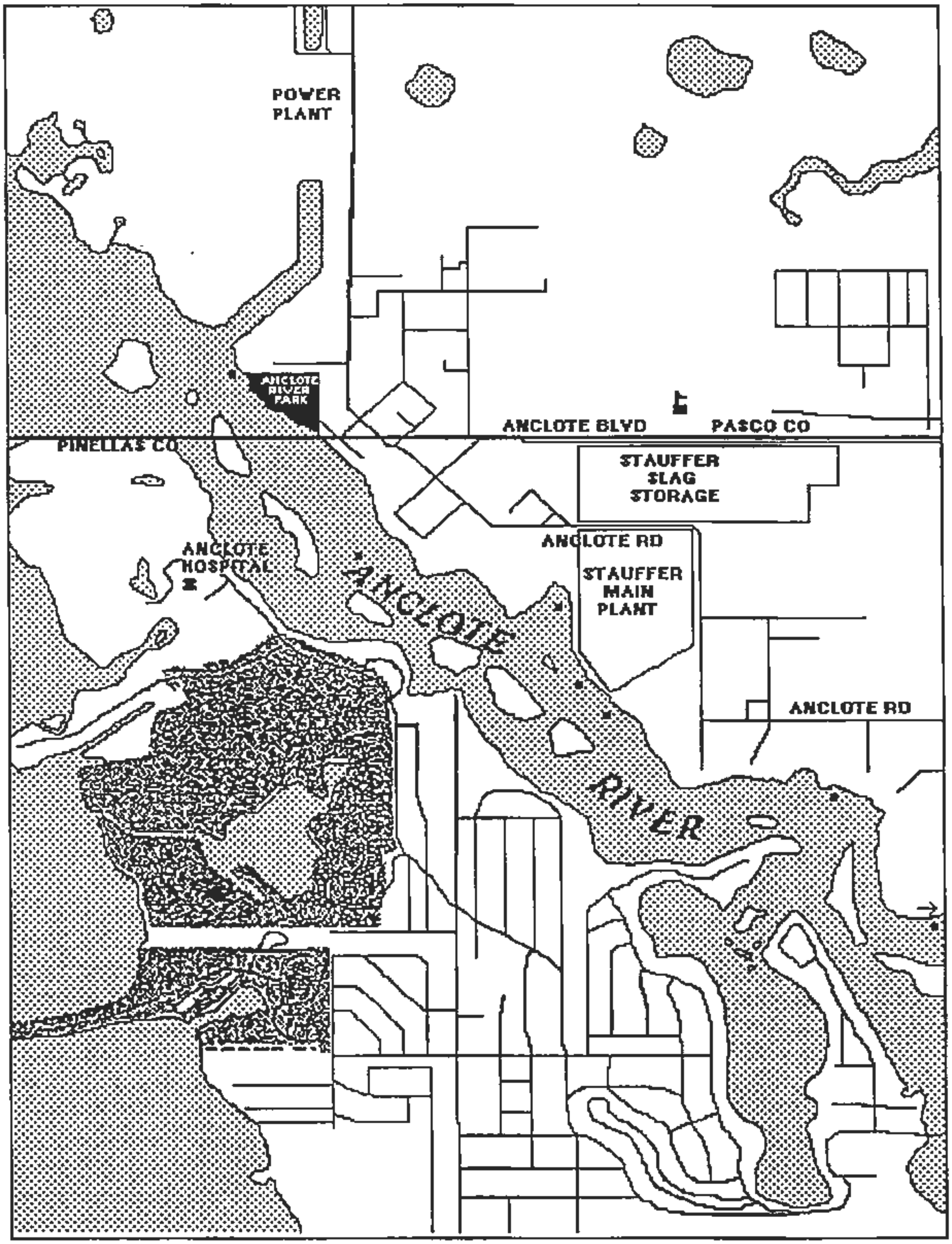
