Public Health Assessment for

CALLAWAY AND SON DRUM SERVICE
(a/k/a CALLOWAY AND SON DRUM SERVICE)
LAKE ALFRED, POLK COUNTY, FLORIDA
EPA FACILITY ID: FLD094590916
MAY 7, 2001

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

PUBLIC HEALTH ASSESSMENT

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LAKE ALFRED, POLK COUNTY, FLORIDA

EPA FACILITY ID: FLD094590916

Prepared by:

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

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

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FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, fullscale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E56), Atlanta, GA 30333.

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1.0 SUMMARY

From 1977 to 1991, Callaway and Son Drum Service, in Lake Alfred, Florida, cleaned and recycled 55-gallon drums containing oil and citrus residues. Between 1984 and 1994, the Environmental Protection Agency (EPA) and the Florida Department of Environmental Regulation (FDER) detected metals, solvents, pesticides and gasoline components in on-site soil and groundwater. FDER concluded that the solvents and pesticides in the groundwater are due to the operations of Callaway and Son. FDER also concluded that the heavy metal and gasoline contamination are due to the neighboring sewage treatment plant and a previous gasoline spill, respectively. The Florida Department of Health (FDOH), Bureau of Environmental Epidemiology and the Agency for Toxic Substances and Disease Registry (ATSDR) conducted this Public Health Assessment following the EPA proposing this site to the Superfund National Priorities List.

On-site soil contains arsenic at concentrations that if ingested over a lifetime could increase the risk of bladder, skin and kidney cancer. Prolonged ingestion of on-site soil containing lead, chromium, and arsenic could cause abdominal pain, anemia, cramping, decreased bone density, dermatitis, diarrhea, numbness, mild kidney toxicity and various neurological and reproductive effects. Investigators detected no metal contamination in off-site soil and no pesticides or solvents in either on-site or off-site soil.

The concentrations of solvents and pesticides in the shallow groundwater beneath the site are unlikely to cause illness if ingested. However, both on- and off-site groundwater contained arsenic, barium, cadmium, chromium, lead and nickel at concentrations that, if ingested for a prolonged period, could cause symptoms similar to those described for prolonged soil ingestion. None of the on- or off-site Floridan aquifer wells, however, showed any contamination.

Although the contamination in on-site soil and groundwater appears to be high enough to cause illness, FDOH classifies this site as an "indeterminate public health hazard" because of the limited number of environmental samples collected. Specifically, the lateral and vertical extent of contamination are not known. No groundwater samples were collected south of the site, in the probable direction of groundwater flow. Only one on-site Floridan aquifer sample was collected. In the surrounding areas, many private wells exist that are drilled into the Floridan aquifer. FDER and Polk County Health Department (PCHD) have sampled seven down-gradient Floridan aquifer wells south of the site and detected no contamination. The environmental agencies, however, are not sure of the direction the contaminants are moving. In addition, no soil samples were collected from the south either on or off the site, where trespassers would likely enter the property.

FDOH recommends that environmental agencies restrict access to the site and continue to collect soil and groundwater samples to better characterize the lateral and vertical extent of soil and groundwater contamination. In addition, FDOH recommends that environmental agencies collect sediment samples from the ditch that drains surface water from this site. To detect potential exposures, PCHD has agreed to offer testing of private and public supply wells within one quarter mile of the site.

2.0 PURPOSE

The Florida Department of Health (FDOH), Bureau of Environmental Epidemiology conducted this Public Health Assessment when the Environmental Protection Agency (EPA) proposed the Callaway and Son Drum Service site to the National Priorities List (NPL). In this report, FDOH assesses the past, current and future public health threats from exposure to chemicals in the environment at and around the Callaway and Son Drum Service hazardous waste site. FDOH estimates which groups of people may be at risk under past, current and potential future conditions. FDOH estimates if these exposures are likely to be causing illness now, or may likely cause illness in the future. In this Public Health Assessment, FDOH, in cooperation with the Agency for the Toxic Substances and Disease Registry (ATSDR), evaluates the public health significance of the Callaway and Son Drum Service site. ATSDR, in Atlanta, GA, is a federal agency within the U.S. Department of Health and Human Services. Financial support for this project is provided entirely by the ATSDR.

3.0 BACKGROUND

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) authorizes the ATSDR to conduct Public Health Assessments of hazardous waste sites. Specifically, FDOH will determine whether illness is possible from exposure to contaminants from the site and recommends actions to reduce or prevent these exposures and therefore, the illnesses.

3.1 Site Description and History

Callaway and Son Drum Service is at 890 East Lake Drive (US 17-92) in Lake Alfred, Polk County, Florida (Figures 1 and 2, Appendix A). Currently, the site posts a "Callaway and Son Satellite Systems" sign, corresponding to the business that occupied the site after the drum service. The northern border of the site is a rail line which separates the site from a University of Florida Experiment Station. A nursery is southwest of the site and the Lake Alfred sewage treatment plant is due west. A cemetery and an apartment complex are adjacent east of the site. Of potential concern for past exposures was the presence of a playground at this apartment complex. This playground is no longer in existence. The site occupies approximately 9.5 acres and consists of a drum cleaning area, a sandblasting and painting area, and a drum storage area (Figure 3, Appendix A). The vacant office building is on the southern portion of the site. A large pond/wetland is in the central and eastern areas of the site. Surface water from the site drains via a ditch towards Lake Haines approximately 1000 feet south of the site. This ditch enters the site in the northeastern corner, runs down the east side of the pond/wetland and exits the site at the southwest corner (Figure 3, Appendix A).

Callaway and Son Drum Service was owned by Mr. Ronald Callaway and operated between 1977 and 1991. Callaway and Son Drum Service cleaned and recycled 55-gallon citrus and oil drums. The drums were cleaned with a resin solution and then rinsed in a 600-gallon fresh water tank. The specific contents of the resin solution are given in the Groundwater Investigation Report (FDER, 1984). In general, the resin solution was a mix of caustic alkalies, a glycol ether solvent and a detergent. The facility processed about 20 drums per day, 5 days a week. During the citrus season, Callaway and Son Drum Service handled up to 500 drums per day (Jacobs Engineering Group, Inc., 1992). The rinse tank was drained every two weeks into the pond/wetland area on the eastern portion of the property (Black and Veatch Waste Science Corp., 1994). Currently, no business operations exist on-site.

This site first came to the attention of the Florida Department of Environmental Regulation (FDER) in 1984, when the owner submitted an application to operate an industrial wastewater treatment and disposal system. FDER sampled and analyzed the on-site groundwater, surface water and private well water from on the Callaway property and in the surrounding areas. FDER detected no contaminants in off-site private wells or the on-site, deep well. However, the shallow aquifer groundwater and surface water samples on the site contained vinyl chloride, 1,2-dichloroethylene and lead (FDER, 1984).

In 1985, a gasoline pipeline owned by Central Florida Pipeline ruptured and spilled approximately 40,000 gallons of unleaded fuel on the eastern portion of the Callaway property. Central Florida Pipeline performed a clean-up of the spilled fuel. In 1986, FDER sampled the groundwater from the property and confirmed the presence of lead, but also detected chromium, benzene, ethylbenzene, methyl-t-butyl ether and toluene (FDER, 1986). This report concluded that the source of the chromium and lead on the site was neither the gasoline spill nor the Callaway operations, but was the sewage treatment plant to the west.

In 1992, contractors for the Florida Department of Environmental Protection (FDEP), formerly FDER, further detailed the nature of contamination on the site (Jacobs Engineering Group, Inc., 1992). Surface soil samples from the drum cleaning area contained various heavy metals, including arsenic, chromium and lead. Groundwater from the shallow aquifer contained both heavy metals and chlorinated solvents, including vinyl chloride, dichloroethylene, trichloroethylene and tetrachloroethylene. In 1994, EPA contractors collected additional soil, sediment and groundwater samples to further characterize the nature and extent of contamination (Black and Veatch Waste Science Corp., 1994). This study reported a similar profile of contaminants as seen in the 1992 report. In the preparation of this Public Health Assessment, FDOH pooled and evaluated all of the data presented in the EPA and FDER reports (FDER, 1984; 1986; Jacobs Engineering Group, Inc. 1992; Black and Veatch Waste Sciences Corp., 1994).

3.2 Site Visit

On October 19, 1999, Davis Daiker and Randy Merchant of the FDOH, Bureau of Environmental Epidemiology observed the Callaway and Son site on the north side of East Lake Drive (US 17-92) and toured the surrounding areas. Neither the main entrance nor the surrounding fence displayed signs indicating that hazardous wastes may be present on the site. The office building on the southeast side of the site is still present although it is in disrepair. The majority of the site is unpaved and covered with heavy brush and tall grass. The site appears abandoned and no signs of trespass were observed. However, on April 26, 2000, Beth Copeland of the FDOH, Bureau of Environmental Epidemiology observed evidence of child activities on the site. A pathway from the Redwood Apartment complex leads into the eastern side of the site and the on-site concrete building has drawings on it. The Lake Alfred Recreation Director told Ms. Copeland that some kids had requested that he build a fishing pier over the on-site pond. He reported these kids do fish in the pond. This pond was the focus of a television investigation in 1994. Ms. Copeland also spoke with local officials who expressed their concerns regarding the presence of leftover drums on the site. Mr. Daiker and Mr. Merchant observed the mobile home developments south of the site and on a drive-through inspection, observed several private wells and one public supply well within the area south of the site. They were told by an associate of one of the parks that the residents receive their drinking water from a public supply well.

3.3 Demographics, Land Use and Natural Resource Use

3.3.1 Demographics - Based on 1990 census information, approximately 1,300 residents (Table 10, Appendix B), approximately 550 under the age of 17, live within one mile of the site. Of this population, 86% were white, 10% were black, and 4% were Hispanic or from other racial/ethnic groups.

3.3.2 Land Use - Land use in this area is a mix of commercial and residential. The apartments to the east are the nearest residential buildings. Across East Lake Drive to the southeast but north of Lake Haines is a large mobile home community. To the southwest, there is a residential neighborhood with many homes within one-half of a mile of the site. Residential properties are also northwest of the site. North, west and northeast of the site are predominantly commercial or non-residential establishments. Three schools are within one mile of the site. An elementary school and a career center within 1 mile southwest of the site and a third school is 0.3 miles northwest of the site. All of these schools receive municipal water.

3.3.3 Natural Resource Use - This region of Florida has both the surficial and the Floridan aquifers, which are separated by a semi-permeable, intermediate layer. The surficial aquifer begins two to five feet below the surface and is 50 to 75 feet thick (FDER, 1992). A semi-permeable clay layer lies below the surficial aquifer and ranges 15 to 20 feet thick. This clay layer is considered semi-permeable because of the presence of sinkholes, which allow for recharge of the Floridan aquifer (FDER, 1984; 1986). Therefore, contaminants in the surficial aquifer can leach into the Floridan aquifer. The Floridan aquifer lies beneath the clay layer and continues several hundred feet deep. Because of the poor water quality in the surficial aquifer, the Floridan aquifer is the major source of potable water in this region of Florida. FDEP and EPA identified at least two public supply wells within one mile of the site, which service approximately 275 people. FDOH, with the help of the Southwest Florida Water Management District, has identified several irrigation and private wells within 1 mile of the site. In addition to these public and private wells, the Lake Alfred municipal wells, which supply much of the area with drinking water, are just over one mile west of the site. FDOH does not anticipate the groundwater contamination to move in the direction of the municipal wells. However, as a precaution FDOH and PCHD will test municipal water supply this year. The private wells of greatest concern are south-southwest of the site in the direction that the groundwater in the Floridan and surficial aquifer reportedly flows.

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). These uncertainties are addressed in Public Health Assessments by using worst-case 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 made throughout this Public Health Assessment err in the direction of protecting public health.

