PUBLIC HEALTH ASSESSMENT

LANDIA CHEMICAL COMPANY
(a/k/a FLORIDA FAVORITE FERTILIZER)
LAKELAND, POLK COUNTY, FLORIDA
EPA FACILITY ID: FLD042110841

June 27, 2000

Prepared by:

Bureau of Environmental Toxicology
Florida Department of Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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1.0 SUMMARY

This 12-acre site is in Lakeland, Polk County, Florida. Until 1987, Landia Chemical Company operated a pesticide storage, blending, and manufacturing business on half the site. The Florida Favorite Fertilizer Company continues to operate a fertilizer storage, mixing, and distribution business on the other half. In 1983, nearby residents complained that smoke from a fire at Landia caused chest pains and difficulty breathing. They also complained that pesticide odors from the ditch that receives stormwater runoff from the site were causing nausea, headaches, dizziness, and eye and respiratory irritation. Because of an investigation by the Florida Department of Environmental Protection (DEP), Landia removed contaminated sediment from the ditch in 1983.

Since 1983 DEP, the U.S. Environmental Protection Agency (EPA), and consultants for Landia Chemical Company/Florida Favorite Fertilizer Company have collected and analyzed many soil, surface water, sediment, and ground water samples. Data collected suggest that nearby residents could have been exposed in the past to contaminants from this site by breathing contaminated air, by touching contaminated water/sediments, or by accidentally eating small amounts of contaminated soil. Nearby residents could be exposed in the future to contaminants from this site if they go on the site or use contaminated ground water.

The Florida Department of Health classifies this site as an indeterminate public health hazard for past exposures. Assessing the probability of illness from past inhalation of contaminated dust or vapors is not possible because of the lack of air monitoring data. Currently there is no apparent public health hazard for nearby residents. Site access is restricted and there is no current use of the contaminated ground water. This site, however, may be a public health hazard in the future. If in the future people are exposures to on-site surface soil, ground water, or contaminated dust, they will likely become ill. If in the future, children accidentally eat small amounts of arsenic-contaminated surface soil from on the site or drink contaminated ground water they are likely to suffer serious illness. Likewise, adults who accidentally eat small amounts of arsenic-contaminated surface soil from the site or drink contaminated ground water over a lifetime will likely develop cancer.

First, we recommend nearby residents not have access to on-site surface soil. Second, we recommend contaminated ground water not be used as a drinking water supply. Third, we recommend collection and analysis of off-site air samples. Fourth, we recommend control of dust generation and intensive air monitoring during any future cleanup that disturbs on-site soil.

The Florida Department of Health (DOH) has warned nearby residents of the risk of using contaminated ground water. Florida DOH will test fish from a nearby stormwater pond will review area cancer rates.

2.0 PURPOSE AND HEALTH ISSUES

On June 15, 1998, the Florida Department of Environmental Protection (DEP) requested assistance from the Florida Department of Health and the Polk County Health Department (CHD). DEP requested an investigation of the area surrounding the Landia Chemical Company/Florida Favorite Fertilizer Company hazardous waste site in Lakeland, Florida (Gerard 1998). DEP based this request on the severity of the contamination, the large areal extent of the contamination, and the length of time the contamination has existed. The Florida Department of Health (DOH), Bureau of Environmental Toxicology agreed to assess the public health threat at this site. This is the first assessment of this site by either DOH or the federal Agency for Toxic Substances and Disease Registry (ATSDR).

In this report, DOH assesses the past, current, and future public health threat from exposure to chemicals in the environment at and around the Landia Chemical Company/Florida Favorite Fertilizer Company hazardous waste site. Identification of a contaminant of concern does not necessarily mean that exposure will cause illness. Identification serves to narrow the focus of this report to those contaminants most important to public health. DOH estimates which groups of people may have been exposed in the past, are currently being exposed, or may be exposed in the future. DOH estimates if these exposures are likely to have caused illness in the past, are likely to be causing illness now, or may likely cause illness in the future.

DOH conducted this public health assessment under a cooperative agreement with the federal ATSDR. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) authorizes ATSDR to conduct public health assessments at hazardous waste sites. ATSDR, in Atlanta, Georgia, is a federal agency within the U.S. Department of Health and Human Services.

3.0 BACKGROUND

3.1 Site History

3.1.1 Landia Chemical Company - Standard Spray and Chemical owned and operated a pesticide storage, blending, and manufacturing business at this site between October 1945 and November 1976. Agrico Chemical company owned the site between November 1976 and November 1977. The Landia Chemical Company (Landia) purchased the site in November 1977 and operated a pesticide storage, blending, and manufacturing business until 1987. Landia handled these groups of pesticides: organophosphate, organochlorine, sulphur, and metal-containing. Landia also used solvents such as various alcohols, methylene chloride, various glycols, and sulfuric acid (CH_2MHill 1988).

In May 1983, the Lakeland Fire Department received about 200 telephone calls from nearby residents. They complained of chest pains and difficulty breathing. The fire department attributed these complaints to a fire in a vat at Landia containing the pesticide azinphos-methyl (LFD 1983).

In September 1983, residents along Wayman Street, south of the site, complained about a strong, obnoxious, "rotten cabbage" pesticide odor coming from the ditch behind their houses. These residents reported milky, yellow-colored water in this ditch, which receives runoff from the Landia site. DEP (formerly Department of Environmental Regulation) investigated. DEP found extremely high concentrations of toxaphene and other pesticides in the water and sediments in the unlined, north-south ditch, west of Beech Avenue, that drains the site (DEP 1983a). Simultaneously, DEP investigated a fish kill in the nearby Itchepackesassa Creek about two miles west of the site and found the same pesticides they found at Landia. DEP concluded that the fish kill in Itchepackesassa Creek was caused by pesticides from Landia (DEP 1983a). DEP advised anyone who had contact with the water or sediments in the drainage ditch to contact their physician. The Polk County Health Department posted temporary warning signs along the banks of this drainage ditch. In November 1983, under the direction of DEP, Landia removed pesticide-contaminated sediments from the first 1,000 feet of this ditch south of Olive Street. Landia disposed of the pesticide-contaminated ditch sediments (about 140 tons) at the Emile, Alabama hazardous waste landfill (DEP 1983b).

On May 17, 1984, Lakeland General Hospital treated two Landia workers for organophosphate pesticide poisoning. The federal Occupational Safety and Health Administration investigated and fined Landia $490 for not providing dust resistant coveralls (Harry 1985).

Landia ceased operations in 1987. On April 27, 1992, an underground pipeline along the railroad tracks, on the north side of the site, ruptured. The pipeline spilled about 6,200 gallons of Jet-A fuel on the ground along the border between Landia and Florida Favorite Fertilizer. The pipeline owners, Central Florida Pipeline, recovered about 4,500 gallons of the jet fuel and removed about 10 cubic yards of contaminated soil (Delta 1994).

On July 8, 1999, the Polk County Health Department distributed a contaminated ground water advisory flyer to all of the homes in a ten-block area south of the site (Appendix D).

Landia currently leases an office building on the southern part of the site to a pump supply business.

3.1.2 Florida Favorite Fertilizer Company - The Florida Favorite Fertilizer Company (FFF) currently operates a fertilizer storage, mixing, and distribution business. FFF's handling of fertilizer has resulted in soil and ground water contamination. Leaking underground fuel tanks have also contaminated soil and ground water. In 1989, FFF removed one 2,000-gallon gasoline and two 3,000-gallon diesel underground storage tanks. In 1991, FFF removed two 10,000-gallon aboveground fuel tanks (Missimer 1992). Also in 1991, a nearby plant nursery owner complained that dust from FFF caused respiratory irritation and had killed about 100 plants (DEP 1991). FFF still operates a fertilizer storage, mixing, and distribution business at this site.

3.2 Site Description

The Landia Chemical/Florida Favorite Fertilizer site is about 12 acres: Landia owns about five acres on the east side and Florida Favorite Fertilizer owns about seven acres on the west side (Figures 1 and 2, Appendix A). Except for a shallow depression in the southwest corner, most of the Landia property is either covered by buildings or paved. The western part of the Florida Favorite Fertilizer property is paved; the eastern part along the border with Landia is not paved. Both the Landia and Lakeland Fertilizer properties are fenced but site access is not strictly controlled.

3.2.1 Demographics - The site is along the northern boundary of U.S. Census Bureau's tract #109 for Polk County. This one-square-mile census tract is bounded on the north by the Seaboard Coastline railroad tracks, on the east by Central Avenue, on the south by Ariana Street, and on the west by Wabash Avenue (Figure 1, Appendix A). In 1990, 3867 people lived in census tract #109. Twenty-seven percent were under the age of 18. Of the total population, 79% were white, 18% were black, 2% were Hispanic, and 1% were from other racial/ethnic groups (Florida Legislature 1991).

3.2.2 Land Use - The site is in a mixed industrial/commercial/residential area of west Lakeland (Figure 3, Appendix A). The land within 250 feet south of the site, along Olive Street, is commercial. The land between 250 feet and 2,000 feet south of the site is residential. Land use west of the site is industrial/warehouse. North of the site are tracks of the Seaboard Coast Line railroad. Land use northwest of the railroad tracks is open space (golf course). Land use northeast of the railroad tracks is industrial/warehouse. Land use east of the site is residential (CH_2MHill 1988).

3.2.3 Natural Resource Use - The area surrounding the site is within the service area of the municipal water supply. Individual wells in the area primarily are used for lawn or garden irrigation. In November 1983, DEP found nine wells within one mile of the site. Only one well 0.5 mile south of the site was used for drinking water (DEP 1983c). In 1987 the Southwest Florida Water Management District had records for 60 wells within one mile of the site. Most of these wells were monitor wells, abandoned wells, or irrigation and agricultural wells. Contractors for Landia found no domestic wells less than 0.5 mile hydraulically down gradient (generally southwest) of the site (CH_2MHill 1988).

Stormwater runoff from the site flows south then west through a series of ditches to a stormwater pond about 1.5 miles west-southwest of the site. This stormwater pond is on the north side of Highland Street between Jensen and Lebanon Roads (Figure 4, Appendix A). People reportedly eat fish caught in this stormwater pond. Discharge from this pond then flows through a series of ditches to Itchepackesassa Creek which discharges into Hillsborough Bay.

Lake Bonnet is about 0.5 miles north of the site, Lake Beulah is about 0.5 miles east of the site, and Lake Hunter is about 0.75 miles southeast of the site. These lakes are used for boating and recreational fishing. Because shallow ground water flow at this site is generally toward the southwest, water quality in these lakes likely has not been affected.

3.3 Site Visits

On July 16, 1998, Randy Merchant with the DOH Bureau of Environmental Toxicology, visited the site. He was accompanied by Tom McNally of the Polk County Health Department. They observed Landia and Florida Favorite Fertilizer on the north side of Olive Street between Beech and Westgate Avenues. Landia is no longer in business. J-line Pumps and another business lease buildings on the southern portion of the Landia property. They observed a chain-link fence and a two-foot high earthen berm separating Landia and Florida Favorite Fertilizer. Recent rains left standing water on either side of the berm. Runoff from the west side of the Landia site seemed contained on-site but runoff from the east side appeared to flow under Olive Street into the unlined ditch.

Mr. Merchant and Mr. McNally observed a working-class neighborhood south of Olive Street (Figure 2, Appendix A). The population was a mixture of both black and white residents. They did not observe any vegetable gardens. The back yards of the houses on Beech Avenue border the north-south unlined ditch that receives stormwater runoff from the Landia Chemical property. They observed evidence of children playing in these back yards (bicycles, tricycles, wading pools, etc.). Few fences or other barriers prevent access to this ditch. The ditch is about 10 feet wide and three feet deep. It had rained recently and the ditch had about two or three inches of water in it. The vegetation in the ditch was about one foot high.

Mr. Merchant and Mr. McNally viewed the east-west, concrete-lined drainage ditch south of Wayman Street (Appendix D). They spoke with one resident on Wayman Street. This resident had noticed a pesticide smell and odd colors in the ditch behind his house when he moved there in 1982. This resident reported moving his family temporarily to a motel a couple of times in 1983 because of the strong pesticide odor. He did not attribute any illnesses to those pesticide odors.

Later on July 16, 1998, Mr. Merchant met with DEP and Polk County Health Department staff in Bartow, Florida to discuss DEP's request for assistance.

On August 5, 1999, Randy Merchant and Beth Copeland of the DOH Bureau of Environmental Toxicology visited the site. Following an afternoon rain, they observed standing water on-site behind the berm on both sides of the border between Landia and Florida Favorite Fertilizer. Stormwater runoff also accumulated on both sides of Olive Street near the border between the two properties. Starting at Olive Street and ending at Southern Avenue, they observed warning signs along the ditch draining the site. About 1.5 miles west-southwest of the site, on the north side of Highland Street between Jensen and Lebanon Roads, they observed the two-acre pond that receives stormwater runoff from the site (Figure 4).

Later on August 5, Mr. Merchant and Ms. Copeland drove through the working-class neighborhood south of the site. They met with about 65 nearby residents in a home on Wayman Street. They provided each resident at this meeting with a copy of this draft public health assessment, a summary fact sheet, the ground water advisory, and other background information. Mr. Merchant gave a brief presentation stressing that the DOH assesses the public health hazard and makes recommendations to protect public health. He stressed that the US Environmental Protection Agency (EPA) ensures the responsible parties test and clean up the site. Most residents questioned whether their illnesses were site related. Some complained that the contamination had existed for years, no clean up had occurred, and no one had kept them informed. One resident reported that children eat fish they catch from the stormwater pond north of Highland Street between Jensen and Lebanon Roads.