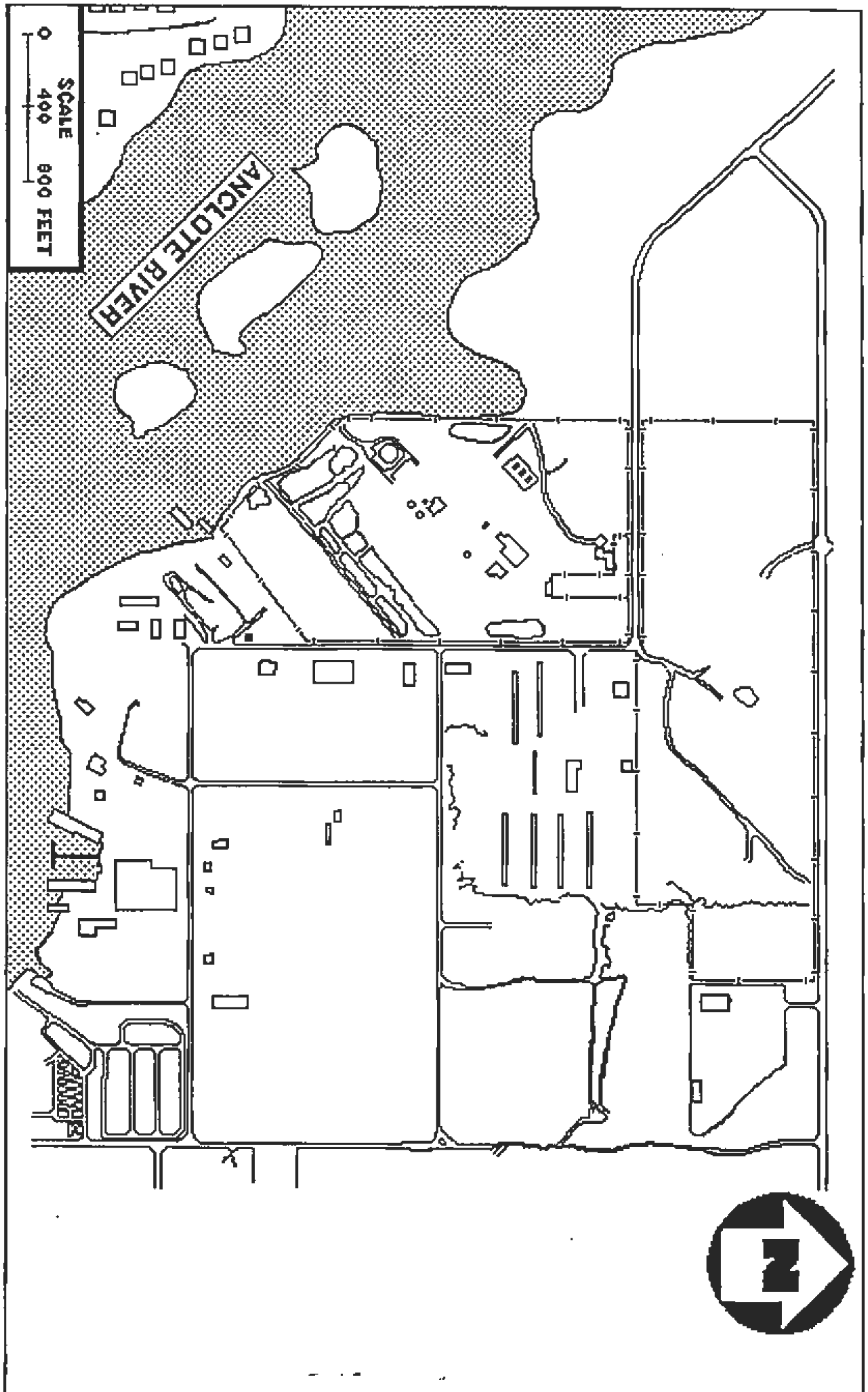