4.1 Environmental Contamination

We used the following ATSDR standard comparison values (ATSDR 1992a; 1999a), in order of priority, to select potential contaminants of concern at this site:

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

2. EMEG - Environmental Media Evaluation Guide - 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.

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

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

5. SCTL or GWCTL - Soil Clean-up Target Level or Groundwater Clean-up Target Level as determined by the Florida Department of Environmental Protection. This value is used only when no values exist for #1 through #4.

We use ATSDR standard comparison values to select chemicals for further consideration, not for determining the possibility of illness. Identification of a contaminant of concern (COC) in this section does not mean that exposure will cause illness. Identification of COCs serves to narrow the focus of the Public Health Assessment to those contaminants that are most important to public health. When we select a COC in one medium (i.e., soil), we report that contaminant in all other media (i.e., groundwater). We evaluate the COC in subsequent sections and estimate whether exposure is likely to cause illness. All available documents were evaluated when we identified the contaminants of concern. The environmental data is presented in Tables 1 through 8 (Appendix B).

4.1.1 On-Site Contamination - In a series of site investigations, EPA and FDER contractors sampled the groundwater, surface soil (0-6"), and sediment from the pond/wetland. These samples were then analyzed for solvents, pesticides and metals. For this Public Health Assessment, "on-site" refers to the area within the Callaway and Son property boundaries as shown in Figures 3 and 4 (Appendix A).

Groundwater samples taken from the western portion of the site contained both inorganic and organic materials (Tables 1 and 2, Appendix B). Groundwater samples taken from the area of drum cleaning (Figures 3 and 4) were contaminated with tetrachloroethylene, trichloroethylene and dichloroethylene. Gamma-chlordane, a pesticide, and 4,4'-DDE, a breakdown product of DDT, were detected in the same area at concentrations above their respective comparison values and are therefore, considered COCs (Table 1, Appendix B). This organic contamination is a public health concern since these solvents travel very well in groundwater and could, therefore, migrate off-site. Groundwater contamination with metals was highest in the areas of sandblasting and painting activities (Figures 3 and 4, Appendix A). EPA detected aluminum, arsenic, barium, cadmium, chromium, lead, thallium and vanadium in the groundwater at concentrations that exceeded the respective comparison values. Therefore, we considered each of these metals a COC (Table 2, Appendix B). The maximum concentrations, the frequency of detection, and the comparison values used for each COC are given in Tables 1 and 2 (Appendix B). The limited number of on-site groundwater samples served to identify the contaminants present but does not provide insight into the direction of contaminant movement. Of special importance is that FDEP found no contamination in the on-site supply well, which is drilled into the Floridan aquifer (DW-8 [Figure 4, Appendix A]) (FDER, 1984). For the purpose of this Public Health Assessment, on-site groundwater contamination has not been adequately characterized.

One of the 10 on-site surface soil samples contained high levels of chromium and lead. This sample was collected on the western side of the property. Three soil samples contained arsenic at concentrations that exceed the ATSDR screening value. Therefore, only the metals listed above were considered COCs for on-site soil. Neither EPA nor FDER detected organic contaminants (i.e., solvents, pesticides) in soil at concentrations above the ATSDR screening levels. Since no volatile compounds are present in soil, it is unlikely that the site has had an impact on air quality in the area. Tables 3 and 4 (Appendix B) list the COCs for on-site soil and also provide the maximum concentrations at which they were detected. The limited number of on-site soil samples served to identify the COCs but does not clearly delineate the extent of contamination or if there is a public health hazard. In addition, no soil samples were taken from the southern portion of the site, where trespasser access is simple. For the purpose of this Public Health Assessment, on-site soil contamination has not been adequately characterized.

Of the four sediment samples taken from the pond/wetland, only one contained any of the identified COCs at a concentration above the ATSDR screening value. This sample was taken from the sediment in the southwestern portion of the on-site pond/wetland (Figure 4,

Appendix A) and contained arsenic. No organic contaminants were detected in any of the sediment samples. For the purpose of this Public Health Assessment, contamination of the sediment in the pond/wetland has been adequately characterized.

4.1.2 Off-Site Contamination - EPA and FDER contractors also sampled groundwater, soil and surface water from areas off of the Callaway property. The purpose of these samples was to further define the areal extent of contamination and to provide a background concentration of the contaminants. A background concentration is the level of a chemical or metal that is likely to be present in the soil or groundwater that is not due to any spill, accident or release. This is the concentration that can "naturally" be found in the water or soil. Background concentrations help in determining if a hazardous waste site has impacted the areas surrounding it. FDOH uses the available data from these off-site samples to aid in determining whether the contamination was confined to the site. For this Public Health Assessment, "off-site" refers to the area surrounding the Callaway and Son property boundaries as shown in Figures 3 and 4 (Appendix A).

EPA and FDER contractors drilled several off-site shallow monitoring wells and sampled from several currently used potable wells south-southeast of the site. On average the shallow monitoring wells were screened between 10 and 15 feet in the surficial aquifer. One of the shallow monitoring wells was drilled north of the property and the other was drilled near the cemetery to the northeast (Figure 4, Appendix A). The only organic chemical detected in off-site groundwater was the pesticide gamma-chlordane (Table 5, Appendix B). However, off-site groundwater contained aluminum, arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, thallium, and vanadium (Table 6, Appendix B) at concentrations above their respective comparison level. Groundwater from the private or public supply wells contained none of the COCs. Because of the small number of samples and the absence of monitoring wells south of the site, the direction of contaminant movement is not known. For the purpose of this Public Health Assessment, off-site groundwater has not been adequately characterized.

Of the three off-site soil samples reported in the site investigations, two were taken from the playground area east of the site and the third was taken outside the northeast corner of the site. The only sample showing any evidence of contamination was the soil sample from the playground, which contained an amount of arsenic that is only slightly higher than the ATSDR comparison value. Contamination with organic materials (i.e., solvents, pesticides) was not present in any of these samples. Two off-site surface water samples were taken from the drainage ditch. One of these samples was taken where the ditch enters the site and the other was taken where the ditch exits the site. Neither of these samples showed any contamination. Because of the importance of this ditch in regards to human exposure, FDOH concludes that the ditch has not been adequately characterized.

4.2 Quality Assurance and Quality Control

This Public Health Assessment is based on the data presented in the Groundwater Investigation (FDER, 1984), Lake Alfred Fuel Spill, Groundwater Investigation (FDER, 1986), Phase II Site Inspection (Jacobs Engineering Group, Inc., 1992) and the Expanded Site Inspection (Black and Veatch Waste Science Corp., 1994). FDOH has reviewed the data and the quality assurance and quality control measures that EPA and FDEP took in the gathering of the referenced data. FDOH believes that the data is sufficient to support the conclusions made in the original documents for which the data was gathered, and the conclusions made in this document. Appropriate chain-of-custody and data reporting procedures were followed and appropriate laboratory, equipment and sample controls were analyzed. The completeness and reliability of the referenced information determine the validity of the analyses and conclusions drawn in this public health assessment.

Physical Hazards

During the October 19, 1999 site visit, Mr. Daiker and Mr. Merchant observed the damaged building on-site, which could be a physical hazard to trespassers if access to the site is not restricted.

Pathway Analysis

To estimate whether nearby residents have been exposed to contaminants migrating from the site, we evaluated the environmental and human components of contaminant exposure pathways. Exposure pathways consist of five elements: a source of contamination (e.g., chemical spill), an environmental medium (e.g., groundwater), a point of exposure (e.g., tap water), a route of human exposure (e.g., oral), and a receptor population (e.g., area residents).

We eliminate an exposure pathway if at least one of the five elements is missing and will never be present. Exposure pathways that we do not eliminate are either completed or potential. With completed pathways, all five elements exist and exposure to a contaminant has occurred, is occurring, or will occur. A pathway is classified as potential if at least one of the five elements is missing, but may be present in the future. For both complete and potential pathways, an estimation of the likely dose of each COC is calculated and this dose is used to perform a toxicological evaluation.

Completed Exposure Pathways - No completed pathways exist for this site.

4.4.2 Potential Exposure Pathways - All of the potential exposure pathways are shown in Table 9 (Appendix B). The most likely potential exposure pathway is the consumption or use of groundwater by the residents living south of the site. We classify this pathway as potential because we have not identified a point of exposure. In the 1984 Groundwater Investigation, FDER tested several nearby potable wells and found no contamination. Polk County Health Department (PCHD) tested the well at one of the mobile home villages in 1994 and again in 1997 and detected no contaminants. Testing of the area public supply wells by PCHD is scheduled for the year 2000. PCHD does not routinely test private wells, so the status of the private wells to the southwest is not known.

A less likely but important potential pathway is the possible future consumption and use of on-site groundwater by future on-site residents. This pathway is missing a point of exposure, since no potable well exists on site. In addition, no receptor population exists on-site. If the land use were to change to residential and a potable well was drilled on-site, this pathway could be considered complete.

The final potential pathway is the exposure to contaminated soil on-site. Trespassers could have been exposed in the past, or be exposed in the present and future to contaminated soil. In addition, if the land use were to change to residential, future residents could also be exposed to contaminated soil on-site. Due to the presence of the sewage treatment plant due west of the site, it is unlikely that the land use at this site would change to residential but, in the interest of public health, this pathway is examined. In Table 10, we estimate the total population potentially exposed.

4.5 Public Health Implications - In this section, we calculate the dose of a chemical which both adults and children could potentially receive by all likely routes of exposure. We then review the toxicological profile for each COC and determine if the estimated dose could cause illness. For this site, we calculated potential doses from exposure to on-site and off-site groundwater and on-site soil (Tables 11 through 15, Appendix B).

4.5.1 Toxicological Evaluation - In this section, we discuss illnesses that could occur following exposure to COCs at this site. To evaluate the risks of illness, the ATSDR has developed Minimal Risk Levels (MRLs) for contaminants commonly found at hazardous waste sites. A MRL is a conservative estimate of daily human exposure to a contaminant below which noncancerous illnesses are unlikely to occur. The calculation of the MRL is based on animal and human studies, when available. It is calculated very conservatively because the goal of the MRL is to protect public health. MRLs exist for each route of exposure, such as ingestion and inhalation, and for different lengths 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. Toxicological Profiles are chemical-specific and provide information on the health effects, environmental transport, human exposure, and regulatory status of a specific chemical.

To apply the MRL, we estimate the daily dose for each of the COCs using standard exposure parameter estimates (i.e., average volume of water consumed per day, average shower time). Using these, we estimate the number of milligrams of contaminant ingested per day (mg/day) and then divide by the average human body weight. The dose is expressed as the number of milligrams of chemical per kilogram of body weight per day (mg/kg/day). In calculating the potential dose, we assume people are exposed daily to the maximum concentration detected for each contaminant in each medium. In Tables 11 through 15 (Appendix B), we summarize the estimated dose for each contaminant for each exposure pathway using the maximum COC concentration. In Tables 11-15 (Appendix B), a cell containing bold text indicates that the estimated dose exceeds the MRL. Since MRLs are conservative to protect health, a dose above the MRL does not necessarily mean that it will cause illness.

The exposure parameters for each exposure scenario are given below the tables. The values used are standard values for this type of analysis (EPA, 1991; 1997). For groundwater, we estimated the dose of chemical that could be ingested from drinking, absorbed through the skin during showering, and the air concentration that could be inhaled during showering. For soil exposures, we estimated the dose from incidental ingestion of soil and the dose from breathing contaminated dust.

4.5.1.1 Gamma-chlordane, chlorophenol, cresol, 4,4'-DDE, 1,2-dichloroethylene, tetrachloroethylene, and trichloroethylene- None of these organic compounds were detected at high enough concentrations in soil to deliver a dose that would exceed the respective MRL. Therefore, exposure to these chemicals in soil is unlikely to cause illness.