On September 16, 1999, Mr. Merchant again visited the site. The site appeared similar to his last visit on August 5. He also visited the stormwater pond north of Highland Street between Jensen and Lebanon Roads. He observed trailers on both sides of the pond and no barriers to access. He observed tricycles, bicycles, and other evidence of young children living in the neighborhood. From 3:00 to 8:00 p.m. Mr. Merchant attended an open house at the Lakeland Center. About 150 residents from near the site attended and some asked if their illnesses were site related.

On October 19, 1999, Randy Merchant and Davis Daiker with the DOH Bureau of Environmental Toxicology visited the site and the stormwater pond north of Highland Street between Jensen and Lebanon Roads. They observed one small warning sign along the east bank of the stormwater pond.

4.0 DISCUSSION

Uncertainties are inherent in the public health assessment process. These uncertainties fall into four categories: 1) science is never 100% certain, 2) the inexactness of the risk assessment process, 3) the incompleteness of the information collected thus far, and 4) differences in opinion as to the implications of the information (NJDEP 1990). Scientists and public health officials incorporate uncertainties into public health assessments by using health protective assumptions when estimating or interpreting health risks. They also incorporate uncertainties by using wide safety margins when setting health-related threshold values. The assumptions, interpretations, and recommendations in this public health assessment err in the direction of protecting public health.

4.1 Environmental Contamination

This section reviews the environmental data collected at the site, evaluates sampling adequacy, and selects contaminants of concern. Also this section lists the maximum concentration and detection frequency for the contaminants of concern in the various media (that is, water, soil, and air). Contaminants of concern are selected based on the following factors:

1. Concentrations of contaminants on and off the site. Although background concentrations are useful in determining if contaminants are site-related, we only eliminate contaminants from further consideration if both the background and on-site concentrations are below standard comparison values. This is necessary to assess the public health risk of all contaminants detected, whether site related or not.

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

3. Community health concerns.

4. For complete and potential exposure pathways, comparison of maximum concentrations with published ATSDR comparison values. ATSDR comparison values are media-specific (air, water, soil, etc.) concentrations used to select contaminants for further evaluation. Comparison values are not used to predict health effects or to set clean up

levels. Contaminants with concentrations above an ATSDR comparison value do not necessarily represent a health threat, but are selected for further evaluation. Likewise, contaminants with media concentrations below an ATSDR comparison value are unlikely to be associated with illness and are not evaluated further, unless there is a specific community concern about the contaminant.

5. For complete and potential exposure pathways, comparison of maximum concentrations with toxicological information published in ATSDR toxicological profiles documents. These profiles are chemical specific and summarize toxicological information found in scientific literature.

We used the following ATSDR standard comparison values (ATSDR 1992) to select contaminants of concern:

1. EMEG-Environmental Media Evaluation Guide--is derived from the ATSDR's Minimal Risk Level (MRL) using standard exposure assumptions, such as ingestion of two liters of water per day and body weight of 70 kg for adults. MRLs are estimates of daily human exposure to a chemical (generally for a year or longer) likely to be without an appreciable risk of noncancerous illnesses.

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

3. RMEG-Reference Dose Media Evaluation Guide--is derived from the EPA's Reference Dose (RfD) using standard exposure assumptions. RfDs are estimates of daily human exposure to a chemical (generally for a year or longer) likely to be without an appreciable risk of noncancerous illness.

4. LTHA-Lifetime Health Advisory for Drinking Water--is the EPA's estimate of the concentration of a drinking-water contaminant at which illnesses are not expected to occur even over lifetime exposure. LTHAs provide a safety margin to protect sensitive members of the population.

Using the methodology described above, we narrowed our focus to 12 contaminants of concern. We only use ATSDR comparison values to select contaminants of concern for further consideration. Identification of a contaminant of concern in this section does not necessarily mean that exposure will cause illness. Identification serves to narrow the focus of the public health assessment to those contaminants most important to public health. When we selected a contaminant of concern in one medium, we also reported that contaminant in all other media. We evaluate the contaminants of concern in subsequent sections and estimate whether exposure is likely to cause illness.

In this public health assessment, we first discuss the contamination that exists **on** the site and then the contamination that occurs **off** the site.

4.1.1 On-Site Contamination - For this public health assessment, we define "on-site" as the area within the Landia Chemical Company and the Florida Favorite Fertilizer Company property boundaries as shown in Figure 2, Appendix A.

4.1.1.1 On-Site Surface Soil - Between October 1983 and July 1999, EPA, DEP, DEP consultants, and consultants for Landia and FFF collected about 100 on-site surface soil samples (OH Materials 1983, DEP 1986, CH2MHill 1988, BBL 1997, IT 1999, TTEM 1999). We consider soil 0-12 inches deep as "surface soil." We did not include soil samples from deeper than 12 inches or soil from unspecified depths (Missimer 1992, Delta 1994, ViroGroup 1994). Various laboratories analyzed these surface soil samples for solvents, pesticides, and metals. We summarize the results for the on-site surface soil analyses in Table 1, Appendix B. For this public health assessment, on-site surface soil quality has been adequately tested.

4.1.1.2 On-Site Ground Water - Between February 1984 and November 1997, consultants for DEP, Landia, and FFF collected more than 100 on-site ground water samples (PELA 1984a, PELA 1984b, PELA 1984c, CH2MHill 1988, Missimer 1992, Delta 1994, BBL 1997, IT 1999). We considered ground water samples from all depths together. Various laboratories analyzed these samples for solvents, pesticides, and metals. We summarize the results for the on-site ground water analyses in Table 2, Appendix B. For this public health assessment, on-site ground water quality has been adequately tested.

4.1.1.3 On-Site Air - We are unaware of any on-site air monitoring data. Therefore, on-site air quality has not been adequately tested.

4.1.2 Off-Site Contamination - For this public health assessment we define "off-site" as the area outside the Landia Chemical Company and the Florida Favorite Fertilizer Company property boundaries as shown in Figure 2, Appendix A.

4.1.2.1 Off-Site Surface Soil - On February 20, 1984, contractors for Landia collected five off-site surface soil samples east, west, and south of the site and analyzed for pesticides (PELA 1984a). In July 1994 consultants for the Landia Group collected two off-site surface soil samples along the banks of the stormwater ditch just south of the site and analyzed for solvents, pesticides, and metals (BBL 1997). In April and November 1997, consultants for DEP collected 17 off-site surface soil samples and analyzed for solvents, pesticides, and metals (IT 1999). Most of these samples were in the industrial area west of the site. Only three of these samples were in the residential area south of the site. In July 1999, EPA consultants collected one off-site surface soil sample and analyzed for pesticides and metals (TTEM 1999). We summarize the results from the off-site surface soil analyses in Table 3, Appendix B.

Most of these off-site surface soil samples were collected from the industrial areas north and west of the site. Only a few were collected in the residential area south of the site. Therefore, for this public health assessment, off-site surface soil quality has not been adequately tested.

4.1.2.2 Off-Site Ground Water - Between April 1985 and March 1999, Landia consultants, DEP, and their consultants collected 39 off-site ground water samples (PELA 1985, CH2MHill 1988, BBL 1997, IT 1999, DEP 1999). Most of these ground water samples were within 200 feet of the site. Various laboratories analyzed these samples for solvents, pesticides, and metals. We summarize the results from the off-site ground water analyses in Table 4, Appendix B. The off-site boundary of the ground water contamination has not been determined. This is especially true for highly soluble contaminants such as nitrate. Elevated concentrations of nitrate have been found in private wells as far south as Wayman Street. For this public health assessment, off-site ground water quality has not been adequately tested. Additional testing is necessary to determine the extent of the off-site ground water contamination.

4.1.2.3 Off-Site Drainage Ditch Water (Before November 1983 Sediment Removal) - On September 21, 1983, DEP consultants collected 12 water samples from the ditch that receives stormwater runoff from the site and analyzed them for pesticides (OH Materials 1983). Landia Chemical consultants split three of DEP's water samples and analyzed them for pesticides using a different laboratory (PELA 1983). We summarize the results from the off-site surface water analyses (before November 1983) in Table 5, Appendix B.

4.1.2.4 Off-Site Drainage Ditch Water (After November 1983 Sediment Removal) - Between December 1983 and March 1999 DEP, its consultant, and the University of Florida collected 15 off-site water samples from the ditch that receives stormwater runoff from the site (DEP 1983f, UF 1991, IT 1999, DEP 1999). They analyzed these samples for solvents, pesticides, and metals. We summarize the results from the off-site surface water analyses (after November 1983) in Table 6, Appendix B. For this public health assessment, off-site drainage ditch water quality after November 1983 has been adequately tested.

4.1.2.5 Off-Site Drainage Ditch Sediments (Before November 1983 Sediment Removal) - On September 21, 1983, DEP consultants collected 10 sediment samples from the first one-thousand feet of ditch that receives stormwater runoff from the site. DEP consultants collected five more sediment samples along the first six miles of the drainage from this site. They analyzed these sediment samples for pesticides (OH Materials 1983). Landia consultants split three of DEP's sediment samples and analyzed them for pesticides using a different laboratory (PELA 1983). On November 14, 1983, EPA collected two sediment samples from the ditch that receives stormwater runoff from the site. One sediment sample was about 0.5 mile downstream of the site and the other was about 1.0 mile downstream of the site. EPA analyzed these sediment samples for pesticides (EPA 1983). We summarize the results from the off-site sediment analyses (before November 1983) in Table 7, Appendix B.

4.1.2.6 Off-Site Drainage Ditch Sediments (After November 1983 Sediment Removal) - On February 20, 1984 Landia consultants collected one off-site sediment sample from the ditch that drains the site and analyzed for pesticides (PELA 1984a). On June 6, 1990, the University of Florida collected 10 off-site sediment samples spread along the first three miles of the drainage from this site. They analyzed for solvents and pesticides (UF 1991). In July 1999, EPA consultants collected three off-site sediment samples from this ditch within 300 feet of the site and analyzed for pesticides and metals (TTEM 1999). We summarize the results from the off-site sediment analyses (after November 1983) in Table 8, Appendix B. Stormwater runoff from the eastern portion of this site continues to enter the ditch south of Olive Street. For this public health assessment, off-site drainage ditch sediment quality has not been adequately tested. Additional samples are necessary to characterize the quality of the sediment in the drainage ditch, especially in the unlined portion between Plateau Avenue and the stormwater pond on Highland Street between Jensen and Lebanon Roads.

4.1.2.7 Off-Site Fish - On September 21, 1983, the DEP collected one Nile perch (*Talapia aurea*) from the Itchepackesassa Creek at Galloway Road, approximately two miles west of the site (DEP 1983e). This fish was dead when collected. DEP analyzed it for pesticides and found hexachlorocyclohexane and toxaphene (Table 9, Appendix B). For this public health assessment, contamination in fish has not been adequately characterized. Additional fish samples are necessary to characterize the contamination in fish from nearby water bodies.

4.1.2.8 Off-Site Air - We are unaware of any off-site air monitoring data. In May 1983, a vat at Landia containing azinphos-methyl caught fire. About 200 people called the Lakeland Fire Department complaining of chest pains and difficulty breathing (LFD 1983). Because there has not been any air monitoring, we conclude that off-site air quality has not been adequately tested.

4.1.3 Quality Assurance and Quality Control - In preparing this public health assessment, we relied on the existing environmental data. The completeness and reliability of the referenced information determine the validity of the analyses and conclusions drawn for this public health assessment. It appears that the governmental agencies and consultants who collected and analyzed these samples followed adequate quality assurance and quality control measures concerning chain-of-custody, laboratory procedures, and data reporting.

4.2 Physical Hazards

During his July 16, 1998, August 5, 1999, September 16, 1999, and October 19, 1999 site visits, Mr. Merchant did not observe any on- or off-site physical hazards.

4.3 Pathways Analyses

To estimate whether nearby residents have contacted 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.

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

In the past, workers at Southern Spray & Chemical and Landia Chemical Company were exposed to pesticide dust by inhalation, incidental ingestion, and/or skin absorption. In 1984 Lakeland General Hospital treated two Landia workers for organophosphate pesticide poisoning. We estimate that between 1940 and 1987 about 100 workers were exposed to pesticide dust at this site. Currently, there are about 10 workers at Florida Favorite Fertilizer Company and five workers at the J-Line Pump Company on the Landia property. This report does not estimate either exposure or the possibility of illness for these workers. Worker health and safety are the responsibility of the federal Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH).

4.3.1 Completed Exposure Pathways - We considered the following human exposure pathways complete (Table 10, Appendix B):

4.3.1.1 Azinphos-methyl Fire - In May 1983, about 200 nearby residents were probably exposed to azinphos-methyl vapors and related combustion products resulting from a fire in an azinphos-methyl containing vat at Landia. Exposure was by inhalation.

4.3.1.2 Drainage Ditch Pesticide Vapors - We estimate that between 1940 and 1983, about 100 residents along the Wayman Street ditch were probably exposed intermittently to pesticide vapors and associated carrier/solvents from site surface water runoff. Exposure was by inhalation.

4.3.1.3 Drainage Ditch Water - We estimate that between 1940 and 1983, about 50 nearby children were probably exposed to water contaminated with pesticides and associated carrier/solvents while playing in the ditches that receive stormwater runoff from the site. Exposure was by skin absorption.

4.3.1.4 Drainage Ditch Sediments - We estimate that between 1940 and 1983, about 50 nearby children were probably exposed to pesticide-contaminated sediments while playing in the ditch that receives stormwater runoff from the site. Exposure was by skin absorption.

4.3.1.5 Fish Consumption - We estimated that between 1940 and 1983, about 100 people were probably exposed to pesticides by eating contaminated fish caught in the Highland Street stormwater pond and Itchepackesassa Creek.