Figure 17. Off-site Air Monitoring Sample Locations



B. Tables

Table 1. Maximum Concentrations in On-Site Surface Soil

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	46	2/3	ND	20	RfD
Arsenic	270	6/57	ND	15	RfD
Beryllium	1.2	1/3	ND	0.16	CREG
Boron	NA	NA	NA	NA	NA
Cadmium	214	7/57	ND	10	EMEG
Chromium	122	0/57	0.89	250	RfD
Fluoride	4,230	1/53	65	3,000	RfD
Lead	440	0/57	3.1	NONE	Carcinogen
Radium (pCi/g)	73.8	0/29	2.0	NONE	NONE
Radon	NA	NA	NA	NA	NA
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	32	0/7	ND	NONE	NONE
Vanadium	110	0/7	3	NONE	NONE

NA - not analyzed
ND - not detected
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
Sources: Donaghue 1988; NUS 1989, 1991; Weston 1990

Table 2. Maximum Concentrations in On-Site Subsurface Soil

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	28	4/20	ND	20	RfD
Arsenic	340	25/45	ND	15	RfD
Beryllium	1.1	3/20	ND	0.16	CREG
Boron	NA	NA	NA	NA	NA
Cadmium	66	25/45	ND	10	EMEG
Chromium	130	0/45	ND	250	RfD
Fluoride	410,000	4/36	ND	3,000	RfD
Lead	321	0/45	ND	NONE	Carcin-ogen
Radium (pCi/g)	40.3	0/59	0.2	NONE	NONE
Radon	NA	NA	NA	NA	NA
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	37	0/29	ND	NONE	NONE
Vanadium	59	0/29	ND	NONE	NONE

NA - not analyzed
ND - not detected
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
Sources: Donaghue 1988; NUS 1989, 1991; Weston 1990

Table 3. Maximum Concentration in On-Site Sediments

Contaminants of Concern	Maximum Concen-tration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Back-ground Concen-tration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	NA	NA	NA	NA	NA
Arsenic	5,800	14/14	ND	15	RfD
Beryllium	NA	NA	NA	NA	NA
Boron	NA	NA	NA	NA	NA
Cadmium	53	13/14	ND	10	EMEG
Chromium	62	10/14	ND	250	RfD
Fluoride	NA	NA	93	3,000	RfD
Lead	310	0/14	1.3	NONE	Carcin -ogen
Radium (pCi/g)	22	0/9	0.2	NONE	NONE
Radon	NA	NA	NA	NA	NA
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	32	0/14	ND	NONE	NONE
Vanadium	82	0/14	1.1	NONE	NONE

NA - not analyzed
ND - not detected
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
Sources: Donaghue 1988; NUS 1989, 1991; Weston 1990

Table 4. Maximum Concentration in On-Site Shallow Groundwater

Contaminants of Concern	Maximum Concentration (ug/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (ug/L)	Comparison Value	
				(ug/L)	Source
Antimony	210	12/150	ND	4	RfD
Arsenic	180	71/158	ND	3	RfD
Beryllium	ND	0/20	ND	.0081	CREG
Boron	2,400	13/98	ND	600	LTHA
Cadmium	100	2/20	ND	2	EMEG
Chromium	560	10/158	ND	50	RfD
Fluoride (mg/l)	400	132/150	ND	0.6	RfD
Lead	110	4/20	ND	15	FLMCL
Radium (pCi/L)	3.5	0/131	NA	5	FLMCL
Radon (pCi/L)	11,600	23/149	NA	300	PMCL
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	100	3/20	ND	.4	LTHA
Vanadium	340	8/16	ND	20	LTHA

NA - not analyzed
ND - not detected
ug/L - micrograms per liter
pCi/L - picoCuries per liter
FLMCL - Florida Maximum Contaminant Level
PMCL - Proposed Maximum Contaminant Level
Sources: Boison 1987; Harris 1988-1991a; McClellan 1986-1987b; Donaghue 1988; NUS 1989, 1991

Table 5. Maximum Concentration in On-Site Deep Groundwater

Contaminants of Concern	Maximum Concentration (ug/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (ug/L)	Comparison Value	
				(ug/L)	Source
Antimony	ND	0/4	ND	4	RfD
Arsenic	19	2/5	ND	3	RfD
Beryllium	ND	0/2	ND	.0081	CREG
Boron	50	0/2	ND	600	LTHA
Cadmium	ND	0/2	ND	2	EMEG
Chromium	55	1/4	ND	50	RfD
Fluoride (mg/L)	2.8	2/4	ND	0.6	RfD
Lead	ND	0/2	ND	15	FLMCL
Radium (pCi/L)	0.7	0/2	NA	5	FLMCL
Radon (pCi/L)	3,379	8/10	NA	300	PMCL
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	ND	0/2	ND	.4	LTHA
Vanadium	ND	0/2	5	20	LTHA