These contaminants were also not detected in groundwater, either on-site or off-site, at high enough concentrations to deliver an oral dose that would exceed the oral MRL (Tables 11 and 14, Appendix B). The future use of on-site groundwater for showering, however, may generate an air concentration of dichloroethylene, tetrachloroethylene and trichloroethylene that exceeds the respective inhalation MRLs. We do not anticipate any illness from these air concentrations because of (1) the conservative nature in which the MRLs are calculated, (2) the brief exposure time during showering, and (3) shower use of on-site groundwater could only occur if a private well was drilled on-site. Therefore, noncancerous illnesses are not anticipated from exposure to these solvents and pesticides in groundwater when either consumed or used for showering. Although the private wells off-site were not contaminated, FDOH cannot conclude that off-site groundwater is safe due to the lack of comprehensive off-site sampling.

The U.S. Department of Health and Human Services has classified tetrachloroethylene, trichloroethylene, dichloroethylene, cresol, chlorophenol, DDE and chlordane as either "possible" or "probable carcinogens". Results from animal studies suggest that these compounds may be capable of causing cancer, but only limited evidence in humans has been found (ATSDR, 1989, 1992b, 1994, 1996a; 1997a; 1997b; 1999b). Given the low estimated doses of these compounds in relation to this site and the weak carcinogenicity of these compounds, it is unlikely that the estimated exposures to these chemicals in drinking water would cause cancer.

4.5.1.2 Vinyl chloride- Vinyl chloride, like the other organic contaminants, was not detected in soil or sediment samples.

However, consumption or showering with on-site groundwater could deliver a dose that exceeds the oral and inhalation MRL (Tables 11 and 14, Appendix B). These doses could cause a mild, non-symptomatic effect on the liver. Mild liver responses have been observed in mice chronically treated with only slightly higher doses than those estimated for this site. FDOH, however, does not anticipate illness from vinyl chloride because the most recent groundwater samples did not contain vinyl chloride and currently no functioning private well exists on the site.

Vinyl chloride can cause liver cancer by both oral and inhalation exposure routes and at doses only slightly higher than what could be encountered with this site (ATSDR, 1997c). However, FDOH does not anticipate an increase in illness or cancer from use of on-site groundwater due to the absence of vinyl chloride from the most recent groundwater samples and the absence of an on-site private well.

4.5.1.3 Aluminum - The concentration of aluminum in on- or off-site soil was not high enough to consider this metal a COC in soil (Table 4, Appendix B). Therefore, aluminum exposure from contaminated soil will not likely cause illness in area residents.

Using the maximum detected groundwater concentration, we estimated the maximum dose for a child and for an adult. These doses were calculated under conditions where residents are living on-site and consuming groundwater from an on-site well. The dose expected from off-site groundwater would be only slightly less (Tables 12 and 15, Appendix B), since the groundwater concentrations of aluminum were very similar between on- and off-site. The MRL for aluminum is based on a study where mice exhibited a decreased motor activity after treatment for six weeks with aluminum (Golub et al., 1989). Scientists have also found that certain populations may be susceptible to aluminum neurotoxicity (ATSDR, 1999c). Persons with reduced kidney function are at an increased risk of aluminum accumulation and therefore, are susceptible to the toxic effects of aluminum. The percent of aluminum absorbed is normally very low (<1%), but in persons that do not excrete the aluminum as efficiently (kidney disorders), the aluminum may accumulate. Although the calculated doses are above the MRL, we do not anticipate aluminum exposure to cause illness because the typical dose from chronic antacid use is 6 to 35 times the MRL and no health effects have been associated with chronic antacid use.

Available cancer studies of aluminum in animals do not indicate that aluminum is carcinogenic. Studies in humans show no correlation between aluminum and cancer mortality (ATSDR, 1999c). Therefore, consumption of aluminum in groundwater is unlikely to cause cancer.

4.5.1.4 Arsenic - The dose of arsenic that could be ingested in either on- or off-site soil is less than the MRL for arsenic (Table 13, Appendix B). Therefore, we do not anticipate that ingestion of arsenic in soil will cause illness.

Ingestion of arsenic in groundwater, either on-site or off-site, however, could result in a dose of arsenic that would exceed the MRL (Tables 12 and 15, Appendix B). Ingestion of comparable doses for a period of up to 20 years in humans was associated with abdominal pain (Holland et al., 1904), anemia (Mizuta et al., 1956) and mild tingling of hands and feet (Mazumder et al., 1988). Similar symptoms could be expected in relation to this site.

Arsenic is classified as a known human carcinogen by the EPA, ATSDR and IARC (International Agency for Research on Cancer). Arsenic exposure from consumption of groundwater could cause a moderate increase the risk of skin, bladder, lung, and liver cancers (ATSDR, 1999d). Based on the low concentration present in soil, ingestion of on-site soil could deliver one-tenth of the dose associated with skin cancer in humans. FDOH concludes that ingestion of arsenic in soil could cause a low increase in the risk of bladder, kidney and skin cancer.

4.5.1.5 Barium - The concentration of barium in on- or off-site soil was not high enough to consider this metal a COC in soil (Table 4, Appendix B). Therefore, barium exposure from contaminated soil will not likely cause illness in area residents.

FDOH estimates that ingestion of either on-site or off-site groundwater would deliver a dose of barium that exceeds EPA's chronic oral reference dose (Tables 11 and 14, Appendix B). In one animal study, rats treated with barium doses comparable to those estimated from this site for over a year, had an increased blood pressure (Perry et al., 1983, 1985, 1989). However, a study in humans showed that prolonged exposure to comparable barium doses had no effect on blood pressure (Wones et al., 1990). Individuals taking barbiturates or having a pre-existing heart condition may be more sensitive to the cardiovascular effects of barium.

The cancer classification of barium is currently "not classified". No evidence exists to suggest that barium causes cancer (ATSDR, 1992c).

4.5.1.6 Cadmium - The concentration of cadmium in soil was not high enough to consider this metal a COC in soil (Table 4, Appendix B). Therefore, cadmium exposure from contaminated soil will not likely cause illness in area residents.

Our estimates of doses of cadmium from drinking either on- or off-site groundwater are above the MRL, which is based on a human population consuming cadmium for a lifetime. Based on the calculated doses, lifetime exposure to cadmium in on- or off-site groundwater could cause mild kidney toxicity. The highest child dose estimated for this site is only slightly below a dose shown to cause kidney lesions following lifetime exposure. Children may be at an increased risk for kidney toxicity because younger animals tend to more efficiently absorb cadmium (Ogoshi et al., 1989). Persons with pre-existing kidney conditions may also be at an increased risk.

Cadmium is classified as a "probable human carcinogen" based on human and animal studies. The association between cadmium exposure and cancer applies to inhalation exposure. The oral doses of cadmium that have been associated with cancer development in animal studies are over 300 times the doses that we estimated in this report. No cause-effect relationship has been established between oral exposure to cadmium and cancer. Therefore, FDOH does not anticipate cadmium in the groundwater will cause cancer (ATSDR, 1999e).

4.5.1.7 Chromium - Since no oral MRL exists for chromium, FDOH evaluated the potential toxicity of oral exposure to chromium in soil and groundwater. Single exposure to doses slightly higher than what was estimated from ingestion of on-site soil has been shown to enhance a pre-existing inflammation of the skin due to chromium (Kaaber and Veien, 1977). Therefore, prolonged (i.e., years) ingestion of chromium in soil could be associated with skin irritation and inflamation. Abdominal cramping and diarrhea in humans are also possible following prolonged exposure (Zhang and Li, 1987). Therefore, ingestion of chromium in on-site surface soil could cause illness. The estimated air concentration of chromium in dust is below the inhalation MRL and, therefore, is unlikely to cause illness (ATSDR, 1998).

FDOH estimates that consumption of on- or off-site groundwater would deliver a dose comparable to the dose from ingestion of soil (Tables 12 and 15, Appendix B). These doses could cause similar symptoms as those described above for prolonged ingestion of soil.

Showering with contaminated water is unlikely to create an air concentration of chromium that could cause illness.

In humans, inhalation exposure to chromium has been associated with lung cancer. However, the air concentration that caused lung cancer in humans is 500 times higher than the estimated air concentration at this site. Therefore, inhalation of chromium from contaminated soil is unlikely to cause cancer. No studies have demonstrated that ingestion of comparable doses of chromium causes cancer and therefore, ingestion of chromium in soil or groundwater is also not likely to cause cancer (ATSDR, 1998).

4.5.1.8 Lead - Currently no oral or inhalation MRL exists for lead. Therefore, all exposure scenarios are evaluated.

We estimated that the doses of lead resulting from incidental ingestion of on-site surface soil over an extended period could likely cause illness (Table 13, Appendix B). These anticipated effects include impaired heme synthesis (Cools et al., 1976; Stuik, 1974), increased blood pressure (Perry and Erlanger, 1978), mild changes in the liver (Krasovskii et al., 1979), various mild neurological and possible visual effects (ATSDR, 1999f), decreased bone thickness (Escribano et al., 1997) and reproductive disturbances in both male and females (ATSDR, 1999f).

The estimated doses of lead from consuming contaminated water (Tables 12 and 15, Appendix B) are likely to produce symptoms similar to those that would be expected from exposure through ingestion of contaminated soil. Of special importance in both of the exposure pathways described above, children absorb substantially more lead than adults and thus, are more sensitive to lead contamination.

Currently lead is classified as a "possible human carcinogen", based on limited human evidence. No studies have been published that demonstrate the cancer-causing effect of ingestion of lead. In animal studies, lead was shown to be carcinogenic at doses at least 200 times the estimated doses for this site. Therefore, it is unlikely that lead ingestion will cause cancer.

4.5.1.9 Mercury - The concentration of mercury in soil was not high enough to consider this metal a COC in soil (Table 4, Appendix B). Therefore, mercury exposure from contaminated soil will not likely cause illness in area residents.

The maximum dose of mercury that could be expected from consumption of off-site groundwater is equal to the MRL (Table 15, Appendix B) (ATSDR, 1999g). Mercury was not detected in on-site groundwater. FDOH does not anticipate any illness due to mercury in groundwater or soil.

Cancer: No evidence from human studies indicates an increased risk of cancer from mercury-contaminated water (ATSDR, 1999g).

4.5.1.10 Nickel - The concentration of nickel in on- or off-site soil was not high enough to consider this metal a COC in soil (Table 4, Appendix B). Therefore, nickel exposure from contaminated soil will not likely cause illness in area residents.

Only off-site groundwater contained a concentration of nickel that if used as potable water could deliver a dose (Table 15, Appendix B) that exceeds the MRL. Previous studies in humans suggest that a single exposure to comparable doses of nickel can induce an allergic inflammation of the skin in nickel-sensitive persons (Cronin et al., 1980). Some evidence suggests that females, blacks and persons with kidney dysfunction may be more sensitive to nickel-induced dermatitis (ATSDR, 1997d).

No studies were located that associated nickel and cancer development in humans. Animal studies have not shown nickel to induce cancers in mice or rats (ATSDR, 1997d).

4.5.1.11 Selenium - The concentration of selenium in on- or off-site soil was not high enough to consider this metal a COC in soil (Table 4, Appendix B). Therefore, selenium exposure from contaminated soil will not likely cause illness in area residents.

We estimated that the maximum concentration of selenium in off-site groundwater could deliver a dose just slightly above the MRL (Table 13, Appendix B) (ATSDR, 1996b). We do not anticipate illness from these doses of selenium because, of the many human studies presented in the toxicological profile, no health effects were produced by doses comparable to those estimated for this site.

Currently, the carcinogenic category of selenium is "not classified". However, several studies have shown no association of selenium intake and the incidence of cancer. Therefore, it is unlikely that exposure to this low dose would cause cancer.

4.5.1.12 Thallium - The concentration of thallium in on- or off-site soil was not high enough to consider this metal a COC in soil (Table 4, Appendix B). Therefore, thallium exposure from contaminated soil will not likely cause illness in area residents.