4.3.1.6 Incidental Soil Ingestion - We estimate that between 1940 and the present, about 100 people at nearby homes and businesses probably have been exposed to metals and pesticides in off-site surface soils. Exposure is by accidental (incidental) ingestion.

4.3.2 Potential Exposure Pathways - We consider the following human exposure pathways currently incomplete (no current exposure) but could be complete in the future (Table 11, Appendix B).

4.3.2.1 Ground Water - Ground water contamination exists below this site and extends southwest of the site. Exposure to contaminated ground water (ingestion and skin contact) is a potential future exposure pathway. Ground water use surveys do not suggest that people have been exposed in the past or are currently exposed to contaminated ground water from this site. In the future, however, if wells are installed in areas of ground water contamination or if contaminated ground water reaches nearby wells, people could be exposed.

4.3.2.2 On-Site Surface Soil - If in the future land use at this site changes, incidental ingestion of on-site surface soil by children and adults is possible.

4.3.2.3 Contaminated Dust - In the future, soil excavation for site clean up could create pesticide-contaminated dust. If not controlled, about 100 people in nearby homes and businesses could be exposed.

4.4 Public Health Implications

In the following sections, we discuss possible health effects for persons exposed to specific contaminants.

4.4.1 Toxicological Evaluation - In this subsection, we discuss exposure levels and possible health effects that might occur in people exposed to the contaminants of concern at the site. Also in this subsection, we discuss general ideas such as the risk of illness, dose response and thresholds, and uncertainty in public health assessments.

To evaluate exposure, we estimated the daily dose of each contaminant of concern found at the site. Kamrin (1988) explains a dose in this manner:

"...all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus the amount of a chemical a person is exposed to is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they must consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant.

"Thus instead of using the amount that is administered or to which an organism is exposed, it is more realistic to use the amount per weight of the organism. Thus 1 ounce administered to a 1-pound rat is equivalent to 2000 ounces to a 2000-pound (1-ton) elephant. In each case, the amount per weight is the same: 1 ounce for each pound of animal.

"This amount per weight is the dose. We use dose in toxicology to compare the toxicity of different chemicals in different animals."

We express the daily dose in milligrams of contaminant per kilogram of body weight per day (mg/kg/day).

To calculate the daily dose of each contaminant, we used standard assumptions about body weight, ingestion and inhalation rates, exposure time length, and other factors needed for dose calculation (ATSDR 1992, EPA 1997). In calculating the dose, we assume people are exposed to the maximum concentration measured for each contaminant in each medium. In Table 12, Appendix B, we summarize the maximum estimated exposure doses for all 12 contaminants of concern.

To estimate exposure from incidental ingestion of contaminated soil, we made the following assumptions: 1) children between the ages of one and six ingest an average of 200 milligrams (mg) of soil per day, 2) adults ingest an average of 100 milligrams of soil per day, 3) children weigh an average of 15 kilograms (kg), 4) adults weigh an average of 70 kg, 5) children and adults ingest soil at the maximum concentration measured for each contaminant.

To estimate exposure from ingestion of contaminated fish, we made the following assumptions: 1) in the past some recreational anglers ate an average of 10 grams of fish per day and children ate an average of five grams of fish per day from the Itchepackesassa Creek EPA 1997), 2) these adults weighed an average of 70 kilograms (kg), 3) these adults were exposed for up to 43 years (1940 to 1983), and 4) these adults were exposed to the concentrations of pesticides measured in the 1983 fish sample.

To estimate possible future exposure from drinking contaminated ground water, we made the following assumptions: 1) children between the ages of one and six ingest an average of 1 liter of water per day, 2) adults ingest an average of 2 liters of water per day, 3) children weigh an average of 15 kilograms (kg), 4) adults weigh an average of 70 kg, 5) children and adults ingest contaminated ground water at the maximum concentration measured for each contaminant.

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

4.4.1.1 **Aldrin/Dieldrin (total)** - People who accidentally eat small amounts of contaminated surface soil either <u>on</u>- or <u>off</u>-site are unlikely to become ill from the pesticide aldrin/dieldrin. Estimating the likelihood of illness from touching aldrin/dieldrin-contaminated soil/sediments or breathing aldrin/dieldrin-contaminated air is not possible because the rate of skin absorption is unknown and air monitoring data are nonexistent. If, in the future, people drink contaminated ground water, either on- or off-site, they are unlikely to become ill from aldrin/dieldrin.

Some adults and children living near this site may have been exposed to aldrin/dieldrin by accidental (incidental) ingestion of small amounts of contaminated surface soil. Our estimate of a child's maximum exposure to aldrin/dieldrin (total) by incidental ingestion of off-site surface soil is greater than the ATSDR minimal risk level (MRL) for short-term (<14 days) exposure. This MRL, however, is based on impaired antigen processing in mice following two weeks of exposure to dieldrin in their food. This MRL also includes a safety factor of one thousand to account for the use of the lowest observed adverse effect level, extrapolation from animals to humans, and for human variability. Because of the large safety factors included in the MRL, we do not expect any illnesses from this exposure. A study of people that ate levels of aldrin/dieldrin similar to what we estimated for 18 months did not find any liver, nervous system, or blood system damage (ATSDR 1993).

Epidemiological studies have been inadequate to decide whether aldrin/dieldrin cause cancer in humans. Several studies have shown that aldrin/dieldrin cause liver cancer in mice (ATSDR 1993). We estimate that there is no apparent increased risk of cancer from exposure to the aldrin/dieldrin contaminated surface soil or ground water.

We estimated a child's maximum exposure to aldrin/dieldrin (total) by ingestion if, in the future, contaminated ground water is used as a drinking water source. Our exposure estimate is only slightly higher than the ATSDR minimal risk level (MRL) for both short-term (<14 days) and long-term (> 365 days) exposure. Because of the large safety factors included in MRLs, we do not expect any illnesses from possible future exposures to aldrin/dieldrin in ground water.

Children playing in the ditch that receives stormwater runoff from the site may have been exposed to aldrin/dieldrin in the water and sediments by skin absorption. Although we know aldrin/dieldrin are absorbed across the skin, because the rate of absorption is unknown, exposure cannot be estimated.

Some people living near this site may have been exposed to aldrin/dieldrin by breathing contaminated dust. Since air monitoring data are nonexistent, the probability of illness from breathing aldrin/dieldrin-contaminated dust is unknown. Because of its low volatility, it is unlikely that aldrin/dieldrin caused the symptoms reported by residents along the Wayman Street ditch (nausea, headaches, dizziness). It is more likely that these symptoms were caused by the volatile carrier/solvents used to dissolve these pesticides.

4.4.1.2 **Arsenic** - Arsenic is a heavy metal. It exists in both organic and inorganic forms. We make the health-protective assumption that all of the arsenic at this site is in the more toxic inorganic form. The following discussion pertains only to inorganic arsenic.

Human studies have shown that arsenic in drinking water can cause illness. Human studies on the probability of illness from eating arsenic in soil, however, are limited. Arsenic in soil is not absorbed as fast as arsenic in drinking water, but the difference in rates is unknown. We address this uncertainty by making the health-protective assumption that arsenic in soil is absorbed at the same rate as arsenic in drinking water.

The highest concentrations of arsenic in on-site surface soil from three independent studies were 7186, 6550, 3242, and 1518 milligrams per kilogram (mg/kg). We used the maximum concentration to estimate exposure via accidental soil ingestion. This errs on the side of protecting public health. If in the future people go on this site, they would likely be exposed to these concentrations of arsenic and suffer the illnesses described below.

If in the future, people drink arsenic-contaminated ground water, either on- or off-site, they are likely to become ill. Incidental ingestion of arsenic-contaminated on-site surface soil is also likely to cause illness. Incidental ingestion of arsenic-contaminated off-site surface soil, however, is unlikely to cause illness. Because arsenic is not well absorbed across the skin, touching arsenic-contaminated soil/sediments is unlikely to cause illness. Estimating the likelihood of illness from breathing arsenic-contaminated dust is not possible because air monitoring data are nonexistent.

Our estimate of a child's maximum short-term (< 14 days) exposure to arsenic by incidental ingestion of on-site surface soil or drinking on- or off-site ground water is likely to cause vomiting, diarrhea, fatigue, and rapid heart rate. In addition, intermediate-term exposure (15-364 days) is likely to cause abdominal pain, gastrointestinal bleeding, fever/chills, and sore throat. Intermediate-term exposure is also likely to cause dark warts on the palms of the hands and soles of the feet, memory loss, mild loss of feeling or tingling in the legs in children (ATSDR 1998a).

Our estimate of an adult's maximum long-term (>365 days) exposure to arsenic by incidental ingestion of on-site surface soil or drinking on- or off-site ground water is likely to cause thickening and darkening of the skin, especially on the palms of the hands and soles of the feet. Long-term exposure is also likely to cause anemia, abdominal pain, enlargement of the liver, and tingling in the hands and feet (ATSDR 1998a).

There is clear evidence from studies in humans that exposure to arsenic may increase the risk of cancer. In workers exposed by the inhalation route, the predominant risk is lung cancer. When exposure occurs by the oral (ingestion) route, the predominant risk is skin cancer. This is based on a number of epidemiological studies of people with elevated levels of arsenic in their drinking water. There is also evidence that ingestion of arsenic increases the risk of liver, lung, bladder, and kidney cancer (ATSDR 1998a). Our estimate of an adult's maximum long-term (>365 days) exposure to arsenic by incidental ingestion of on-site surface soil or on- or off-site ground water is likely to cause skin, liver, lung, bladder, and kidney cancer.

Children playing in the ditch that receives stormwater runoff from the site may have been exposed to arsenic in the water and sediments by skin absorption. Because arsenic is not easily absorbed across the skin, this exposure is unlikely to cause illness.

Some people living near this site may have been exposed to arsenic by breathing contaminated dust. Because air monitoring data are nonexistent, the public health risk from breathing arsenic-contaminated dust is unknown.

4.4.1.3 **Azinphos-methyl** - About 200 people living near the site may have inhaled this organophosphate pesticide, its carrier/solvent, and/or their breakdown products during a May 1983 fire at Landia. Determining the probability of illness from this exposure is not possible because air monitoring data are nonexistent. Reported symptoms (chest pains and difficulty breathing), however, could have been caused by smoke, azinphos-methyl, its carrier/solvent, and/or their breakdown products.

Other symptoms of azinphos-methyl poisoning include nausea, vomiting, abdominal cramps, diarrhea, salivation, tearing, blurred vision, constricted pupils, dizziness, and sweating. Symptoms of azinphos-methyl poisoning usually disappear completely within one week after exposure ends (Mobay 1990). Subsequent environmental investigations did not analyze for azinphos-methyl because it breaks down rapidly and is unlikely to be found in the environment after a short time.

4.4.1.4 **Benzene** - If, in the future, people use contaminated ground water on or near this site as a source of drinking water, concentrations of benzene are not likely to cause illness. Although benzene, a solvent, is known to cause cancer (acute myelocytic leukemia) in people, the highest ground water concentration would not likely cause cancer (ATSDR 1997a).

4.4.1.5 **Chlordane (total)** - People who accidentally eat small amounts of contaminated soil either on- or off-site are unlikely to become ill from this pesticide. Estimating the likelihood of illness from touching chlordane-contaminated soil/sediments or breathing chlordane-contaminated air is not possible because the rate of skin absorption is unknown and air monitoring data are nonexistent. If in the future, people drink contaminated ground water, either on- or off-site, they are unlikely to become ill from chlordane.

Some adults and children living near this site may have been exposed to chlordane by accidental (incidental) ingestion of small amounts of contaminated soil. Our estimate of a child's maximum exposure to chlordane by incidental ingestion of off-site soil is greater than the ATSDR minimal risk level (MRL) for short-term, intermediate-term, and long-term exposure. These MRLs, however, are based on feeding studies in mice and rats and include safety factors to account for the use of the lowest observed adverse effect level, extrapolation from animals to humans, and for human variability. In studies of workers who made chlordane, no harmful effects on health have been confirmed. Studies of workers who made or used chlordane do not link exposure with cancer, but the information is not sufficient to know for sure (ATSDR 1994a). We estimate that people who accidentally eat small amounts of contaminated soil either on- or off-site are unlikely to become ill from the pesticide chlordane.

We estimated children's and adults' maximum exposure to chlordane by ingestion if, in the future, contaminated ground water is used as a drinking water source. Our exposure estimate is less than the ATSDR minimal risk level (MRL) for short-term (<14 days), intermediate-term (15-364 days), and long-term (> 365 days) exposure. Therefore, we would not expect any illnesses from possible future exposures to chlordane in ground water.

Children playing in the ditch that receives stormwater runoff from the site may have been exposed to chlordane in the water and sediments by skin absorption. Although chlordane is absorbed across the skin, because the rate is unknown, exposure cannot be estimated.

Some people living near this site may have been exposed to chlordane by breathing contaminated dust. Since air monitoring data are nonexistent, the probability of illness from breathing chlordane contaminated dust is unknown. Because of its low volatility, it is unlikely that chlordane caused the symptoms reported by residents along the Wayman Street ditch (nausea, headaches, dizziness). It is more likely that these symptoms were caused by the volatile carrier/solvents used to dissolve this pesticide.

4.4.1.6 **DDT/DDE/DDD (total)** - Studies have shown that oral exposure to DDT in animals can cause liver cancer. Studies of DDT-exposed workers did not show increases in cancers. These studies, however, had problems or flaws so possible increases in cancer may not have been detected. The U.S. Department of Health and Human Services has determined that DDT may reasonably be anticipated to be a human carcinogen (ATSDR 1994b). Based on extrapolation from animal studies, we estimate that lifetime exposure to on-site surface soil or ground water would result in a moderate increased risk of cancer. Lifetime exposure to off-site surface soil or ground water is not likely to cause cancer.