NA - not analyzed
ND - not detected
ug/L - micrograms per liter
pCi/L - picoCuries per liter
FLMCL - Florida Maximum Contaminant Level
PMCL - Proposed Maximum Contaminant Level
Sources: Donaghue 1988; NUS 1989, 1991

Table 6. Maximum Concentration in Off-Site Surface Soil

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	ND	0/1	NA	20	RfD
Arsenic	ND	0/8	5	15	RfD
Beryllium	ND	0/1	NA	0.16	CREG
Boron	NA	NA	NA	NA	NA
Cadmium	1.7	0/8	0.06	10	EMEG
Chromium	5.1	0/12	100	250	RfD
Fluoride	109	0/6	200	3,000	RfD
Lead	77.3	0/3	10	NONE	Carcin-ogen
Radium (pCi/g)	4.4	0/2	1.0	NONE	NONE
Radon	NA	NA	NA	NA	NA
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	ND	0/3	ND	NONE	NONE
Vanadium	3	0/3	3	NONE	NONE

NA - not analyzed
ND - not detected
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
Sources: Weston 1990; NUS 1991

Table 7. **Maximum Concentrations in Off-Site Subsurface Soil**

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	ND	0/3	NA	20	RfD
Arsenic	ND	0/3	5	15	RfD
Beryllium	ND	0/3	NA	0.16	CREG
Boron	NA	NA	NA	NA	NA
Cadmium	ND	0/3	0.06	10	EMEG
Chromium	4.7	0/3	100	250	RfD
Fluoride	19,000	1/3	200	3,000	RfD
Lead	1.5	0/3	10	NONE	Carcin-ogen
Radium (pCi/g)	0.3	0/5	1.0	NONE	NONE
Radon	NA	NA	NA	NA	NA
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	ND	0/3	NA	NONE	NONE
Vanadium	3.5	0/3	NA	NONE	NONE

NA - not analyzed
ND - not detected
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
Sources: NUS 1989; Weston 1990

Table 8. Maximum Concentration in Off-Site Sediment

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	ND	0/10	ND	20	RfD
Arsenic	8.5	0/10	ND	15	RfD
Beryllium	ND	0/10	ND	0.16	CREG
Boron	NA	NA	NA	NA	NA
Cadmium	ND	0/10	ND	10	EMEG
Chromium	30	0/24	ND	250	RfD
Fluoride	18,000	3/10	93	3,000	RfD
Lead	21	0/24	1.3	NONE	Carcin -ogen
Radium	NA	NA	NA	NA	NA
Radon	NA	NA	NA	NA	NA
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	7,800	0/24	ND	NONE	NONE
Vanadium	32	0/10	1.1	NONE	NONE

NA - not analyzed
ND - not detected
mg/kg - milligrams per kilogram
Sources: NUS 1989, 1991

Table 9. Maximum Concentration in Off-Site Shallow Groundwater

Contaminants of Concern	Maximum Concentration (mg/L)	Total # Exceeding Comparison Value/ Total # Samples	Background Concentration (mg/L)	Comparison Value	
				(mg/L)	Source
Antimony	ND	0/5	NA	4	RfD
Arsenic	213	3/9	NA	3	RfD
Beryllium	11	2/5	NA	.0081	CREG
Boron	NA	NA	NA	NA	NA
Cadmium	7	3/9	NA	2	EMEG
Chromium	700	3/9	NA	50	RfD
Fluoride (mg/L)	9.8	4/5	NA	0.6	RfD
Lead	48	1/5	NA	15	FLMCL
Radium	NA	NA	NA	NA	NA
Radon (pCi/L)	1,386	2/4	NA	300	PMCL
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	ND	0/5	NA	0.4	LTHA
Vanadium	360	1/5	NA	20	LTHA

NA - not analyzed
ND - not detected
mg/L - milligrams per liter
pCi/L - picoCuries per liter
FLMCL - Florida Maximum Contaminant Level
PMCL - Proposed Maximum Contaminant Level
Sources: Donaghue 1988; NUS 1989, 1991