We estimated that consumption of both on- and off-site groundwater could deliver doses that would exceed the oral MRL (Tables 12 and 15, Appendix B). However, results from animal studies have shown that doses as much as 100 times those estimated for this site caused no deleterious effect (ATSDR, 1992d). Therefore, with the exception of people with preexisting neurological, kidney or liver diseases, it is unlikely that these low concentrations of thallium would cause illness.

Currently, the cancer class of thallium is "not classified". No studies in humans or animals have examined an association between thallium exposure and cancer (ATSDR, 1992d).

4.5.1.13 Vanadium - The concentration of vanadium in soil was not high enough to consider this metal a COC in soil (Table 4, Appendix B). Therefore, vanadium exposure from contaminated soil will not likely cause illness in area residents.

We estimate that consumption of both on- and off-site groundwater would deliver a dose that slightly exceeds the MRL (Tables 12 and 15, Appendix B). However, studies in both humans and animals showed no toxicity of vanadium doses as much as ten times the doses estimated with this site (ATSDR, 1992e).

Currently, the cancer class of vanadium is "not classified". No studies in humans or animals have examined an association between vanadium exposure and cancer.

4.5.1.14 Mixtures- The literature on the effects of exposure to mixtures focuses on high doses and reports that doses well in excess of typical environmental concentrations are required to produce the effects associated with mixtures. All of the COCs associated with this site are present at levels far the below levels where the effects of mixtures have been seen. Therefore, ATSDR considers that the mixture effect of these contaminants is not likely to be of public health concern.

4.5.2 Children and Other Unusually Susceptible Populations - The unique vulnerabilities of infants and children demand special emphasis in communities faced with the contamination of their environment. Children are at a greater risk than adults from certain kinds of exposure to hazardous substances emitted from waste sites. They are more likely to be exposed because they play outdoors and because they often bring food into contaminated areas. They are shorter than adults, which means they breathe dust, soil, and heavy vapors close to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. In addition, the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. Children are a special consideration in regards to this site because we have observed evidence of children on the site and children may be more sensitive to metals. Children may absorb metals from the intestine more efficiently than adults and may be more sensitive to the toxicity of metals.

5.0 COMMUNITY HEALTH CONCERNS

In August, FDOH distributed approximately 575 fact sheets to educate residents living near the Callaway and Son hazardous waste site. This fact sheet also served to solicit comments and concerns from area residents and announce the August 15th public availability session. The following section addresses the comments and concerns that area residents and city officials have expressed.

1. Several area residents have asked why it has taken so long for FDOH to become involved with this site.

> FDOH became aware of this site in 1999 when EPA began considering this site to be included on their national priorities list. FDOH then evaluated the existing environmental data, prepared a report, and informed area residents about the site.

2. "Can this site affect swimming or fishing in Lake Haines?" and "Have fish been tested?". In addition, city officials expressed concerns that the drainage ditch that runs through the site may carry contaminants in surface water south to the nearby residential areas, on its way to Lake Haines.

Currently, FDOH does not have enough information to sufficiently answer these concerns. A limited number of samples suggest there is no contamination in the ditch leading from the site to Lake Haines. However, no samples have been collected from the lake or from fish. To address these concerns, FDOH recommends environmental agencies collect sediment samples from the drainage ditch. Contaminants that persist in the environment, including chromium and lead, tend to settle out of water and can commonly be detected in sediment. If the initial ditch samples contain site-specific contaminants, more ditch sediment samples should be collected further from the site and closer to Lake Haines. If the contamination has reached Lake Haines, FDOH will consider recommending analysis of fish.

3. "Will it affect the drinking water in my home or in the elementary schools?"

With the limited data, FDOH cannot conclude which direction the groundwater contamination is moving, although preliminary evidence suggests it flows south. FDOH recommends environmental agencies install additional monitoring wells to identify (1) if the contamination is moving, (2) the direction it is moving, and (3) how quickly it is moving. This information will allow FDOH to better assess the threat to area drinking water wells.

For individuals connected to the municipal water service, these wells are located over one mile west of the site and are not anticipated to be impacted by the contamination. In addition, the City of Lake Alfred tests this water supply every three years and found these supplies to be clean in 1999. All the area schools receive municipal water, which is unaffected by this site.

4. Both area residents and workers near the site have asked about the effects of this site on air quality.

FDOH does not anticipate any airborne contamination from the site. EPA and FDEP only detected elevated levels of metals in soil (Section 4.1.1, On-site Contamination, Page 6). These compounds do not typically evaporate into the air. Also, the heavy grass and brush, which cover much of the site, prevent these metals from entering the air in dusts. However, the southern part of the site and the driveway, where the grass is short or absent, may generate higher amounts of dust. Since EPA and FDEP did not collect soil samples from this part of the site, FDOH recommends environmental agencies collect additional soil samples from the southern region of the site. FDOH is unable to evaluate the health effect of past air exposures since no air data exists from the time of Callaway and Son operations.

5. One resident inquired about the location of the contaminants and specifically, how far from the site did EPA and FDEP detect contamination.

The furthest from the site that FDEP and EPA collected off-site soil and groundwater samples was from just outside of the Callaway property. The soil contamination that EPA and FDEP detected is unlikely to move. However, contaminants in groundwater are capable of moving with the flow of groundwater. FDOH recommends environmental agencies collect groundwater samples from south of the site, in the predicted direction of groundwater flow, to better address this question. The locations where EPA and FDEP detected contaminants, both on and off the site, are discussed in Sections 4.1 of this report (Environmental Contamination, Page 5).

6. "Based on the chemicals found at the site, what potential danger to Lake Alfred residents do these contaminants pose?"

Due to a limited amount of data, FDOH cannot conclude what the overall health risk of this site is. Only one soil sample contained chromium and lead at concentrations that could produce illness if ingested regularly. Symptoms could include skin and gastrointestinal irritation due to chromium, mild effects on the liver and blood, possible vision effects, and reproductive effects due to lead. Regular ingestion of either on- or off-site groundwater could produce similar symptoms as those for on-site soil. FDOH discusses the health symptoms that could be associated with the maximum dose for each chemical of concern in Section 4.5.1 of this report (Toxicological Evaluation, Page 9).

6.0 CONCLUSIONS

Because of the limited data both on and off the site, FDOH classifies the Callaway and Son Drum Service hazardous waste site as an "indeterminate public health hazard". The contamination of the soil and groundwater, both on-site and off-site, have not been adequately characterized. Without sufficient data, we are unable to make a definitive determination. In areas of contamination, no receptor population was conclusively identified. In areas with a receptor population, no contamination has been identified. FDOH makes the following conclusions based on the limited data collected to date:

1. Physical hazards exist on-site in the from of damaged buildings and leftover drums; however, the EPA Project Manager informed FDOH that access to the site has been restricted

2. One on-site soil sample contained severely elevated concentrations of chromium and lead. Three on-site soil samples contained concentrations of arsenic typically present in Florida but in excess of ATSDR's comparison value.

    A. Prolonged incidental ingestion of on-site soil by trespassers or future residents could deliver a dose of chromium and lead high enough to cause illness. The estimated dose of chromium from prolonged soil ingestion could cause abdominal cramping, diarrhea and skin irritation. The estimated dose of ingested lead from soil could have mild effects on blood cells, vision, blood pressure, the liver, the neurological system and reproductive system.

B Prolonged incidental ingestion of arsenic in contaminated on-site soil could cause a low increase in the risk of skin, bladder and kidney cancer.

C. Because of the limited number of on-site samples, on-site soil contamination has not been adequately characterized.

3. No off-site soil samples or surface water samples contained any of the contaminants detected on the site. However, the extent of off-site soil contamination has not been adequately characterized. Specifically, no soil samples were taken south of the site, where surface water flows and access is unrestricted. Therefore, FDOH cannot conclude that off-site soil is safe.

4. Exposure to contaminants in on-site groundwater could cause illness in on-site populations (i.e., future residents), if a potable well is drilled into the surficial aquifer on-site.

   A. Prolonged ingestion of metals in on-site, surficial groundwater is likely to cause illness. Abdominal pain, diarrhea, increased blood pressure, kidney toxicity, anemia, tingling in the extremities and skin irritation are probable effects of consumption of on-site groundwater containing arsenic, barium, cadmium, chromium, and nickel.

   B. Consumption of arsenic in on-site groundwater is likely to increase the risk of skin, bladder and kidney cancer.

5. Shallow groundwater samples taken off-site to the north contained similar metals as on-site groundwater and are likely to produce the same symptoms if ingested. In contrast, no contaminants were detected in the Floridan aquifer wells south-southeast of the site. This suggests that either the contaminated groundwater has not reached these wells, or the contaminants have not reached the Floridan aquifer.

6. The contamination of both on- and off-site groundwater has not been adequately characterized. Specifically, the horizontal and vertical extent of contamination and the direction of contaminant movement have not been defined. Therefore, whether contaminants are likely to reach a receptor population is not known.

7. The existing on-site supply well (DW-8), which showed no contamination, may serve as a potential vertical pathway for contaminants to travel from the surficial aquifer to the Floridan aquifer.

7.0 RECOMMENDATIONS

Because the potential exposure pathways that could increase illness and cancer are from exposure to contaminated soil and groundwater, the following recommendations focus on reducing these exposures.

1. Continue to restrict access to the site, post warning signs regarding the hazardous nature of the site and remove any remaining drums from the site.

2. Collect soil samples from the southern portion of the property.

3. Collect additional soil and sediment samples off-site just south of the property border.

4. Restrict the drilling of drinking water wells on the Callaway and Son property.

5. Test private potable wells within a 0.25 mile radius of the site (Figure 2, Appendix A) for contaminants of concern.

6. Collect additional groundwater samples from the surficial and Floridan aquifers. In addition, confirm the direction of surficial and Floridan aquifer groundwater flow.

7. Regularly test the on-site supply well for the contaminants.

8.0 PUBLIC HEALTH ACTION PLAN

This section describes what ATSDR and/or FDOH 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 FDOH will do the following:

1 FDOH, Bureau of Environmental Epidemiology will inform and educate nearby residents in the surrounding residential areas about the potential health threat at this site by:

   a. Circulating a fact sheet on the site and the contaminants detected.

   b. Offering to meet with area residents to discuss the site and the potential health hazards from the site.

2. The Polk County Health Department will offer to sample private and public supply wells within one quarter mile of the site to identify any potential receptor populations.

3. FDOH, Bureau of Environmental Epidemiology will continue to work with the environmental agencies to ensure that cleanup activities protect public health and to track the implementation of the recommendations in this report.

The conclusions and recommendations in this report are based on the information reviewed. When additional information becomes available FDOH, Bureau of Environmental Epidemiology, will evaluate it to determine what additional recommendations, if any, to make.