Lifetime exposures to DDT/DDE/DDD in either on-site or off-site surface soil and ground water are unlikely to cause any noncancerous illnesses. Estimating the likelihood of illness from touching DDT/DDE/DDD-contaminated soil/sediments or breathing DDT/DDE/DDD-contaminated air is not possible because the rate of skin absorption is unknown and air monitoring data are nonexistent.

4.4.1.7 **Endosulfan (I, II, sulfate)** - People who accidentally eat small amounts of contaminated surface soil or drink ground water either on- or off-site are unlikely to become ill from the pesticide endosulfan. Estimating the likelihood of illness from touching endosulfan-contaminated soil/sediments or breathing endosulfan-contaminated air is not possible because the rate of skin absorption is unknown and air monitoring data are nonexistent. Because of its low volatility, it is unlikely that endosulfan caused the symptoms reported by residents along the Wayman Street ditch (nausea and dizziness). It is more likely that these symptoms were caused by the volatile carriers/solvents used to dissolve this pesticide. We do not know if endosulfan causes cancer in people. The U.S. Department of Health and Human Services has not classified endosulfan as to its ability to cause cancer (ATSDR 1998b).

The maximum dose we estimated for children drinking on-site ground water and accidentally ingesting small amounts of on-site surface soil slightly exceeds the long-term (> 365 days) ATSDR MRL. This MRL, however, is based on a dose from a one-year feeding study of dogs that failed to find any effects on the liver (ATSDR 1998b).

4.4.1.8 **Hexachlorobenzene** - The maximum dose we estimated for children accidentally ingesting small amounts of this pesticide in on-site surface soil is similar to the dose causing changes in the liver and in the number of blood cells in rats after long-term feeding studies (ATSDR 1996a). Estimating the likelihood of illness from touching hexachlorobenzene-contaminated soil/sediments or breathing hexachlorobenzene-contaminated air is not possible because the rate of skin absorption is unknown and air monitoring data are nonexistent. Hexachlorobenzene was not detected in any off-site soil, sediment, surface water, or ground water samples.

The U.S. Department of Health and Human Services has determined that hexachlorobenzene may reasonably be expected to be a carcinogen. Based on extrapolation from animal studies, we estimate that incidental ingestion of hexachlorobenzene in on-site surface soil over a lifetime may cause cancer. We estimate that drinking hexachlorobenzene in on-site ground water over a lifetime would not cause cancer.

4.4.1.9 **Hexachlorocyclohexane (all isomers)** - Hexachlorocyclohexane is also known as benzene hexachloride or "BHC." The gamma isomer is well known by its trade name "Lindane." People who in the future drink contaminated off-site ground water, and people who accidentally eat small amounts of contaminated off-site surface soil are unlikely to become ill from the pesticide hexachlorocyclohexane. Although the concentrations of hexachlorocyclohexane in one fish from Itchepackesassa Creek are unlikely to cause illness, additional fish samples are necessary to characterize the public health threat from fish consumption.

It is not known what noncancerous illnesses, if any, might be caused in people exposed to hexachlorocyclohexane in on-site surface soil and on-site ground water. The maximum hexachlorocyclohexane dose we estimated for children and adults drinking on-site ground water or children accidentally ingesting small amounts of on-site surface soil is similar to the dose causing changes in the immune system of mice after intermediate-term feeding studies. The same dose in rats, however, did not cause any illness (ATSDR 1997b).

Estimating the likelihood of illness from touching hexachlorocyclohexane-contaminated soil/sediments or breathing hexachlorocyclohexane-contaminated air is not possible because the rate of skin absorption is unknown and air monitoring data are nonexistent. Because of its low volatility, it's unlikely that hexachlorocyclohexane caused the symptoms reported by residents along the Wayman Street ditch (eye/respiratory irritation, headaches, dizziness). It is more likely that these symptoms were caused by the volatile carrier/solvents used to dissolve these pesticides.

After long-term exposure to hexachlorocyclohexane, mice and rats develop liver cancer. The ability of hexachlorocyclohexane to cause cancer in humans is not known. The U.S. Department of Health and Human Services, however, has determined that hexachlorocyclohexane can reasonably be anticipated to cause cancer in humans. Extrapolating from animal studies, we estimate that drinking hexachlorocyclohexane in on-site ground water over a lifetime would cause cancer (ATSDR 1997b).

4.4.1.10 **Nitrate** - Drinking either on- or off-site ground water contaminated with the highest concentration of nitrate would likely be fatal to infants less than three months old. Because of low acidity (high pH), bacteria in the stomach of newborn infants convert nitrates to nitrites. Nitrites then combine with hemoglobin in the blood preventing it from carrying oxygen from the lungs to the body. This causes methemoglobinemia ("blue baby" syndrome) which is fatal if not treated quickly (NAS 1977). Because of the high concentrations of dissolved solids, ground water on and near this site would, however, be distasteful and difficult to drink.

4.4.1.11 **Sulfate** - Drinking either on- or off-site ground water contaminated with sulfate would likely cause diarrhea (NAS 1977). Because of the high concentrations of dissolved solids, ground water on and near this site would, however, be distasteful and difficult to drink.

4.4.1.12 **Toxaphene** - People who in the future drink on- or off-site ground water or people who accidentally eat small amounts of on- or off-site surface soil are unlikely to suffer any noncancerous illness from the pesticide toxaphene (ATSDR 1996b). Although the concentrations of toxaphene in one fish from Itchepackesassa Creek are unlikely to cause illness, additional fish samples are necessary to characterize the public health threat from fish consumption.

There is no evidence that toxaphene causes cancer in people but animal evidence suggests that it could. After long-term exposure to toxaphene, rats and mice develop thyroid and liver cancer. Extrapolating from these animal studies, we estimate that drinking toxaphene in on- and off-site ground water or incidental ingestion of on-site surface soil over a lifetime would cause cancer (ATSDR 1996b).

Estimating the likelihood of illness from touching toxaphene-contaminated soil/sediments or breathing toxaphene-contaminated air is not possible because the rate of skin absorption is unknown and air monitoring data are nonexistent.

4.4.2 Risk of Illness, Dose Response/Threshold and Uncertainty - In Appendix C we discuss limitations on estimating the risk of illness. In Appendix C we discuss the theory of dose response and the concept of thresholds. Also in Appendix C, we discuss the sources of uncertainty inherent in public health assessments.

4.5 Children and Other Unusually Susceptible Populations

Small children may have greater exposures to environmental contaminants than adults. Pound for pound, children drink more water, eat more food, and breathe more air than adults. For example, children in the first six months of life drink seven times as much water per pound as the average adult. Children's exposure to contaminants in the environment is also greater because they play close to the ground. In addition, children may accidentally wander or deliberately trespass onto restricted locations. The obvious implication for environmental health is that children can have much greater "doses" than adults to contaminants that are present in soil, water, and air (ATSDR 1998c). For these reasons, we gave special consideration to children's health in this assessment.

Before birth, children are forming the body organs that need to last a lifetime. This is the time when exposure to contaminants may lead to serious injury or illness. Injury during certain periods of fetal growth and development may lead to malformation of organs (teratogenesis), disruption of function, and premature death. Exposure of the mother leads to exposure of the fetus since some contaminants (such as aldrin/dieldrin and hexachlorocyclohexane) cross the placental barrier (ATSDR 1998c). The estimated exposure to aldrin/dieldrin and hexachlorocyclohexane at this site, however, is unlikely to have caused birth defects.

If newborn infants were exposed to either on-site or off-site ground water, they would be at risk for nitrate poisoning. Newborn infants (0-3 months old) are especially susceptible to nitrate. Giving water, either plain or mixed with formula, with more than 10 milligrams nitrate per liter to a newborn can cause methemoglobinemia ("blue baby" syndrome) which is fatal if not treated quickly.

5.0 COMMUNITY HEALTH CONCERNS

In this section we address community health concerns with our findings above.

1. In May 1983, the Lakeland Fire Department received about 200 telephone calls from nearby residents complaining of chest pains and difficulty breathing. The fire department attributed these complaints to a fire in a vat at Landia containing azinphos-methyl.

About 200 people living near the site may have inhaled this organophosphate pesticide, its carrier/solvent, and/or their breakdown products during the May 1983 fire at Landia. Smoke from most fires can cause difficulty breathing and resulting chest pains. Determining the probability of illness from this exposure is not possible because air monitoring data are nonexistent. Reported symptoms (chest pains and difficulty breathing), however, could have been caused by smoke, azinphos-methyl, its carrier/solvent, and/or their breakdown products.

2. In September 1983, residents along Wayman Street, south of the site, complained about a strong, obnoxious, "rotten cabbage" pesticide odor coming from the ditch behind their houses. They complained this odor caused nausea, headaches, dizziness, and eye and respiratory irritation. Some complained of skin rashes. One resident reported "feeling sick" after getting water from the ditch on her hands. Residents were concerned that exposure to pesticides in this ditch might cause other illnesses.

Because there are no air monitoring data, we are unable to assess the probability of illness from inhalation of vapors from the ditch that receives stormwater runoff from the site. Because of their low volatility, it's unlikely that the pesticides aldrin/dieldrin, chlordane, endosulfan, or hexachlorocyclohexane found in the ditch caused the reported symptoms (nausea, headaches, dizziness, and eye/respiratory irritation). It is more likely, however, that these symptoms were caused by the volatile carrier/solvents used to dissolve these pesticides. Because the rate of skin absorption is unknown, we are unable to estimate the probability of illness from touching the contaminated ditch water.

3. Some community members have complained of the number of cancers in the area.

Estimating the likelihood of cancer from breathing contaminated air or touching contaminated soil or sediments is not possible because air monitoring data are nonexistent and the rate of skin absorption is unknown. Accidentally eating small amounts of off-site surface soil is unlikely to cause cancer.

If however, in the future, adults drink on-site or off-site ground water or accidentally eat (incidental ingestion) small amounts of on-site surface soil for long periods (> 365 days), they are likely to develop skin, liver, lung, bladder, kidney, and thyroid cancer.

The Florida Department of Health, Bureau of Environmental Epidemiology will review area cancer rates contained in the Florida Cancer Data System.

4. Some nearby residents have complained of kidney problems.

Exposure to arsenic is associated with kidney cancer in people. Our estimate of an adult's maximum long-term (>365 days) exposure to arsenic by incidental ingestion of on-site surface soil or on- or off-site ground water would likely cause kidney cancer. Since, however, site access and ground water use is now restricted, continued exposures to arsenic and resulting kidney cancer are unlikely. None of the other estimated exposures to contaminants from this site are known to cause other kidney or urinary tract problems.

5. Some nearby residents have complained of warts on the soles of the feet.

Perhaps the single most characteristic effect of long-term oral exposure to inorganic arsenic is a pattern of skin changes. This includes a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. While these skin changes are not considered a health concern in their own right, some corns may ultimately develop into skin cancer.

Although accidental (incidental) ingestion of arsenic-contaminated soil outside the site is unlikely to cause these skin changes, accidentally eating small amounts of arsenic-contaminated surface soil from on the site or drinking contaminated ground water over a lifetime would significantly increase the risk of these warts, and left untreated, skin cancer. Since, however, site access and ground water use is now restricted, continued exposures to arsenic and resulting skin cancer are unlikely.

6. Some nearby residents have complained of children having abdominal pain/stomachaches, diarrhea, and vomiting.

Our estimate of a child's maximum intermediate to long-term (>14 days) exposure to arsenic by incidental ingestion of on-site surface soil or by drinking on- or off-site ground water would likely cause abdominal pain/stomachaches, diarrhea, and vomiting. Since, however, site access and ground water use is now restricted, continued exposures to arsenic and resulting abdominal pains/stomachaches, diarrhea, and vomiting are unlikely.

7. Some nearby residents have complained of a burning smell that caused sore throats.

Fires, such as the one that occurred at Landia in 1983, can produce irritating smoke and gasses.

Our estimate of a child's maximum intermediate-term (>14 days) exposure to arsenic by incidental ingestion of on-site surface soil or by drinking on- or off-site ground water could also cause a sore throat. Since, however, site access and ground water use is now restricted, continued exposures to arsenic and resulting sore throats are unlikely.

8. Some nearby residents have complained of skin tingling, especially in their legs and lips.

Our estimate of an adult's future maximum long-term (>365 days) exposure to arsenic by incidental ingestion of on-site surface soil or drinking on- or off-site ground water would likely cause tingling in the hands and feet. Since, however, site access and ground water use is now restricted, continued exposures to arsenic and resulting skin tingling are unlikely.

9. Some nearby residents have complained of lethargy.

Our estimate of an adult's maximum long-term (>365 days) exposure to arsenic by incidental ingestion of on-site surface soil or drinking on- or off-site ground water would likely cause anemia/lethargy. Since, however, site access and ground water use is now restricted, continued exposures to arsenic and resulting anemia/lethargy are unlikely.

10. Some nearby residents have complained of blue baby syndrome.

Blue baby syndrome or methemoglobinemia is caused by using nitrate-contaminated water to mix formula for infants less than three months old. Because of low acidity (high pH), bacteria in the stomach of newborn infants convert nitrates to nitrites. Nitrites then combine with hemoglobin in the blood preventing it from carrying oxygen from the lungs to the body. Blue baby syndrome is fatal if not treated quickly. Drinking either on- or off-site ground water contaminated with the highest concentration of nitrate would likely be fatal to infants less than three months old. Because of the high concentrations of dissolved solids, drinking ground water on or near this site would be distasteful and difficult. Since nearby residents now use municipal water, blue baby syndrome is unlikely.