Table 10. Maximum Concentration in Off-Site Deep Groundwater

Contaminants of Concern	Maximum Concen-tration (ug/L)	Total # Exceeding Comparison Value/ Total # samples	Back-ground Concen-tration (ug/L)	Comparison Value	
				(ug/L)	Source
Antimony	ND	0/7	NA	4	RfD
Arsenic	110	4/18	NA	3	RfD
Beryllium	5	1/9	NA	.0081	CREG
Boron	NA	NA	NA	NA	NA
Cadmium	29	1/15	NA	2	LTHA
Chromium	290	1/15	NA	50	RfD
Fluoride (mg/L)	4.5	1/15	NA	0.6	RfD
Lead	ND	0/15	NA	15	FLMCL
Radium	NA	NA	NA	NA	NA
Radon (pCi/L)	4,864	20/20	NA	300	PMCL
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	2	1/9	NA	0.4	LTHA
Vanadium	320	1/9	NA	20	LTHA

NA - not analyzed
ND - not detected
ug/L - micrograms per liter
pCi/L - picoCuries per liter
FLMCL - Florida Maximum Contaminant Level
PMCL - Proposed Maximum Contaminant Level
Sources: Donaghue 1988; Wyatt 1990; NUS 1989, 1991

Table 11. Maximum Concentration in Off-Site Surface Water

Contaminants of Concern	Maximum Concen-tration (ug/L)	Total # Exceeding Comparison Value/ Total # samples	Back-ground Concen-tration (ug/L)	Comparison Value	
				(ug/L)	Source
Antimony	850	6/45	ND	4	RfD
Arsenic	500	4/45	ND	3	RfD
Beryllium	ND	0/7	ND	.0081	CREG
Boron	5,800	27/30	ND	600	LTHA
Cadmium	ND	0/7	ND	2	EMEG
Chromium	80	1/45	ND	50	RfD
Fluoride (mg/L)	47	32/45	ND	0.6	RfD
Lead	150	1/7	ND	15	FLMCL
Radium (pCi/L)	4.1	0/38	NA	5	FLMCL
Radon (pCi/L)	120	0/38	NA	300	PMCL
Sulfur dioxide	NA	NA	NA	NA	NA
Thallium	300	1/7	ND	0.4	LTHA
Vanadium	370	2/7	ND	20	LTHA

NA - not analyzed
ND - not detected
ug/L - micrograms per liter
pCi/L - picoCuries per liter
FLMCL - Florida Maximum Contaminant Level
PMCL - Proposed Maximum Contaminant Level
Sources: NUS 1989, 1991; Boison 1987; Harris 1988a-1991a; McClellan 1987a, 1987b

Table 12. Maximum Concentration in Off-Site Air

Contaminants of Concern	Maximum Concentration (ug/m^3)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (ug/m^3)	Comparison Value	
				(ug/m^3)	Source
Antimony	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA
Boron	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA
Fluoride	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA
Radium	NA	NA	NA	NA	NA
Radon	NA	NA	NA	NA	NA
Sulfur dioxide	14	1/30	NA	12	FATWL
Thallium	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA

NA - not analyzed
ND - not detected
ug/m^3 - micrograms per cubic meter
FATWL - Florida Air Toxics Working List
Source: Robbins 1983

Table 13. Completed Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Surface Soil	Stauffer site	Surface Soil	On-site	Ingestion/ Inhalation	Workers on-site	Past Present Future
Ground-water	Stauffer site	Deep Groundwater	On-site/ Off-site private wells	Ingestion	Private well users	Past Present Future
Surface Water	Stauffer site	Surface Water	Anclote River	Ingestion	Swimmers	Past Present Future
Sediment	Stauffer site	Sediment	Anclote River	Ingestion	Swimmers	Past Present Future
Ambient Air	Stauffer site	Air	On-site/ Off-site	Inhalation	On-site workers/ Residents	Past Future

Table 14. Potential Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
On-site Sub-surface Soil	Stauffer site	Subsurface soil	Stauffer site	Ingestion	On-site workers	Future
Off-site Surface Soil	Stauffer site	Surface soil	Off-site residences/ businesses	Ingestion/ Inhalation	Community residents	Past Present Future
Sediment	Stauffer site	Sediment	Stauffer site	Ingestion/ Inhalation	On-site workers	Future