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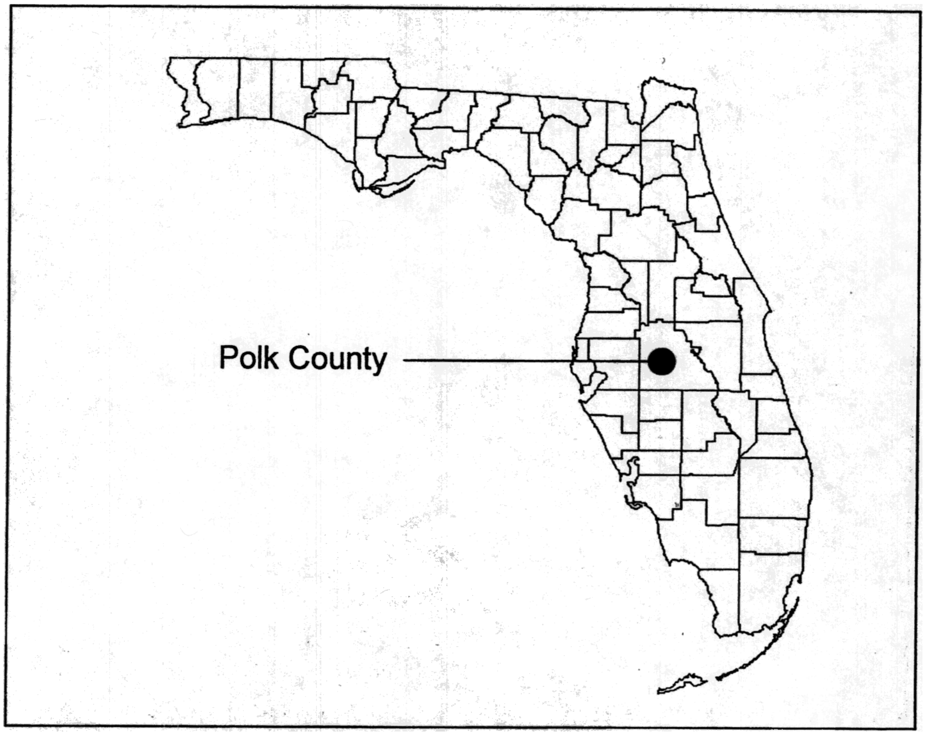
APPENDIX A. FIGURES



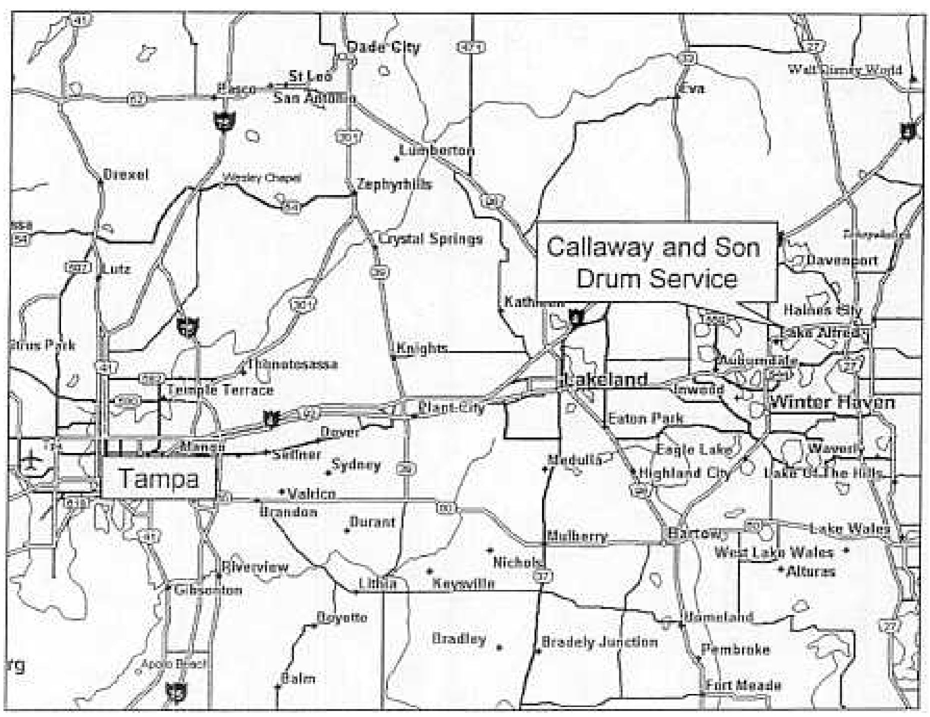
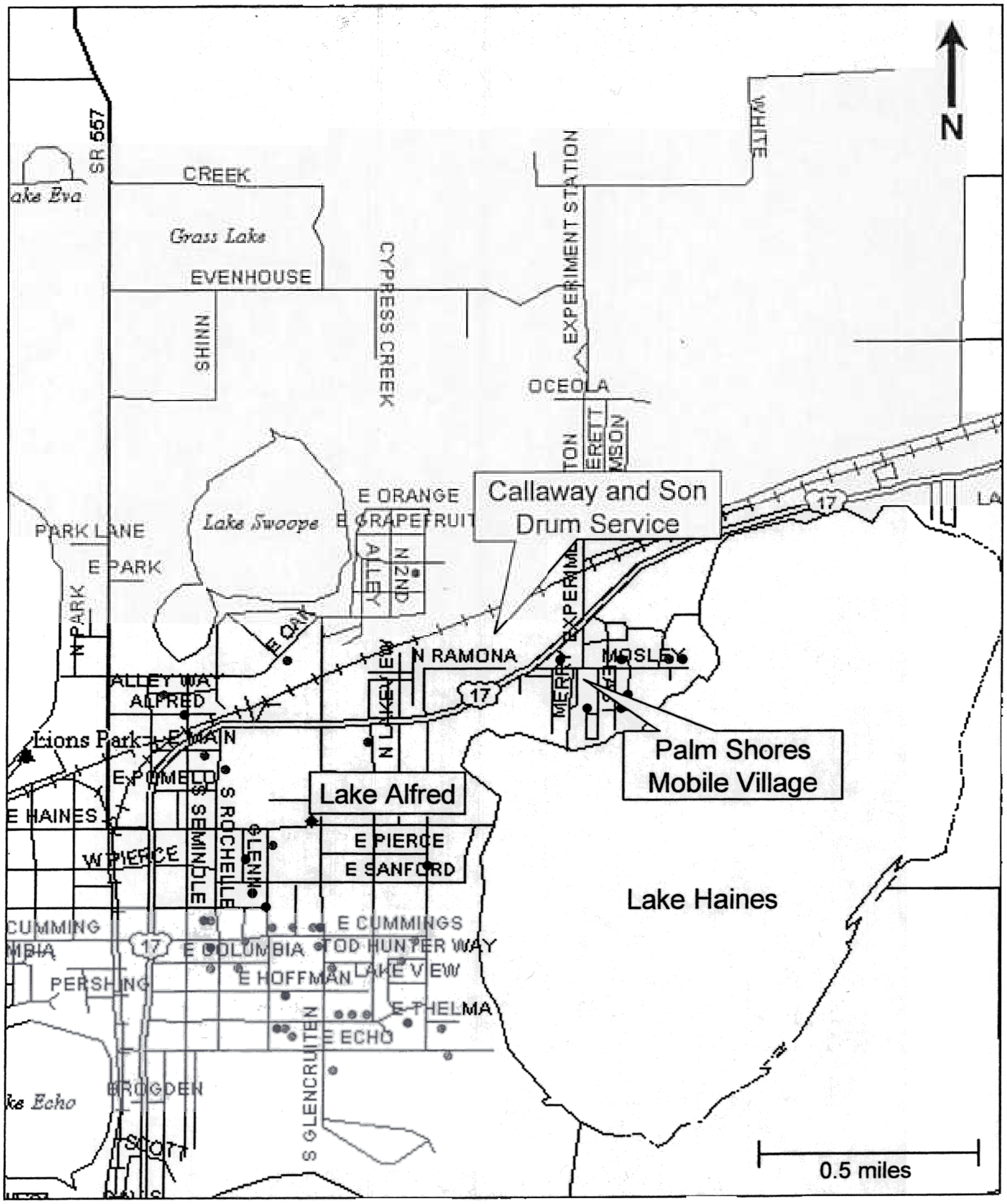


FIGURE 1. SITE LOCATION IN FLORIDA



• Domestic well   Irrigation well

FIGURE 2. SITE LOCATION IN LAKE ALFRED

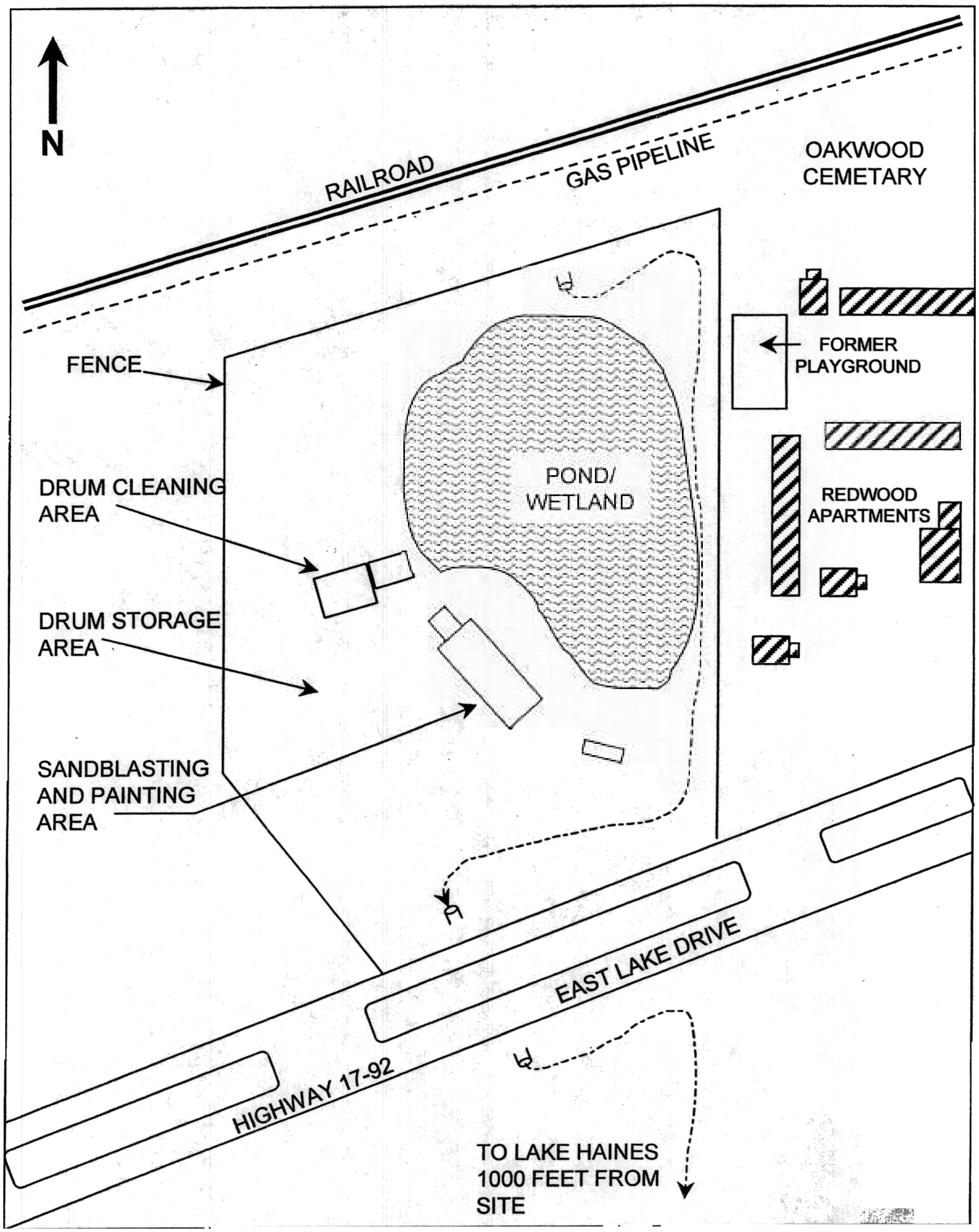
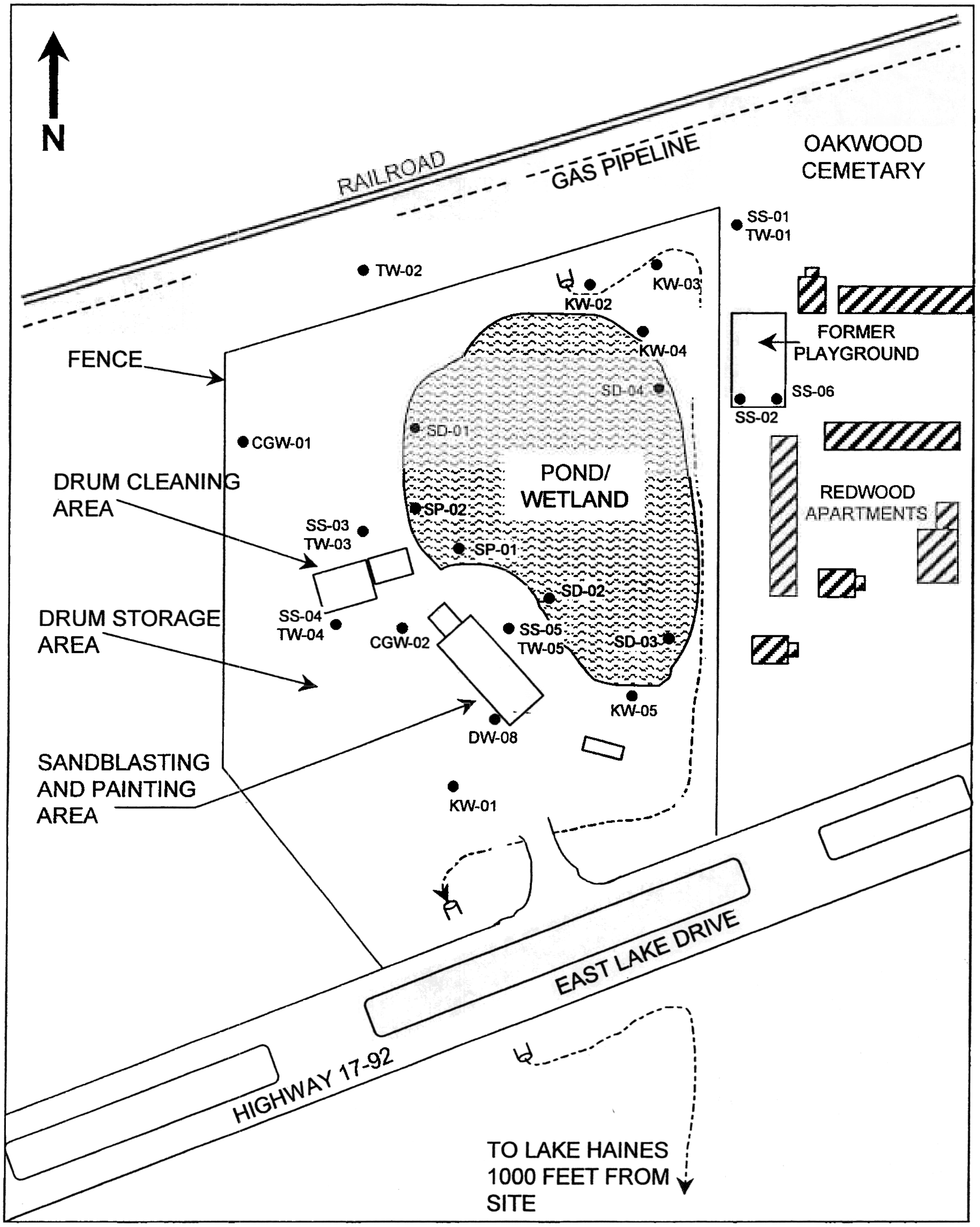