11. Some nearby residents have complained of chronic bronchitis.

Chronic bronchitis is inflammation of the mucous membrane of the bronchial tubes characterized by cough, hypersecretion of mucus, and expectoration of sputum over a long period. It is associated with frequent bronchial infection usually due to inhalation, over a prolonged period, of air contaminated by dust or by noxious gases of combustion such as cigarette smoke. About 3 percent of the U.S. population suffers from chronic bronchitis. Most are older than 40 and male sufferers outnumber female suffers two to one. The disease is most prevalent in industrial cities and in smokers (Stedman's 1990, AMA 1989). Although in the past nearby residents have reported severe dust and airborne contamination coming from the site, the lack of air quality measurements prevents determining the cause of chronic bronchitis.

12. Some nearby residents have complained of asthma.

Asthma is an allergic narrowing of the airways of the lungs resulting in difficult breathing. Asthma is characterized by recurrent attacks of breathlessness and accompanied by wheezing when breathing out. The main symptoms are breathlessness, wheezing, a dry cough, and a feeling of tightness in the chest. It varies in severity from day to day and from hour to hour. Attacks may be most frequent in the early morning. Asthma occurs in about 5 percent of the overall population and 10 percent of children. Although asthma can develop at any age, it frequently starts in childhood and clears up or becomes less severe in early adulthood. More than half of the affected children grow out of asthma completely by the age of 21. In most of the remainder, attacks become less severe as they grow older. Asthma attacks are usually triggered by pollens, house dust, house-dust mites, animal fur, dander, or feathers. It can also be triggered by respiratory infections, tobacco smoke, or other air pollutants (AMA 1989). Although in the past nearby residents have reported severe dust and airborne contamination, the lack of air quality measurements prevents determining if contaminants from this site triggered any asthma attacks.

13. Some nearby residents have complained of ulcerative colitis.

Ulcerative colitis is a chronic inflammation and ulceration of the lining of the colon and rectum. The cause is unknown. In the U.S. the disease affects about 0.5 percent of the population. It is most common in young and middle age adults. The main symptom is bloody diarrhea; the feces may also contain pus and mucus. In severe cases, diarrhea and bleeding are extensive and there may be abdominal pain and tenderness, fever, and general malaise. The principal danger of severe ulcerative colitis is anemia, cause by the loss of blood. Usually, medical treatment with corticosteroid and sulfonamide drugs effectively controls the disease (AMA 1989). None of the exposures we estimated at this site are known to cause ulcerative colitis.

14. Some nearby residents have complained of severe allergies/skin rashes.

An allergy is a collection of disease symptoms caused by exposure of the skin to a chemical, of the respiratory system to particles of dust or pollen, or of the digestive system to a particular food. Allergies are exaggerated reactions of the immune system and occur only on the second or subsequent exposure to the offending agent, after the first contact has sensitized the body. Many common illnesses such as asthma are caused by allergic reactions.

Normally, the function of the immune system is to recognize antigens (proteins on bacteria and viruses) and to form antibodies that will destroy them. In allergies, the immune system forms antibodies against harmless substances. Pollen from flowers, grasses, and trees can cause allergies. Animal dander, house dust, house-dust mites, yeasts, certain drugs and foods, and bee/wasp stings can also cause allergic reactions. Milk, eggs, shellfish, dried fruits, nuts, and certain food dyes can cause food allergies. These plant and animal products cause the immune system to produce immunoglobulin antibodies. Immunoglobulin antibodies then coat special mast cells in the skin, stomach, lungs, and upper respiratory airways. When the body is exposed to these plant and animal products again, the mast cells rupture releasing histamines. Histamines then can cause hives, rashes, or itchy skin; sneezing; hay fever; asthma; eye inflammation; vomiting and diarrhea; or anaphylactic shock.

It is not known why certain individuals and not others get allergies. About 12 percent of the population seems to have an inherited predisposition. The most effective treatment for allergies is avoiding the plant or animal material that triggers the allergic reaction. Immunotherapy, antihistamine drugs, and corticosteroid drugs are useful in treatment of allergies (AMA 1989).

None of the exposures we estimated at this site are known to cause severe allergies/skin rashes.

15. Some nearby residents have complained of diabetes.

Diabetes mellitus is a disorder in which the pancreas produces insufficient or no insulin, the hormone responsible for the absorption of glucose into cells for their energy needs and into the liver and fat cells for storage. As a result, glucose in the blood becomes abnormally high, causing excessive urination, constant thirst, and constant hunger. The body's inability to store or use glucose causes weight loss and fatigue. Diabetes mellitus also results in disordered lipid metabolism and accelerated degeneration of small blood vessels.

Non-insulin diabetes (type II) is usually of a gradual onset and occurs mainly in people older than 40. Insulin is produced, but not enough to meet the body's needs, especially when the person is overweight. Usually, insulin-replacement injections are not required; the combination of dietary measures, weight reduction, and oral medication keeps the condition under control. Non-insulin dependent diabetes occurs in as many as 2 percent of the population.

Complications eventually develop in most diabetics. They include damage to the retina, the light-sensitive area at the back of the eye, and the blood vessels serving it; damage to nerve fibers; and kidney damage (AMA 1989).

None of the exposures we estimated at this site are known to cause diabetes.

16. Some nearby residents have complained of fibromyalgia syndrome.

Fibromyalgia is a chronic musculoskeletal pain and fatigue disorder characterized by fatigue, muscle soreness, and headaches. Pain tends to concentrate in tender points clustered around the head, neck, shoulders, elbows, buttocks, and knees. In addition, people with fibromyalgia often report sleep disturbance, irritable bowel syndrome, anxiety, memory loss, depression, difficulty concentrating, and tingling or numbness in the extremities. Fibromyalgia is sometimes misdiagnosed as the flu or clinical depression. Fibromyalgia affects about 2 percent of the American population -- three to six million people. Two-thirds of the sufferers are women who typically develop the syndrome during their 30s and 40s. No one is certain what causes the disorder, but research suggests it may be hereditary. None of the exposures we estimated at this site are known to cause fibromyalgia syndrome.

17. Some nearby residents have complained of heart trouble and high blood pressure.

None of the exposures we estimated at this site are known to cause heart trouble or high blood pressure.

18. Some nearby residents have complained of thyroid problems.

None of the exposures we estimated at this site are known to cause thyroid problems.

19. Some nearby residents have complained of weak immune systems.

None of the exposures we estimated at this site are known to cause immune system problems.

20. Some nearby residents have complained of birth defects.

None of the exposures we estimated at this site are known to cause birth defects.

21. One former resident complained that two recently born grandchildren have problems with being able to sit up.

None of the exposures we estimated at this site are known to interfere with the development of balance or the ability of infants to sit up.

22. Some nearby residents who live along the ditch draining the site are concerned that sediments dredged from the ditch or carried by flood water are now deposited along the banks. They are concerned that contact with these sediments along the ditch banks is a health risk.

The surface soil along the drainage ditch banks has not been tested. Additional surface soil samples should be collected and analyzed for site-related pesticides and arsenic.

6.0 CONCLUSIONS

The Landia Chemical Company/Florida Favorite Fertilizer Company hazardous waste site was an indeterminate public health hazard for past exposures. Assessing the probability of illness from past inhalation of contaminated dust or vapors is not possible because of the lack of air monitoring data.

Currently there is no apparent public health hazard for nearby residents. Site access is restricted and there is no current use of the contaminated ground water.

This site may be a public health hazard in the future. If in the future people are exposures to on-site surface soil or ground water they will likely become ill.

1. If, in the future, children accidentally eat (incidental ingestion) small amounts of arsenic-contaminated surface soil from on the site for short or intermediate periods (<365 days), they are likely to suffer vomiting, diarrhea, gastrointestinal bleeding, abdominal pain, fatigue, rapid heart rate, fever/chills, sore throat, memory loss, mild loss of feeling in the legs, tingling in the legs, and dark warts on the palms of the hands and soles of the feet.

If, in the future, adults accidentally eat (incidental ingestion) small amounts of arsenic-contaminated surface soil from on the site for long periods (> 365 days), they are likely to suffer abdominal pain, anemia, enlargement of the liver, tingling in the hands/feet, and thickening/darkening of the palms of the hands and soles of the feet. These adults may also suffer skin, liver, lung, bladder, and kidney cancer from arsenic and thyroid/liver cancer from toxaphene.

2. If, in the future, newborn infants (0-3 months old) drink nitrate-contaminated groundwater from on or near the site they are likely to suffer methemoglobinemia ("blue baby" syndrome) which is fatal if not treated quickly. The City of Lakeland supplies the site and nearby areas with drinking water.

If, in the future, children drink arsenic-contaminated ground water from on or near the site for a short or intermediate period (<365 days), they are likely to suffer vomiting, diarrhea, gastrointestinal bleeding, abdominal pain, fatigue, rapid heart rate, fever/chills, sore throat, memory loss, mild loss of feeling in the legs, tingling in the legs, and dark warts on the palms of the hands and soles of the feet.

If, in the future, adults drink arsenic-contaminated ground water from on or near the site for long periods (> 365 days), they are likely to suffer abdominal pain, diarrhea, anemia, enlargement of the liver, tingling in the hands and feet, and thickening/darkening of the palms of the hands and soles of the feet. These adults may also suffer skin, liver, lung, bladder, and kidney cancer from arsenic; thyroid/liver cancer from toxaphene; and liver cancer from hexachlorocyclohexane.

3. Estimating the likelihood of illness from inhalation of contaminated dust from the site or vapors from the ditch that receives stormwater runoff from the site is not possible because air monitoring data are nonexistent. Because of their low volatility, it is unlikely that aldrin/dieldrin, chlordane, endosulfan, or hexachlorocyclohexane caused the symptoms reported by residents along the Wayman Street ditch (nausea, headaches, dizziness, and eye and respiratory irritation). It is more likely that these symptoms were caused by the volatile carrier/solvents used to dissolve these pesticides.

About 200 people living near the site may have inhaled this organophosphate pesticide, its arrier/solvent, and/or their breakdown products during the May 1983 fire at Landia. Smoke from most fires can cause difficulty breathing and resulting chest pains. Determining the probability of illness from this exposure is not possible because air monitoring data are nonexistent. Reported symptoms (chest pains and difficulty breathing), however, could have been caused by smoke, azinphos-methyl, its carrier/solvent, and/or their breakdown products.

4. In the future, soil excavation for site cleanup could create pesticide-contaminated dust. If not controlled, people in nearby homes and businesses could be exposed.

5. The geographical extent of off-site ground water contamination has not been determined, especially for soluble contaminants such as nitrate.

6. Off-site surface-soil quality in the neighborhood south of the site has not been adequately tested. The quality of surface soil along the banks of the ditch that drains the site has not been tested.

7. Estimating the likelihood of illness from touching contaminated soil, water, or sediments is not possible because the rate of skin absorption is unknown. Data on sediment contamination in the ditches that receive stormwater runoff from this site are insufficient.

8. One fish sample collected from the Itchepackesassa Creek in 1983 is inadequate to characterize fish contamination in downstream water bodies. Eating the amount of pesticides measured in this one fish sample are not likely, however, to cause illness.

9. Between 1940 and 1987 about 100 workers were exposed to pesticide dust at this site. This report does not estimate either exposure or the possibility of illness for these workers. Worker health and safety are the responsibility of the federal Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH).

7.0 RECOMMENDATIONS

1. Ensure that nearby residents do not have access to on-site surface soil. Restrict site access and future land use to prevent long-term exposures to on-site surface soil.

2. Prevent use of contaminated ground water as a public or private drinking water supply. Restrict permits for new wells near ground water contamination. Encourage residents near ground water contamination not to drink from their irrigation wells.

3. Collect at least three 24-hour off-site air samples downwind and analyze for arsenic and site-related pesticides to estimate current residential exposures. Collect these samples during a gentle north wind. Collect one 24-hour upwind, background air sample for comparison.

4. Control dust generation and conduct intensive air monitoring during any future cleanup that would disturb on-site soil and create dust.

5. Determine the geographical extent of off-site ground water contamination.

6. Collect additional off-site surface-soil samples (0-3 inches deep) in the neighborhood south of the site and analyze for site-related chemicals. Collect one surface soil sample from the bank of the ditch draining the site at each individual property for the first 6,000 feet starting at the site boundary. Analyze these samples for site-related chemicals.

7. Collect about 20 additional sediment grab samples from the ditch that drains the site. Collect these sediment samples every 500 feet starting at Olive Street and continuing through the stormwater pond on the north side of Highland Street between Jensen and Lebanon Roads. Analyze for arsenic and site-related pesticides.

8. Collect at least three fish from the pond on the north side of Highland Street between Jensen and Lebanon Roads. Collect fish likely caught for human consumption (bass, brim, perch, etc.) and analyze for arsenic and site-related pesticides.

9. The federal Occupational Safety and Health Administration (OSHA) or the National Institute for Occupational Safety and Health (NIOSH) should consider a health investigation for former and current workers.

8.0 PUBLIC HEALTH ACTION PLAN

This section describes what ATSDR and/or DOH plan to do at this site. The purpose of a Public Health Action Plan is to reduce any existing health hazards and to prevent any from occurring in the future. ATSDR and/or DOH will do the following:

1. DOH, Bureau of Environmental Toxicology will inform and educate nearby residents about the public health threat at this site. Specifically, DOH will warn nearby residents not to go on the site and not to use contaminated ground water.

2. DOH, Bureau of Environmental Toxicology will collect fish from the stormwater pond on the north side of Highland Street between Jensen and Lebanon Roads and analyze for arsenic and site-related pesticides.

3. DOH, Bureau of Environmental Toxicology will request the Southwest Florida Water Management District to restrict permits for new wells in or near the area of ground water contamination.

4. DOH, Bureau of Environmental Toxicology will forward a copy of this assessment to the federal Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) to determine if a health investigation of former and current workers is warranted.

5. DOH, Bureau of Environmental Toxicology will continue to work with EPA and DEP to ensure that the site is cleaned up to protect public health.

6. DOH, Bureau of Environmental Toxicology will inform and educate local health care professionals about this site, contaminants of concern, potential illnesses, and medical treatment.

7. DOH, Bureau of Environmental Epidemiology will review area cancer rates contained in the Florida Cancer Data System.

8. When additional information becomes available, the DOH, Bureau of Environmental Toxicology, will evaluate it to determine the public health threat and what additional recommendations, if any, to make.

9.0 SITE TEAM/AUTHORS

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APPENDIX A. FIGURES

Figure 1. Site Location Map

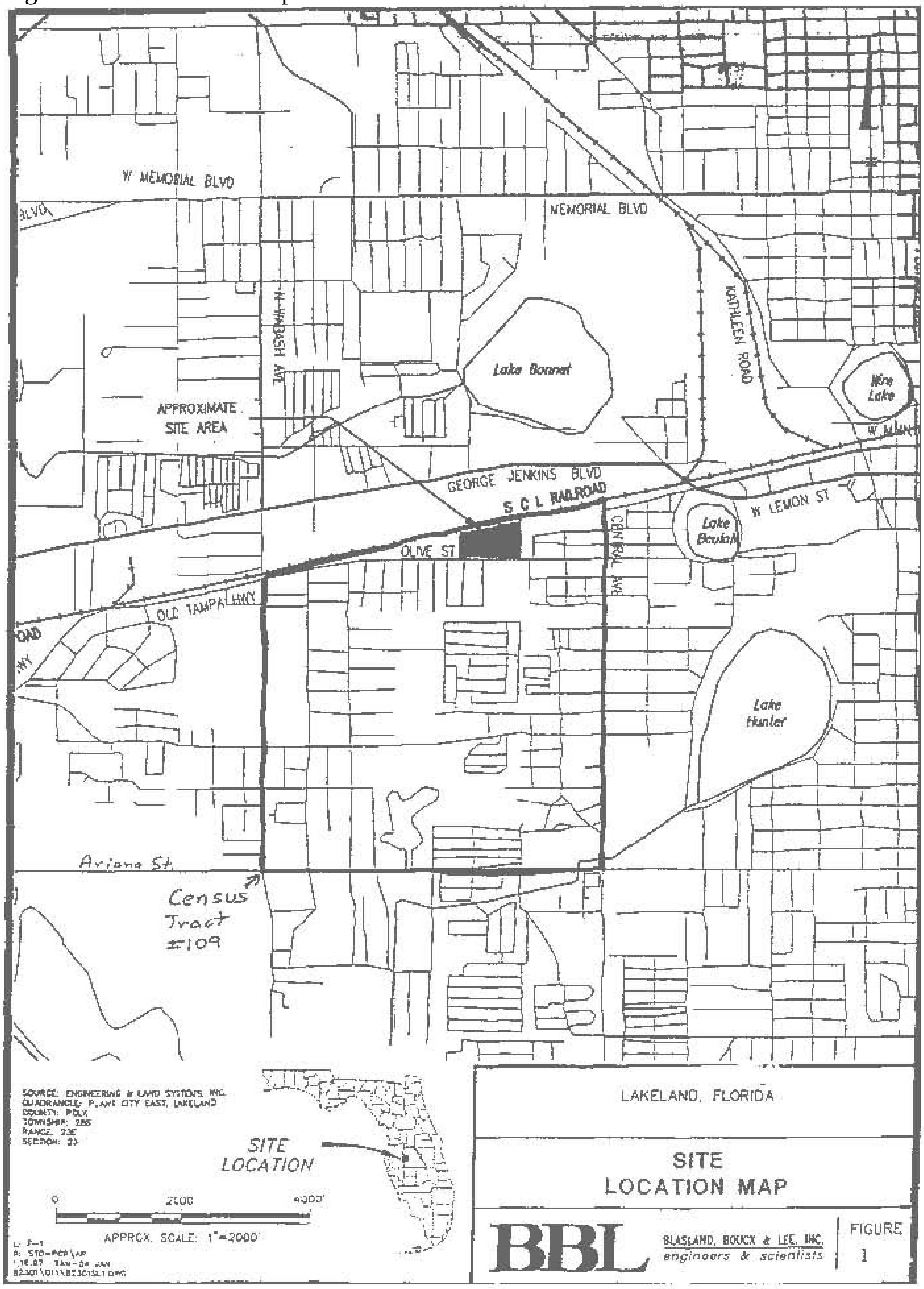


Figure 2. Monitoring Well Locations

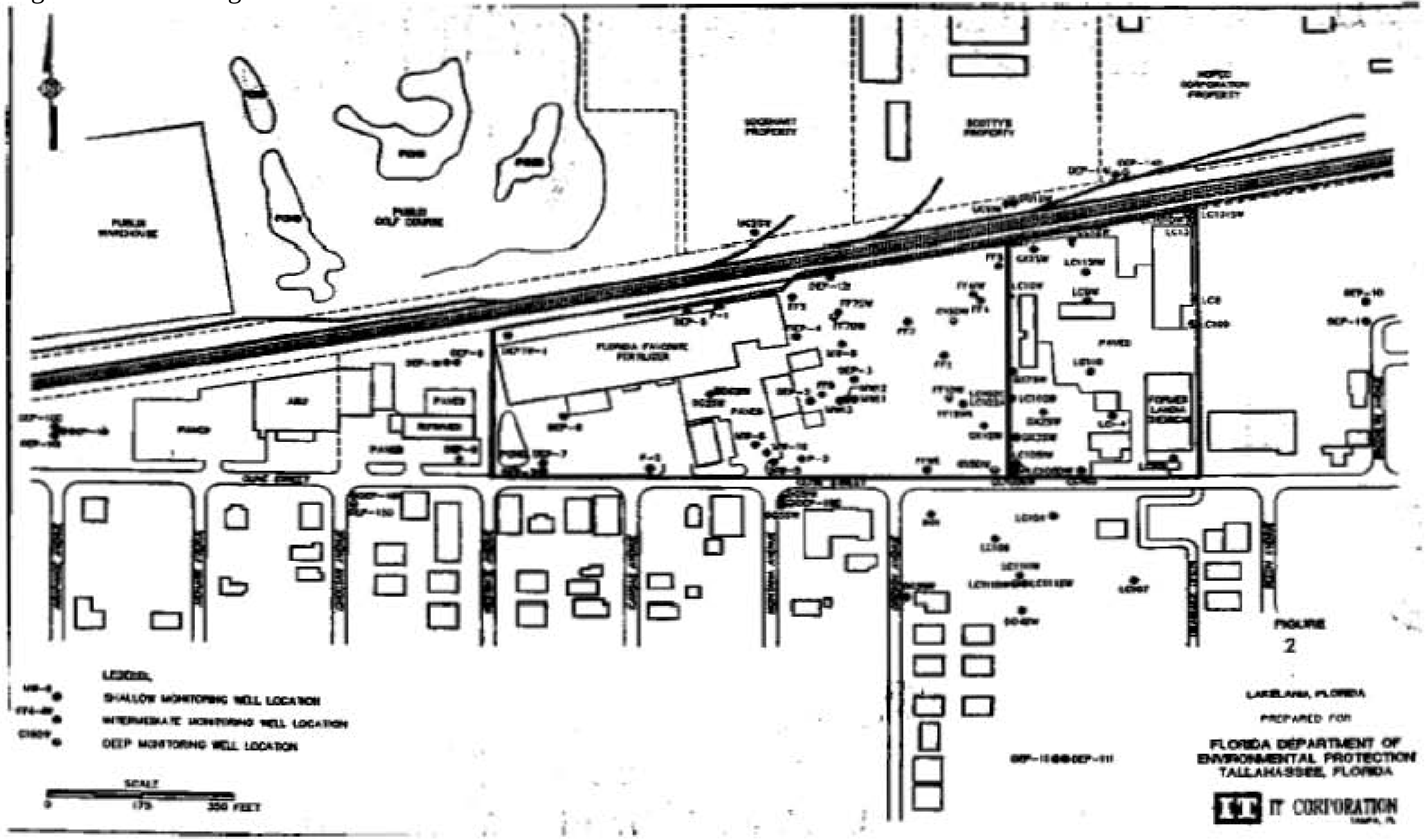
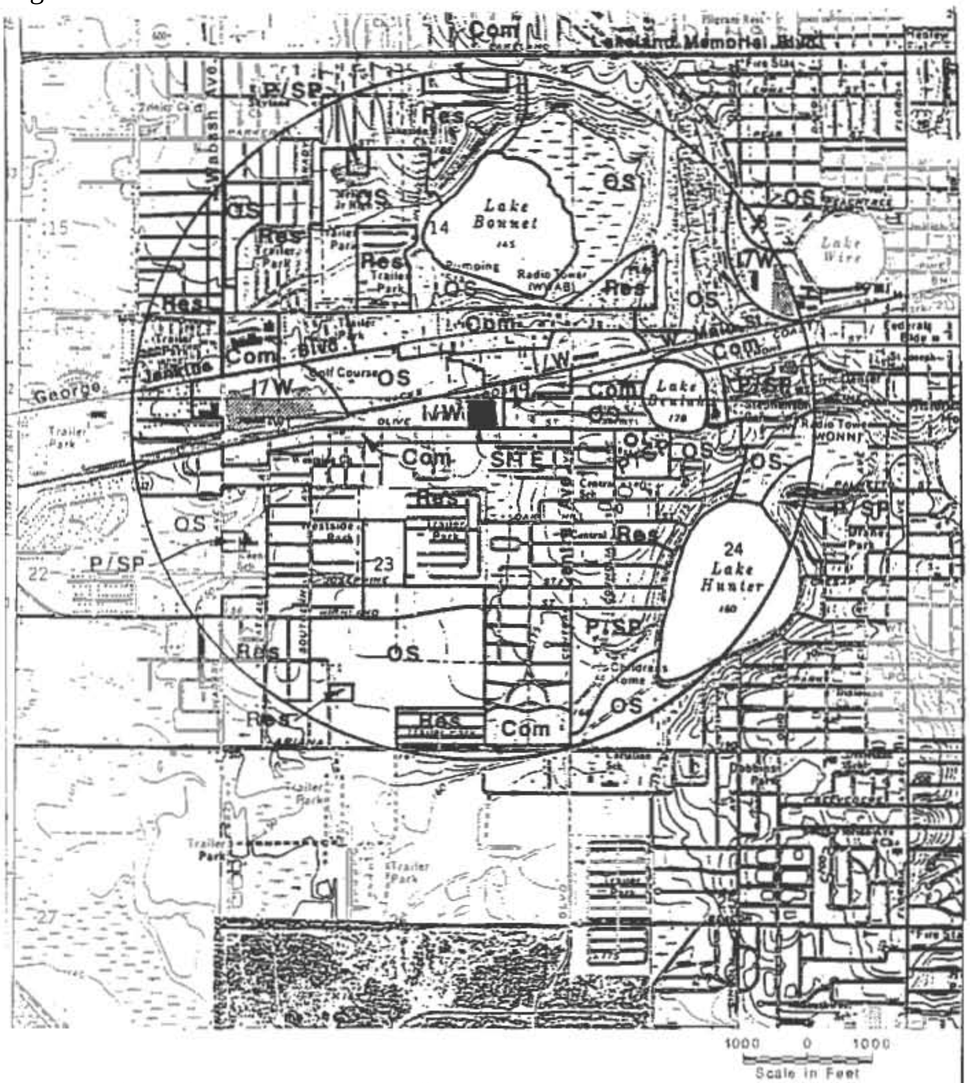