FIGURE 3. SITE LAYOUT



Well locations are approximate only and based on the figures in the reports
KW, CGW, SP and TW are all monitoring wells
DW-08 is the deep supply well on-site
SD- sediment samples, SS- soil sample

FIGURE 4. SAMPLING LOCATIONS

APPENDIX B. TABLES

Table 1. Maximum concentrations of organic contaminants in on-site groundwater

Contaminants of Concern (COC)	Maximum Concentration (µg/L)	Sample I.D.	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(µg/L)	Source
Gamma Chlordane	0.036J	TW-04	1/5	0.03 (CREG)	ATSDR 2000
Chlorophenol	100JN	TW-05	1/5	50 (Ch. RMEG)	ATSDR 2000
4, 4'- DDE	0.27N	TW-05	1/5	0.1 (CREG)	ATSDR 2000
1,2-Dichloroethylene	160	CGW-02	2/17	70 (LTHA)	ATSDR 2000
3 and/or 4-Cresol	78	TW-05	1/5	4 (GWCTL)	FDEP 1999
Tetrachloroethylene	950	CGW-02	2/17	0.7 (CREG)	ATSDR 2000
Trichloroethylene	110	CGW-02	2/17	3 (CREG)	ATSDR 2000
Vinyl Chloride	33	CGW-02	2/17	0.02 (CREG)	ATSDR 2000

* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

µg/L = micrograms per liter of groundwater

J - Estimated value

N - Presumptive evidence of presence of material

Ch- Indicates the standard is based on a child's exposure concentration

Table 2. Maximum inorganic contaminant concentrations in on-site groundwater

Contaminants of Concern (COC)	Maximum Concentration (µg/L)	Sample I.D.	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(µg/L)	Source
Aluminum	270,000	TW-05	3/8	20,000 (Ch. EMEG)	ATSDR 2000
Arsenic	68	TW-05	2/8	0.02 (CREG)	ATSDR 2000
Barium	3,400	TW-05	2/8	700 (Ch. RMEG)	ATSDR 2000
Cadmium	6.4JN	TW-05	1/8	2 (CH. EMEG)	ATSDR 2000
Chromium	530	TW-05	4/15	30 (Ch. RMEG)	ATSDR 2000
Lead	740	TW-05	5/15	15 (GWCTL)	FDEP 1999
Mercury	0.92	TW-05	0/8	2 (LTHA)	ATSDR 2000
Nickel	55	TW-05	0/8	200 (Ch. RMEG)	ATSDR 2000
Selenium	10J	TW-05	0/8	50 (Ch. EMEG)	ATSDR 2000
Thallium	9JN	TW-05	1/8	0.5 (CREG)	ATSDR 2000
Vanadium	1,100	TW-05	2/5	30 (Ch. EMEG)	ATSDR 2000

µg/L = micrograms per liter
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
N.A.- Not analyzed
J - Estimated value
N - Presumptive evidence of presence of material
Ch- Indicates the standard is based on a child's exposure concentration

Table 3. Maximum concentrations of organic contaminants in on-site surface soil (0-6 inches bgs) or sediment

Contaminants of Concern (COC)	Maximum Concentration (mg/kg)	Sample I.D.	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(mg/kg)	Source
Gamma Chlordane	0.023	SS-03	0/10	2 (CREG)	ATSDR 2000
Chlorophenol	N.D.	---	0/11	300 (Ch. RMEG)	ATSDR 2000
4, 4'- DDE	0.017	SS-05	0/11	2 (CREG)	ATSDR 2000
1,2-Dichloroethylene	N.D.	---	0/11	10,000 (Ch. EMEG)	ATSDR 2000
3 and/or 4-Cresol	N.D.	---	0/11	3000 (Ch. RMEG)	ATSDR 2000
Tetrachloroethylene	N.D.	—	0/11	500 (Ch. RMEG)	ATSDR 2000
Trichloroethylene	N.D.	---	0/11	6 (SCTL)	FDEP 1999
Vinyl Chloride	N.D.	---	0/11	0.3 (CREG)	ATSDR 2000

bgs- below ground surface
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
mg/kg = micrograms per kilogram of soil
N.D.- Not detected
Ch- Indicates the standard is based on a child's exposure concentration
Note: The one surface water sample taken from the western side of the site was contaminated with dichloroethylene (250 µg/L).

Table 4. Maximum concentrations of inorganic contaminants in on-site surface soil (0-6 inches bgs) or sediment

Contaminants of Concern (COC)	Maximum Concentration (mg/kg)	Sample I.D.	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(mg/kg)	Source
Aluminum	12,000	SS-03	0/10	100,000 (Ch. EMEG)	ATSDR 2000
Arsenic	6	SS-03	3/10	0.5 (CREG)	ATSDR 2000
Barium	34	SD-03	0/10	4000 (Ch. RMEG)	ATSDR 2000
Cadmium	2.9	SD-01	0/10	10 (CH. EMEG)	ATSDR 2000
Chromium	1500	SS-04	1/10	200 (Ch. RMEG)	ATSDR 2000
Lead	5,300	SS-04	1/10	400 (SCTL)	FDEP 1999
Mercury	N.D.	---	0/10	3.4 (SCTL)	FDEP 1999
Nickel	3.2J	SS-03	0/10	1000 (Ch. RMEG)	ATSDR 2000
Selenium	0.92J	SS-03	0/10	390 (SCTL)	FDEP 1999
Thallium	N.D.	---	0/10	5 (Ch. RMEG)	ATSDR 2000
Vanadium	32	SS-03	0/10	200 (Ch. EMEG)	ATSDR 2000

bgs- below ground surface
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
mg/kg = milligrams per kilogram of soil
Ch- Indicates the standard is based on a child's exposure concentration
N.D.- Not detected
J - Estimated value

Table 5. Maximum concentrations of organic contaminants in off-site groundwater

Contaminants of Concern (COC)	Maximum Concentration (µg/L)	Sample I.D.	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(µg/L)	Source
Gamma Chlordane	0.13	TW-02	1/4	0.03 (CREG)	ATSDR 2000
Chlorophenol	N.D.	---	0/4	50 (Ch. RMEG)	ATSDR 2000
4, 4'- DDE	N.D.	---	0/4	0.1 (CREG)	ATSDR 2000
1,2-Dichloroethylene	N.D.	---	0/11	70 (LTHA)	ATSDR 2000
3 and/or 4-Cresol	N.D.	---	0/4	4 (GWCTL)	FDEP 1999
Tetrachloroethylene	N.D.	---	0/11	0.7 (CREG)	ATSDR 2000
Trichloroethylene	N.D.	---	0/11	3 (CREG)	ATSDR 2000
Vinyl Chloride	N.D.	---	0/11	0.3 (CREG)	ATSDR 2000

* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.

It is important to note that two of the four samples came from private drinking wells south of the site. The first was the public supply well at Palm Shores Mobile Village and the second was the well Camp Hackedy.

µg/L = micrograms per liter of groundwater

N.D.- Not detected

N.A.- Not analyzed

Ch- Indicates the standard is based on a child's exposure concentration

Table 6. Maximum inorganic contaminant concentrations in off-site groundwater

Contaminants of Concern (COC)	Maximum Concentration (µg/L)	Sample I.D.	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(µg/L)	Source
Aluminum	210,000	TW-02	2/11	20,000 (Ch. EMEG)	ATSDR 2000
Arsenic	110	TW-02	1/11	0.02 (CREG)	ATSDR 2000
Barium	6000	TW-02	1/11	700 (Ch. RMEG)	ATSDR 2000
Cadmium	84JN	TW-02	2/11	2 (CH. EMEG)	ATSDR 2000
Chromium	340	TW-02	2/11	30 (Ch. RMEG)	ATSDR 2000
Lead	2,200	TW-02	2/11	15 (GWCTL)	FDEP 1999
Mercury	26	TW-02	2/11	2 (LTHA)	ATSDR 2000
Nickel	390	TW-02	1/11	200 (Ch. RMEG)	ATSDR 2000
Selenium	170J	TW-02	1/11	50 (Ch. EMEG)	ATSDR 2000
Thallium	27JN	TW-02	1/11	0.5 (CREG)	ATSDR 2000
Vanadium	420	TW-02	2/4	30 (Ch. EMEG)	ATSDR 2000

µg/L = micrograms per liter
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
Ch- Indicates the standard is based on a child's exposure concentration
J - Estimated value
N - Presumptive evidence of presence of material

Table 7. Maximum concentrations of organic contaminants in surface soil (0-6 inches bgs) off-site