Figure 3. Land Use

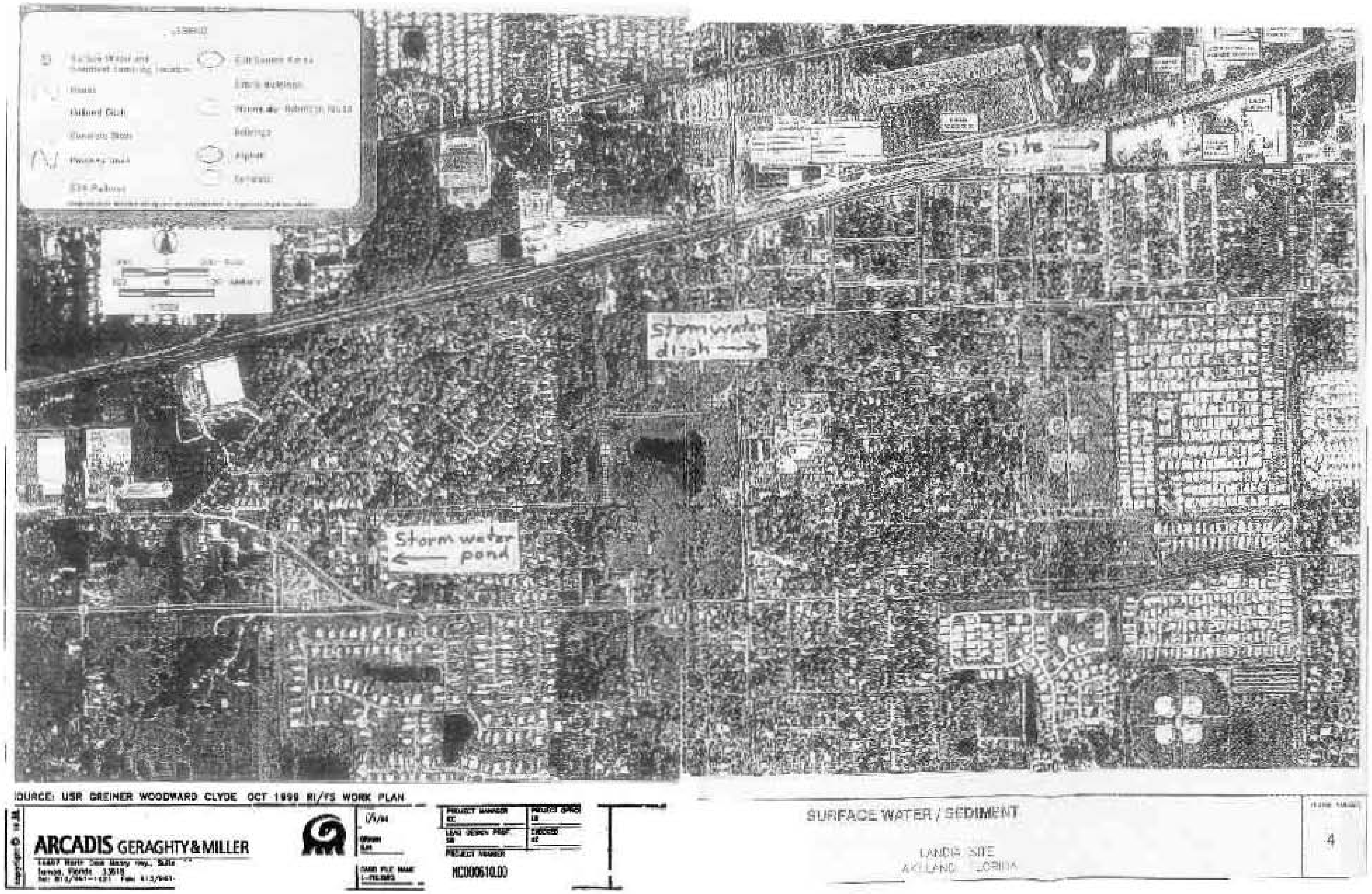


Res Residential
I/W Industrial/Warehouse
Com Commercial
OS Open Space
P/SP Public/Semi-Public Facilities

LAND USE MAP

FIGURE 3

Figure 4. Surface Water/Sediment



APPENDIX B. TABLES

Table 1.

Maximum Concentrations in On-Site Surface Soils (0-1 Foot Deep)

Contaminants of Concern	Maximum Concentration (mg/kg)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(mg/kg)	Source
Aldrin/Dieldrin	530	66/115	0.04	ATSDR 1999
Arsenic	7,186	50/105	0.5	ATSDR 1999
Azinphos-methyl	Not analyzed	-----------------	----	-----
Benzene	Not detected	0/86	20	ATSDR 1999
Chlordane (total)	445	91/115	0.5	ATSDR 1999
DDT/DDE/DDD (total)	2,268	82/115	2	ATSDR 1999
Endosulfan (I, II, sulfate)	280	2/115	100	ATSDR 1999
Hexachlorobenzene	2,448	3/10	0.4	ATSDR 1999
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	2,078	44/129	0.4	ATSDR 1999
Nitrate	4,000	0/35	80,000	ATSDR 1999
Sulfate	36,000	0/35	500,000	ATSDR 1999
Toxaphene	2,000	53/129	0.6	ATSDR 1999

Source: PELA 1984a, DEP 1986, CH2MHill 1988, BBL 1997, IT 1999, TTEM 1999
mg/kg = milligrams per kilogram
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

Table 2.

Maximum Concentrations in On-Site Ground Water (All Depths)

Contaminants of Concern	Maximum Concentration (mg/L)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(mg/L)	Source
Aldrin/Dieldrin	0.002	10/104	0.000002	ATSDR 1999
Arsenic	1.5	49/89	0.00002	ATSDR 1999
Azinphos-methyl	Not analyzed	------------	----------	-----
Benzene	0.02	19/120	0.001	ATSDR 1999
Chlordane (total)	0.006	9/104	0.00003	ATSDR 1999
DDT/DDE/DDD (total)	0.081	34/104	0.0001	ATSDR 1999
Endosulfan (I, II, sulfate)	0.02	1/104	0.02	ATSDR 1999
Hexachlorobenzene	0.005	1/104	0.00002	ATSDR 1999
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	0.57	66/104	0.00002	ATSDR 1999
Nitrate	2,100	22/83	20	ATSDR 1999
Sulfate	32,000	58/83	500	ATSDR 1999
Toxaphene	0.06	3/104	0.00003	ATSDR 1999

Source: PELA 1984a, PELA 1984b, PELA 1984c, CH2MHill 1988, Missimer 1992, Delta 1994, IT 1999
mg/L = milligrams per liter
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

Table 3.

Maximum Concentrations in Off-Site Surface Soils (0-1 Foot Deep)

Contaminants of Concern	Maximum Concentration (mg/kg)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(mg/kg)	Source
Aldrin/Dieldrin	370	11/25	0.04	ATSDR 1999
Arsenic	0.1	0/18	0.5	ATSDR 1999
Azinphos-methyl	Not analyzed	----------------------	--------	-----
Benzene	Not detected	0/17	20	ATSDR 1999
Chlordane (total)	396	16/25	0.5	ATSDR 1999
DDT/DDE/DDD (total)	103	14/25	2	ATSDR 1999
Endosulfan (I, II, sulfate)	61	0/25	100	ATSDR 1999
Hexachlorobenzene	Not detected	0/5	0.4	ATSDR 1999
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	11	9/25	0.4	ATSDR 1999
Nitrate	8	0/17	80,000	ATSDR 1999
Sulfate	35,000	0/17	500,000	ATSDR 1999
Toxaphene	180	10/25	0.6	ATSDR 1999

Source: PELA 1984a, BBL 1997, IT 1999, TTEM 1999
mg/kg = milligrams per kilogram
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

Table 4.

Maximum Concentrations in Off-Site Ground Water (All Depths)

Contaminants of Concern	Maximum Concentration (mg/L)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(mg/L)	Source
Aldrin/Dieldrin	0.001	4/39	0.000002	ATSDR 1999
Arsenic	0.7	11/38	0.00002	ATSDR 1999
Azinphos-methyl	Not analyzed	-----------------------	-----	-----
Benzene	0.003	1/39	0.001	ATSDR 1999
Chlordane (total)	0.002	4/39	0.00003	ATSDR 1999
DDT/DDE/DDD (total)	0.007	4/39	0.0001	ATSDR 1999
Endosulfan (I, II, sulfate)	0.0002	0/39	0.02	ATSDR 1999
Hexachlorobenzene	Not detected	0/39	0.00002	ATSDR 1999
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	0.028	19/39	0.00002	ATSDR 1999
Nitrate	3,700	7/38	20	ATSDR 1999
Sulfate	3,900	14/39	500	ATSDR 1999
Toxaphene	0.04	3/39	0.00003	ATSDR 1999

Source: PELA 1985, CH2MHill 1988, BBL 1997, IT 1999, DEP 1999
mg/L = milligrams per liter
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

Table 5.

Maximum Concentrations in Off-Site Drainage Ditch Water (Before 11/83)

Contaminants of Concern	Maximum Concentration (mg/L)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(mg/L)	Source
Aldrin/Dieldrin	0.01	3/15	0.000002	ATSDR 1999
Arsenic	Not analyzed	--------------------------	-----	-----
Azinphos-methyl	Not analyzed	--------------------------	-----	-----
Benzene	Not analyzed	--------------------------	-----	-----
Chlordane (total)	0.06	3/15	0.00003	ATSDR 1999
DDT/DDE/DDD (total)	0.03	3/15	0.001	ATSDR 1999
Endosulfan (I, II, sulfate)	52	8/15	0.02	ATSDR 1999
Hexachlorobenzene	Not analyzed	--------------------------	-----	-----
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	15	13/15	0.00002	ATSDR 1999
Nitrate	Not analyzed	--------------------------	-----	-----
Sulfate	Not analyzed	------------------------	-----	-----
Toxaphene	210	11/15	0.00003	ATSDR 1999

Source: OH Materials 1983, PELA 1983
mg/L = milligrams per liter

Table 6.

Maximum Concentrations in Off-Site Drainage Ditch Water (After 11/83)

Contaminants of Concern	Maximum Concentration (mg/L)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(mg/L)	Source
Aldrin/Dieldrin	Not detected	0/15	0.000002	ATSDR 1999
Arsenic	Not detected	0/2	0.00002	ATSDR 1999
Azinphos-methyl	Not analyzed	------------------------	-----	-----
Benzene	Not detected	0/15	0.001	ATSDR 1999
Chlordane (total)	Not detected	0/15	0.00003	ATSDR 1999
DDT/DDE/DDD (total)	Not detected	0/15	0.0001	ATSDR 1999
Endosulfan (I, II, sulfate)	0.032	2/15	0.02	ATSDR 1999
Hexachlorobenzene	Not analyzed	--------------------------	-----	-----
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	0.001	4/15	0.00002	ATSDR 1999
Nitrate	0.8	0/2	20	ATSDR 1999
Sulfate	130	0/2	500	ATSDR 1999
Toxaphene	Not detected	0/15	0.00003	ATSDR 1999

Source: DEP 1983f, UF 1991, IT 1999, DEP 1999
mg/L = milligrams per liter
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

Table 7.

Maximum Concentrations in Off-Site Drainage Ditch Sediments (Before 11/83)

Contaminants of Concern	Maximum Concentration (mg/kg)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(mg/kg)	Source
Aldrin/Dieldrin	1.0	2/3	0.04	ATSDR 1999
Arsenic	Not analyzed	-------------------------	-----	-----
Azinphos-methyl	Not analyzed	-------------------------	-----	-----
Benzene	Not analyzed	-------------------------	-----	-----
Chlordane (total)	3.0	2/3	0.5	ATSDR 1999
DDT/DDE/DDD (total)	0.6	0/3	2	ATSDR 1999
Endosulfan (I, II, sulfate)	17	0/18	100	ATSDR 1999
Hexachlorobenzene	Not analyzed	-------------------------	-----	-----
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	0.5	1/15	0.4	ATSDR 1999
Nitrate	Not analyzed	-------------------------	-----	-----
Sulfate	Not analyzed	-------------------------	-----	-----
Toxaphene	460	15/18	0.6	ATSDR 1999

Source: OH Materials 1983, PELA 1983, EPA 1983
mg/kg = milligrams per kilogram
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

Table 8.

Maximum Concentrations in Off-Site Drainage Ditch Sediments (After 11/83)

Contaminants of Concern	Maximum Concentration (mg/kg)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(mg/kg)	Source
Aldrin/Dieldrin	0.26	3/14	0.04	ATSDR 1999
Arsenic	110	4/4	0.5	ATSDR 1999
Azinphos-methyl	Not analyzed	--------------------------	-----	-----
Benzene	Not detected	0/3	20	-----
Chlordane (total)	3.2	4/14	0.5	-----
DDT/DDE/DDD (total)	1.0	0/14	2	ATSDR 1999
Endosulfan (I, II, sulfate)	0.2	0/14	100	ATSDR 1999
Hexachlorobenzene	Not detected	0/3	0.4	ATSDR 1999
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	0.4	0/14	0.4	ATSDR 1999
Nitrate	Not analyzed	--------------------------	-----	-----
Sulfate	Not analyzed	--------------------------	-----	-----
Toxaphene	27	1/14	0.6	ATSDR 1999

Source: PELA 1984a, UF 1991, TTEM 1999
mg/kg = milligrams per kilogram
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

Table 9.

Maximum Concentrations in Off-Site Fish

Contaminants of Concern	Maximum Concentration (mg/kg)	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
			(m/kg)	Source
Aldrin/Dieldrin	Not detected	0/1	-----	-----
Arsenic	Not analyzed	--------------------------	-----	-----
Azinphos-methyl	Not analyzed	--------------------------	-----	-----
Benzene	Not analyzed	--------------------------	-----	-----
Chlordane (total)	Not detected	0/1	-----	-----
DDT/DDE/DDD (total)	Not detected	0/1	-----	-----
Endosulfan (I, II, sulfate)	Not detected	0/1	-----	-----
Hexachlorobenzene	Not detected	0/1	-----	-----
Hexachlorocyclohexane (benzene hexachloride or BHC) total of all isomers	0.1	-/1	none	-----
Nitrate	Not analyzed	------------------------	-----	-----
Sulfate	Not analyzed	--------------------------	-----	-----
Toxaphene	1.0	-/1	none	-----

Source: DEP 1983e
mg/kg = milligrams per kilogram
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

Table 10.

Completed Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Azinphos-methyl Fire	On-site azinphos-methyl fire	Air	Off-site homes	Inhalation	About 200 nearby residents	May 1983
Drainage Ditch Pesticide Vapors	Pesticides in water from ditch draining the site	Air	Off-site homes along drainage ditch	Inhalation	About 100 residents along ditch draining the site	Past (1940 to 1983)
Drainage Ditch Water	Pesticides in water from site-runoff	Ditch water	Ditch draining the site	Skin absorption	About 50 children	Past (1940 to 1983)
Drainage Ditch Sediments	Pesticides in sediments of ditch draining the site	Ditch sediments	Ditch draining the site	Skin absorption	About 50 children	Past (1940 to 1983)
Fish Consumption	Fish in stormwater ponds and Itchepacke-sassa Creek	Fish	Eating fish from stormwater ponds and Itchepacke-sassa Creek	Ingestion	About 100 people who ate fish from ponds/ Itchepacesassa Creek	Past (1940 to 1983)
Incidental Soil Ingestion	Contaminated off-site soils	Soil	Nearby homes & businesses	Ingestion and skin absorption	About 100 people at nearby homes and businesses	Past, present, and future

Table 11.