Contaminants of Concern (COC)	Maximum Concentration (mg/kg)	Sample I.D.	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(mg/kg)	Source
Gamma Chlordane	N.D.	---	0/3	2 (CREG)	ATSDR 2000
Chlorophenol	N.D.	---	0/3	300 (Ch. RMEG)	ATSDR 2000
4, 4'- DDE	N.D.	---	0/3	2 (CREG)	FDEP 1999
1,2-Dichloroethylene	N.D.	---	0/3	10,000 (Ch. EMEG)	ATSDR 2000
3- and 4-Cresol	N.D.	---	0/3	3000 (Ch. RMEG)	FDEP 1999
Tetrachloroethylene	N.D.	---	0/3	500 (Ch. RMEG)	FDEP 1999
Trichloroethylene	N.D.	---	0/3	6 (SCTL)	FDEP 1999
Vinyl Chloride	N.D.	—	0/3	0.3 (CREG)	ATSDR 2000

bgs- below ground surface
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
mg/kg = micrograms per kilogram of soil
N.D.- Not detected
Ch- Indicates the standard is based on a child's exposure concentration

Table 8. Maximum concentrations of inorganic contaminants in off-site surface soil (0-6 inches bgs) or sediment

Contaminants of Concern (COC)	Maximum Concentration (mg/kg)	Sample I.D.	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(mg/kg)	Source
Aluminum	5,300	SS-02	0/4	100,000 (Ch. EMEG)	ATSDR 2000
Arsenic	0.68J	SS-02	1/4	0.5 (CREG)	ATSDR 2000
Barium	63	SS-02	0/4	4000 (Ch. RMEG)	ATSDR 2000
Cadmium	N.D.	---	0/4	10 (CH. EMEG)	ATSDR 2000
Chromium	5.3	SS-02	0/4	200 (Ch. RMEG)	ATSDR 2000
Lead	15	SS-02	0/4	400 (SCTL)	FDEP 1999
Mercury	N.D.	---	0/1	3.4 (SCTL)	FDEP 1999
Nickel	25	SS-06	0/4	1000 (Ch. RMEG)	ATSDR 2000
Selenium	N.D.	---	0/4	390 (SCTL)	FDEP 1999
Thallium	N.D.	---	0/4	5 (Ch. RMEG)	ATSDR 2000
Vanadium	2.1	SS-02	0/3	200 (Ch. EMEG)	ATSDR 2000

bgs- below ground surface
* Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
Ch- Indicates the standard is based on a child's exposure concentration
J - Estimated value
N.D.- Not detected

Table 9. Potential Exposure Pathways

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population	
On-site Soil/sediment Ingestion	On-site soil contamination	On-site soil/sediment	On the property	Incidental ingestion of soil/sediment	On-site residents or trespassers	Current/ Future
On-site Soil Inhalation	On-site soil contamination	On-site dusts from soil	On the property	Inhalation of dusts	On-site residents or trespassers	Current/ Future
Ingestion of On-site groundwater	On-site soil contamination	Groundwater	On-site wells/ Tap water	Ingestion of contaminated groundwater	On-site residents	Future
Inhalation of vapors from on-site groundwater	On-site soil contamination	Groundwater	On-site wells/ Tap water	Inhalation of vapors from contaminated water	On-site residents	Future
Off-site Soil/sediment Ingestion	Contaminated surface water in drainage ditch	Off-site soil/sediment	Drainage ditch	Incidental ingestion of soil/sediment	Off-site residents/children	Current/Future
Off-site Soil Inhalation	Contaminated surface water in drainage ditch	Off-site dusts from soil	Drainage ditch	Inhalation of dusts	Off-site residents/children	Current/Future
Ingestion of off-site groundwater	On-site soil contamination	Groundwater	Off-site wells/ Tap water	Ingestion of contaminated groundwater	Off-site residents	Current/ Future
Inhalation of vapors from off-site groundwater	Migration of on-site groundwater	Groundwater	Off-site wells/ Tap water	Inhalation of vapors from contaminated water	Off-site residents	Current/ Future

Table 10. Total Population Estimation Table

Pathway Types	Estimated Total Population in Potential Exposure Pathways*	Minimum Population*	Maximum Population*
Potential Pathways On-site	0	0	1-50
Potential Pathways Off-site	1300	0	501-2500
Total Potential On and Off-site	**1300**	**0**	**501-2500**
Completed Pathways On-site	10	0	1-50
Completed Pathways Off-site	0	0	0
Total Completed On and Off-site	**10**	**0**	**1-50**
Potential and Completed Pathways On-site	10	0	1-50
Potential and Completed Pathways Off-site	1300	0	501-2500
Total Potential and Completed On and Off-site	**1310**	**0**	**501-2500**

Table 11. Calculated dose of organic chemicals from residential use of on-site groundwater

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Groundwater-Ingestion (mg/kg/day)		Groundwater-Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Groundwater-Inhalation (mg/m^3)	
		Child	Adult	Child	Adult		Child	Adult
Gamma-Chlordane (0.000036 mg/L)	0.0006	0.000002	0.000001	$2x10^{-9}$	$2x10^{-9}$	0.00002	N.S.	N.S.
Chlorophenol (0.1 mg/L)	0.005	0.007	0.003	0.0005	0.0003	N.A.	1	1
3 or 4-Cresol (0.078 mg/L)	0.05	0.005	0.002	0.0003	0.00009	N.A.	0.78	0.78
4,4'-DDE (0.00027 mg/L)	0.0005	0.00002	0.000008	0.0001	0.00007	N.A.	0.003	0.003
1,2-Dichloroethylene (0.16 mg/L)	0.2	0.01	0.005	0.0008	0.0006	0.9	**1.6**	**1.6**
Tetrachloroethylene (0.95 mg/L)	0.05	**0.06**	0.03	0.03	0.02	0.27	**10**	**10**
Trichloroethylene (0.11 mg/L)	0.2	0.007	0.003	0.0008	0.0005	0.55	**1.1**	**1.1**
Vinyl Chloride (0.033 mg/L)	0.00002	**0.002**	**0.0009**	0.00007	0.00005	0.078	**0.33**	**0.33**

These doses were calculated using Risk Assistant software and accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA, 1991). Bold text indicates that the estimated dose exceeds the appropriate MRL.

N.A.- Not available

N.S.- Not significant

The above doses were calculated using the following values and an average shower time of 0.2 hours:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult water consumption-	2 liters/day	Child water consumption-	1 liter/day
Adult skin surface area-	$23,000cm^2$	Child skin surface area-	$7,200cm^2$

mg/kg/day= milligram of contaminant per kilogram body weight per day

mg/m^3= milligram of contaminant per cubic meter

Table 12. Calculated dose of metals from residential use of on-site groundwater

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Groundwater- Ingestion (mg/kg/day)		Groundwater- Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Groundwater- Inhalation (mg/m^3)	
		Child	Adult	Child	Adult		Child	Adult
Aluminum (270 mg/L)	2	**18**	**8**	0.03	0.02	N.A.	N.S.	N.S.
Arsenic (0.068 mg/L)	0.0003	**0.005**	**0.002**	0.000007	0.000004	N.A.	N.S.	N.S.
Barium (3.4 mg/L)	0.07*	**0.2**	**0.1**	0.0003	0.0002	N.A.	N.S.	N.S.
Cadmium (0.0064 mg/L)	0.0002	**0.0004**	0.0002	0.0000006	0.0000004	N.A.	N.S.	N.S.
Chromium (0.53 mg/L)	N.A.	**0.04**	**0.02**	0.000006	0.000004	0.0005	N.S.	N.S.
Lead (0.74 mg/L)	N.A.	**0.05**	**0.02**	0.00007	0.00005	N.A.	N.S.	N.S.
Thallium (0.009 mg/L)	0.00008	**0.0006**	**0.0003**	0.000001	0.0000007	N.A.	N.S.	N.S.
Vanadium (1.1 mg/L)	0.003	**0.07**	**0.03**	0.0001	0.00007	0.0002	N.S.	N.S.

These doses were calculated using Risk Assistant software and accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA, 1991). Bold text indicates that the estimated dose exceeds the appropriate MRL.

N.A.- Not available

N.S.- Not significant

* - EPA's chronic oral reference dose

The above doses were calculated using the following values and an average shower time of 0.2 hours:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult water consumption-	2 liters/day	Child water consumption-	1 liter/day
Adult skin surface area-	23,000cm^2	Child skin surface area-	7,200cm^2

mg/kg/day= milligram of contaminant per kilogram body weight per day

mg/m^3= milligram of contaminant per cubic meter

The estimated doses for chromium and lead are bold because no oral MRL exits. Therefore, both were evaluated for health effects.

Table 13. Calculated dose of metals from ingestion of on-site surface soil

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Soil/dust- Ingestion (mg/kg/day)		Soil/dust- Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Soil/dust- Inhalation (mg/m^3)	
		Child	Adult	Child	Adult		Child	Adult
Arsenic (6 mg/kg)	0.0003	0.00008	0.000009	N.S.	N.S.	N.A.	N.S.	N.S.
Chromium (1500 mg/kg)	N.A.	**0.02**	0.002	N.S.	N.S.	0.0005	0.00008	0.00008
Lead (5300 mg/kg)	N.A.	**0.07**	**0.008**	N.S.	N.S.	N.A.	**0.0003**	**0.0003**

These doses were calculated using Risk Assistant software and accepted values for soil exposure parameters (EPA, 1991). Bold text indicates that the estimated dose exceeds the appropriate MRL.

N.A.- Not available

N.S.- Not significant

The above doses were calculated using the following values and an average shower time of 0.2 hours:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult soil ingestion-	100 mg/day	Child soil ingestion-	200 mg/day
Adult skin surface area-	$23{,}000 cm^2$	Child skin surface area-	$7{,}200 cm^2$

mg/kg/day= milligram of contaminant per kilogram body weight per day

mg/m^3= milligram of contaminant per cubic meter

The estimated doses for chromium and lead are bold because no oral MRL exits. Therefore, both were evaluated for health effects.

Table 14. Calculated dose of organic compounds from residential use of off-site groundwater

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Groundwater-Ingestion (mg/kg/day)		Groundwater-Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Groundwater-Inhalation (mg/m^3)	
		Child	Adult	Child	Adult		Child	Adult
Gamma-Chlordane (0.00013 mg/L)	0.0006	0.000009	0.000004	$1x10^{-8}$	$9x10^{-9}$	0.00002	N.S.	N.S.
Chlorophenol (N.D.)	0.005	N.D	N.D	N.D	N.D	N.A.	N.D	N.D
3 and/or 4-Cresol (N.D.)	0.05	N.D	N.D	N.D	N.D	N.A.	N.D	N.D
4,4'-DDE (N.D.)	0.34	N.D	N.D	N.D	N.D	N.A.	N.D	N.D
1,2-Dichloroethylene (N.D.)	0.2	N.D	N.D	N.D	N.D	0.9	N.D	N.D
Tetrachloroethylene (N.D.)	0.05	N.D	N.D	N.D	N.D	0.27	N.D	N.D
Trichloroethylene (N.D.)	0.2	N.D	N.D	N.D	N.D	0.55	N.D	N.D
Vinyl chloride (N.D.)	0.00002	N.D	N.D	N.D	N.D	0.078	N.D	N.D

These doses were calculated using Risk Assistant software and accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA, 1991). Bold text indicates that the estimated dose exceeds the appropriate MRL.

N.D.- Not detected
N.A.- Not available
N.S.- Not significant

The above doses were calculated using the following values and an average shower time of 0.2 hours:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult water consumption-	2 liters/day	Child water consumption-	1 liter/day
Adult skin surface area-	23,000cm^2	Child skin surface area-	7,200cm^2

mg/kg/day= milligram of contaminant per kilogram body weight per day
mg/m^3= milligram of contaminant per cubic meter

Table 15. Calculated dose of metals from residential use of off-site groundwater

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Groundwater-Ingestion (mg/kg/day)		Groundwater- Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Groundwater-Inhalation (mg/m^3)	
		Child	Adult	Child	Adult		Child	Adult
Aluminum (210 mg/L)	2	**14**	**6**	0.02	0.01	N.A.	N.S.	N.S.
Arsenic (0.11mg/L)	0.0003	**0.007**	**0.003**	0.00001	0.000007	N.A.	N.S.	N.S.
Barium (6.0 mg/L)	0.07	**0.4**	**0.2**	0.0006	0.0004	N.A.	N.S.	N.S.
Cadmium (0.084 mg/L)	0.0002	**0.006**	**0.002**	0.000008	0.000006	N.A.	N.S.	N.S.
Chromium (0.34 mg/L)	N.A.	**0.02**	**0.01**	0.00003	0.00002	0.0005	N.S.	N.S.
Lead (2.2 mg/L)	N.A.	**0.1**	**0.06**	0.0002	0.0001	N.A.	N.S.	N.S.
Mercury (0.026 mg/L)	0.002	0.002	0.0007	0.000002	0.000002	0.0002	N.S.	N.S.
Nickel (0.39 mg/L)	0.02	**0.03**	0.01	0.00004	0.00003	0.0002	N.S.	N.S.
Selenium (0.17 mg/L)	0.005	**0.01**	0.005	0.00002	0.00001	N.A.	N.S.	N.S.
Thallium (0.027 mg/L)	0.00008	**0.002**	**0.0008**	0.00003	0.00002	N.A.	N.S.	N.S.
Vanadium (0.42 mg/L)	0.003	**0.03**	**0.01**	0.00004	0.00003	0.0002	N.S.	N.S.

These doses were calculated using Risk Assistant software and accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA, 1991). Bold text indicates that the estimated dose exceeds the appropriate MRL.

N.A.- Not available
N.S.- Not significant
* - EPA's chronic oral reference dose

The above doses were calculated using the following values and an average shower time of 0.2 hours:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult water consumption-	2 liters/day	Child water consumption-	1 liter/day
Adult skin surface area-	23,000cm^2	Child skin surface area-	7,200cm^2

mg/kg/day= milligram of contaminant per kilogram body weight per day
mg/m^3= milligram of contaminant per cubic meter
The estimated doses for chromium and lead are bold because no oral MRL exits. Therefore, both were evaluated for health effects.

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. 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 a noncancerous 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 in human 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 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 Callaway and Son.

Environmental chemistry analysis errors can arise from random errors in the sampling and analytical processes, resulting in either an over- or under-estimation 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 under-estimate 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 over-estimation 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 over-estimation 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 under-estimation 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. ATSDR PLAIN LANGUAGE GLOSSARY OF ENVIRONMENTAL HEALTH TERMS Revised -15 Dec 99

Absorption: How a chemical enters a person's blood after the chemical has been swallowed, has come into contact with the skin, or has been breathed in.

Acute Exposure: Contact with a chemical that happens once or only for a limited period of time. ATSDR defines acute exposures as those that might last up to 14 days.

Additive Effect: A response to a chemical mixture, or combination of substances, that might be expected if the known effects of individual chemicals, seen at specific doses, were added together.

Adverse Health Effect: A change in body function or the structures of cells that can lead to disease or health problems.

Antagonistic Effect: A response to a mixture of chemicals or combination of substances that is **less** than might be expected if the known effects of individual chemicals, seen at specific doses, were added together.

ATSDR: The **A**gency for **T**oxic **S**ubstances and **D**isease **R**egistry. ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.

Background Level: An average or expected amount of a chemical in a specific environment. Or, amounts of chemicals that occur naturally in a specific environment.

Biota: Used in public health, things that humans would eat – including animals, fish and plants.

CAP: See **C**ommunity **A**ssistance **P**anel.

Cancer: A group of diseases which occur when cells in the body become abnormal and grow, or multiply, out of control

Carcinogen: Any substance shown to cause tumors or cancer in experimental studies.

CERCLA: See **C**omprehensive **E**nvironmental **R**esponse, **C**ompensation, and **L**iability **A**ct.

Chronic Exposure: A contact with a substance or chemical that happens over a long period of time. ATSDR considers exposures of more than one year to be *chronic*.

Completed Exposure Pathway: See **Exposure Pathway**.

Community Assistance Panel (CAP): A group of people from the community and health and environmental agencies who work together on issues and problems at hazardous waste sites.

Comparison Value: (CVs) Concentrations or the amount of substances in air, water, food, and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media (air, water, food and soil) need additional evaluation while health concerns or effects are investigated.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): **CERCLA** was put into place in 1980. It is also known as **Superfund**. This act concerns releases of hazardous substances into the environment, and the cleanup of these substances and hazardous waste sites. ATSDR was created by this act and is responsible for looking into the health issues related to hazardous waste sites.

Concern: A belief or worry that chemicals in the environment might cause harm to people.

Concentration: How much or the amount of a substance present in a certain amount of soil, water, air, or food.

Contaminant: See **Environmental Contaminant**.

Delayed Health Effect: A disease or injury that happens as a result of exposures that may have occurred far in the past.

Dermal Contact: A chemical getting onto your skin. (see **Route of Exposure**).

Dose: The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as "amount of substance(s) per body weight per day".

Dose / Response: The relationship between the amount of exposure (dose) and the change in body function or health that result.

Duration: The amount of time (days, months, years) that a person is exposed to a chemical.

Environmental Contaminant: A substance (chemical) that gets into a system (person, animal, or the environment) in amounts higher than that found in **Background Level**, or what would be expected.

Environmental Media: Usually refers to the air, water, and soil in which chemcials of interest are found. Sometimes refers to the plants and animals that are eaten by humans. **Environmental Media** is the second part of an **Exposure Pathway**.

Environmental Protection Agency (EPA): The federal agency that develops and enforces environmental laws to protect the environment and the public's health.

Epidemiology: The study of the different factors that determine how often, in how many

people, and in which people will disease occur.
Exposure: Coming into contact with a chemical substance.(For the three ways people can come in contact with substances, see **Route of Exposure**.)

Exposure Assessment: The process of finding the ways people come in contact with chemicals, how often and how long they come in contact with chemicals, and the amounts of chemicals with which they come in contact.

Exposure Pathway: A description of the way that a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical.

ATSDR defines an exposure pathway as having 5 parts:

1. Source of Contamination,
2. Environmental Media and Transport Mechanism,
3. Point of Exposure,
4. Route of Exposure, and
5. Receptor Population.

When all 5 parts of an exposure pathway are present, it is called a **Completed Exposure Pathway**. Each of these 5 terms is defined in this Glossary.

Frequency: How often a person is exposed to a chemical over time; for example, every day, once a week, twice a month.

Hazardous Waste: Substances that have been released or thrown away into the environment and, under certain conditions, could be harmful to people who come into contact with them.

Health Effect: ATSDR deals only with **Adverse Health Effects** (see definition in this Glossary).

Indeterminate Public Health Hazard: The category is used in Public Health Assessment documents for sites where important information is lacking (missing or has not yet been gathered) about site-related chemical exposures.

Ingestion: Swallowing something, as in eating or drinking. It is a way a chemical can enter your body (See **Route of Exposure**).

Inhalation: Breathing. It is a way a chemical can enter your body (See **Route of Exposure**).

LOAEL: **L**owest **O**bserved **A**dverse **E**ffect **L**evel. The lowest dose of a chemical in a study, or group of studies, that has caused harmful health effects in people or animals.

Malignancy: See **Cancer**.

MRL: **M**inimal **R**isk **L**evel. An estimate of daily human exposure – by a specified route and length of time -- to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used as a predictor of adverse health effects.

NPL: The **N**ational **P**riorities **L**ist. (Which is part of **Superfund**.) A list kept by the U.S. Environmental Protection Agency (EPA) of the most serious, uncontrolled or abandoned hazardous waste sites in the country. An NPL site needs to be cleaned up or is being looked at to see if people can be exposed to chemicals from the site.

NOAEL: **N**o **O**bserved **A**dverse **E**ffect **L**evel. The highest dose of a chemical in a study, or group of studies, that did not cause harmful health effects in people or animals.

No Apparent Public Health Hazard: The category is used in ATSDR's Public Health Assessment documents for sites where exposure to site-related chemicals may have occurred in the past or is still occurring but the exposures are not at levels expected to cause adverse health effects.

No Public Health Hazard: The category is used in ATSDR's Public Health Assessment documents for sites where there is evidence of an absence of exposure to site-related chemicals.

PHA: **P**ublic **H**ealth **A**ssessment. A report or document that looks at chemicals at a hazardous waste site and tells if people could be harmed from coming into contact with those chemicals. The PHA also tells if possible further public health actions are needed.

Plume: A line or column of air or water containing chemicals moving from the source to areas further away. A plume can be a column or clouds of smoke from a chimney or contaminated underground water sources or contaminated surface water (such as lakes, ponds and streams).

Point of Exposure: The place where someone can come into contact with a contaminated environmental medium (air, water, food or soil). For examples: the area of a playground that has contaminated dirt, a contaminated spring used for drinking water, the location where fruits or vegetables are grown in contaminated soil, or the backyard area where someone might breathe contaminated air.

Population: A group of people living in a certain area; or the number of people in a certain area.

PRP: **P**otentially **R**esponsible **P**arty. A company, government or person that is responsible for causing the pollution at a hazardous waste site. PRP's are expected to help pay for the clean up of a site.

Public Health Assessment(s): See **PHA**.

Public Health Hazard: The category is used in PHAs for sites that have certain physical features or evidence of chronic, site-related chemical exposure that could result in adverse health effects.

Public Health Hazard Criteria: PHA categories given to a site which tell whether people could be harmed by conditions present at the site. Each are defined in the Glossary. The categories are:

1. Urgent Public Health Hazard
2. Public Health Hazard
3. Indeterminate Public Health Hazard
4. No Apparent Public Health Hazard
5. No Public Health Hazard

Receptor Population: People who live or work in the path of one or more chemicals, and who could come into contact with them (See **Exposure Pathway**).

Reference Dose (RfD): An estimate, with safety factors (see **safety factor**) built in, of the daily, life-time exposure of human populations to a possible hazard that is <u>not</u> likely to cause harm to the person.

Route of Exposure: The way a chemical can get into a person's body. There are three exposure routes:

- breathing (also called inhalation),
- eating or drinking (also called ingestion), and
- or getting something on the skin (also called dermal contact).

Safety Factor: Also called **Uncertainty Factor**. When scientists don't have enough information to decide if an exposure will cause harm to people, they use "safety factors" and formulas in place of the information that is not known. These factors and formulas can help determine the amount of a chemical that is <u>not</u> likely to cause harm to people.

SARA: The **S**uperfund **A**mendments and **R**eauthorization **A**ct in 1986 amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from chemical exposures at hazardous waste sites.

Sample Size: The number of people that are needed for a health study.

Sample: A small number of people chosen from a larger population (See **Population**).

Source (of Contamination): The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an **Exposure Pathway**.

Special Populations: People who may be more sensitive to chemical exposures because of certain factors such as age, a disease they already have, occupation, sex, or certain behaviors (like cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Statistics: A branch of the math process of collecting, looking at, and summarizing data or information.

Superfund Site: See **NPL**.

Survey: A way to collect information or data from a group of people (**population**). Surveys can be done by phone, mail, or in person. ATSDR cannot do surveys of more than nine people without approval from the U.S. Department of Health and Human Services.

Synergistic effect: A health effect from an exposure to more than one chemical, where one of the chemicals worsens the effect of another chemical. The combined effect of the chemicals acting together are greater than the effects of the chemicals acting by themselves.

Toxic: Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.

Toxicology: The study of the harmful effects of chemicals on humans or animals.

Tumor: Abnormal growth of tissue or cells that have formed a lump or mass.

Uncertainty Factor: See **Safety Factor**.

Urgent Public Health Hazard: This category is used in ATSDR's Public Health Assessment documents for sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects and require quick intervention to stop people from being exposed.

CERTIFICATION

This Callaway and Son Drum Service site Public Health Assessment was prepared by the Florida Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health assessment was begun.

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

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