Potential Exposure Pathways

PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Ground Water	Contam-inated On-Site Soil	Ground Water	On- and off-site wells (monitor, irrigation, etc.)	Ingestion and skin absorption	About 150 users of about 60 wells within one mile of the site	Future
On-Site Soil	On-Site Surface Soil	Soil	On-site	Incidental ingestion	Depends on future land use changes	Future
Contaminated Dust	Contam-inated On-Site Soil	Soil	Nearby homes and businesses	Inhalation	About 100 people at nearby homes and businesses	Future

Table 12.

Estimated Maximum Exposure Dose (mg/kg/day)

	On-site				Off-site						ATSDR Oral Minimal Risk Level (MRL)
	child		adult		child			adult			
	soil	g.w.	soil	g.w.	soil	g.w.	fish	soil	g.w.	fish	
Aldrin/Dieldrin	0.007	1x10^{-4}	7x10^{-4}	6x10^{-5}	0.005	7x10^{-5}	N.D.	5x10^{-4}	3x10^{-5}	N.D.	3x10^{-5} C* 2x10^{-3} A*
Arsenic	0.1	0.1	0.01	0.04	1x10^{-6}	0.05	N.A.	1x10^{-7}	0.02	N.A.	3x10^{-4} C
Azinphos-methyl	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	none
Benzene	N.D.	0.001	N.D.	6x10^{-4}	N.D.	2x10^{-4}	N.A.	N.D.	9x10^{-5}	N.A.	none
Chlordane (total)	0.006	4x10^{-4}	6x10^{-4}	2x10^{-4}	0.005	1x10^{-4}	N.D.	6x10^{-4}	6x10^{-5}	N.D.	6x10^{-4} C&I 1x10^{-3} A
DDT/DDE/DDD (total)	0.03	0.005	0.003	0.002	0.001	5x10^{-4}	N.D.	1x10^{-4}	2x10^{-4}	N.D.	5x10^{-4} I&A
Endosulfan (I, II, sulfate)	0.004	0.001	4x10^{-4}	6x10^{-4}	8x10^{-4}	1x10^{-4}	N.D.	9x10^{-5}	6x10^{-6}	N.D.	2x10^{-3} C 5x10^{-3} I
Hexachlorobenzene	0.03	3x10^{-4}	0.003	1x10^{-4}	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	2x10^{-5} C 8x10^{-3} A
Hexachlorocyclohexane total all isomers	0.03	0.04	0.003	0.02	1x10^{-4}	0.002	3x10^{-5}	2x10^{-5}	8x10^{-4}	1x10^{-5}	1x10^{-5} I** 1x10^{-2} A**
Nitrate	0.05	141	0.006	61	1x10^{-4}	248	N.A.	1x10^{-5}	107	N.A.	none
Sulfate	0.5	2,144	0.05	928	0.5	261	N.A.	0.05	113	N.A.	none
Toxaphene	0.03	0.004	0.003	0.002	0.002	0.003	3x10^{-4}	2x10^{-4}	0.001	1x10^{-4}	1x10^{-3} I 5x10^{-3} A

mg/kg/day = milligrams of contaminant per kilogram body weight per day, g.w. = ground water,
* Aldrin, ** gamma isomer (Lindane)
N.D. = not detected, N.A. = not analyzed
C = chronic length exposure (> 365 days), I = intermediate length exposure (14-165 days), A = acute length exposure (<14 days)

APPENDIX C. RISK OF ILLNESS, DOSE RESPONSE/THRESHOLD, AND UNCERTAINTY IN PUBLIC HEALTH ASSESSMENTS

Risk of Illness

In this health assessment, the risk of illness is the chance that exposure to a hazardous contaminant is associated with a harmful health effect or illness. The risk of illness is not a measure of cause and effect; only an in-depth health study can identify a cause and effect relationship. Instead, we use the risk of illness to decide if a follow-up health study is needed and to identify possible associations.

The greater the exposure to a hazardous contaminant (dose), the greater the risk of illness. The amount of a substance required to harm a person's health (toxicity) also determines the risk of illness. Exposure to a hazardous contaminant above a minimum level increases everyone's risk of illness. Only in unusual circumstances, however, do many people become ill.

Information from human studies provides the strongest evidence that exposure to a hazardous contaminant is related to a particular illness. Some of this evidence comes from doctors reporting an unusual incidence of a specific illness in exposed individuals. More formal studies compare illnesses in people with different levels of exposure. However, human information is very limited for most hazardous contaminants, and scientists must frequently depend upon data from animal studies. Hazardous contaminants associated with harmful health effects in humans are often associated with harmful health effects in other animal species. There are limits, however, in only relying on animal studies. For example, scientists have found some hazardous contaminants are associated with cancer in animals, but lack evidence of a similar association in humans. In addition, humans and animals have differing abilities to protect themselves against low levels of contaminants, and most animal studies test only the possible health effects of high exposure levels. Consequently, the possible effects on humans of low-level exposure to hazardous contaminants are uncertain when information is derived solely from animal experiments.

Dose Response/Thresholds

The focus of toxicological studies in humans or animals is identification of the relationship between exposure to different doses of a specific contaminant and the chance of having a health effect from each exposure level. This dose-response relationship provides a mathematical formula or graph that we use to estimate a person's risk of illness. The actual shape of the dose-response curve requires scientific knowledge of how a hazardous substance affects different cells in the human body. There is one important difference between the dose-response curves used to estimate the risk of noncancerous illnesses and those used to estimate the risk of cancer: the existence of a threshold dose. A threshold dose is the highest exposure dose at which there is no risk of illness. The dose-response curves for noncancerous illnesses include a threshold dose that is greater than zero. Scientists include a threshold dose in these models because the human body can adjust to varying amounts of cell damage without illness. The threshold dose differs for different contaminants and different exposure routes, and we estimate it from information gathered inhuman and animal studies. In contrast, the dose-response curves used to estimate the risk of cancer assume there is no threshold dose (or, the cancer threshold dose is zero). This assumes a single contaminant molecule may be sufficient to cause a clinical case of cancer. This assumption is very conservative, and many scientists believe a threshold dose greater than zero also exists for the development of cancer.

Uncertainty

All risk assessments, to varying degrees, require the use of assumptions, judgements, and incomplete data. These contribute to the uncertainty of the final risk estimates. Some more important sources of uncertainty in this public health assessment include environmental sampling and analysis, exposure parameter estimates, use of modeled data, and present toxicological knowledge. These uncertainties may cause risk to be overestimated or underestimated to a different extent. Because of the uncertainties described below, this public health assessment does not represent an absolute estimate of risk to persons exposed to chemicals at or near the Landia Chemical Company and Florida Favorite Fertilizer Company site.

Environmental chemistry analysis errors can arise from random errors in the sampling and analytical processes, resulting in either an over- or underestimation of risk. We can control these errors to some extent by increasing the number of samples collected and analyzed, and by sampling the same locations over several different periods. The above actions tend to minimize uncertainty contributed from random sampling errors.

There are two areas of uncertainty related to exposure parameter estimates. The first is the exposure-point concentration estimate. The second is the estimate of the total chemical exposures. In this assessment we used maximum detected concentrations as the exposure point concentration. We believe using the maximum measured value to be appropriate because we cannot be certain of the peak contaminant concentrations, and we cannot statistically predict peak values. Nevertheless, this assumption introduces uncertainty into the risk assessment that may over- or underestimate the actual risk of illness. When selecting parameter values to estimate exposure dose, we used default assumptions and values within the ranges recommended by the ATSDR or the EPA. These default assumptions and values are conservative (health protective) and may contribute to the overestimation of risk of illness. Similarly, we assumed the maximum exposure period occurred regularly for each selected pathway. Both assumptions are likely to contribute to the overestimation of risk of illness.

There are also data gaps and uncertainties in the design, extrapolation, and interpretation of toxicological experimental studies. Data gaps contribute uncertainty because information is either not available or is addressed qualitatively. Moreover, the available information on the interaction among chemicals found at the site, when present, is qualitative (that is, a description instead of a number) and we cannot apply a mathematical formula to estimate the dose. These data gaps may tend to underestimate the actual risk of illness. In addition, there are great uncertainties in extrapolating from high to low doses, and from animal-to-human populations. Extrapolating from animals to humans is uncertain because of the differences in the uptake, metabolism, distribution, and body organ susceptibility between different species. Human populations are also variable because of differences in genetic constitution, diet, home and occupational environment, activity patterns, and other factors. These uncertainties can result in an over- or underestimation of risk of illness. Finally, there are great uncertainties in extrapolating from high to low doses, and controversy in interpreting these results. Because the models used to estimate dose-response relationships in experimental studies are conservative, they tend to overestimate the risk. Techniques used to derive acceptable exposure levels account for such variables by using safety factors. Currently, there is much debate in the scientific community about how much we overestimate the actual risks and what the risk estimates really mean.

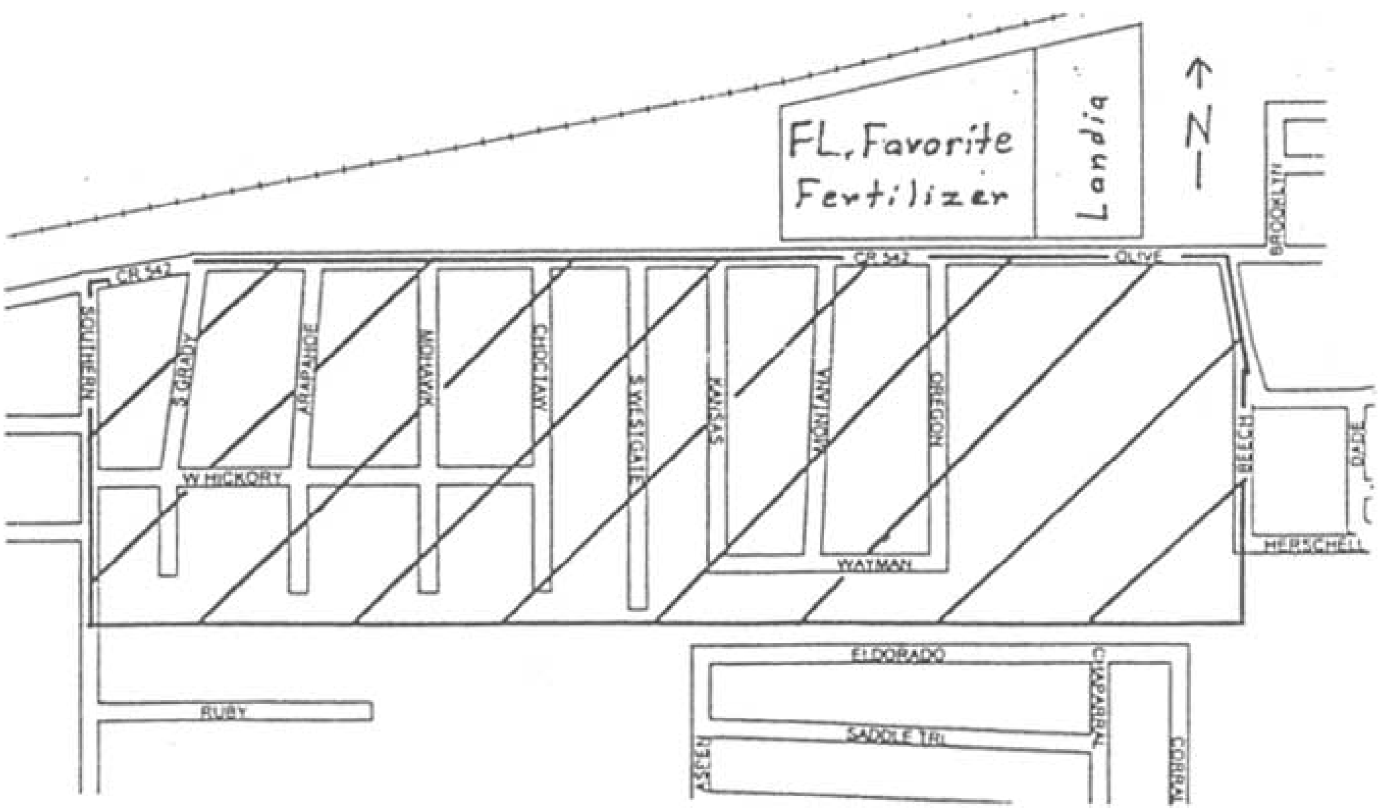
APPENDIX D. JULY 8, 1999 CONTAMINATED GROUND WATER ADVISORY

Florida Dept. of Health and Polk County Health Dept. - July 1999

Contaminated Ground Water Advisory

Lakeland's Westgate Neighborhood

The Florida Department of Health advises against any use of ground water from irrigation wells in a 10 block area of Lakeland's Westgate neighborhood. Chemicals from Landia Chemical/Florida Favorite Fertilizer hazardous waste site have contaminated ground water in this area. If irrigation well water is mixed with infant formula, nitrates in the water could cause "blue baby" syndrome. "Blue baby" syndrome can be fatal. Sulfates in the water can also cause diarrhea in children and adults. Homes and businesses in this area are supplied with city water. City Water is <u>not</u> affected and is <u>safe</u> to use. The U.S. Environmental Protection Agency is requiring the owners of this hazardous waste site to conduct more tests to determine the full extent of the ground water contamination.



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CERTIFICATION

The Landia Chemical Company/Florida Favorite Fertilizer Public Health Assessment was prepared by the Florida Department of Health, Bureau of Environmental Toxicology, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the health assessment was begun.

Debra Gable
Technical Project Officer, SPS, SSAB, DHAC

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

Sven E. Rodenbeck
for Richard Gillig
Branch Chief, SPS, SSAB, DHAC, ATSDR