PUBLIC HEALTH ASSESSMENT

NOCATEE HULL CREOSOTE

NOCATEE, DE SOTO COUNTY, FLORIDA

EPA FACILITY ID: FLD980709398

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.

CONTENTS

Glossary of Environmental Health Terms

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 for only 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 Agency for Toxic Substances and Disease Registry. 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 Community Assistance Panel.

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 Comprehensive Environmental Response, Compensation, and Liability Act.

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: 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 the **Background Level**, or what would be expected.

Environmental Media: Usually refers to the air, water, and soil in which chemicals 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**.

U.S. 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 disease will 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 become exposed to) the chemical. ATSDR defines an exposure pathway as having 5 parts:

- a source of contamination,
- an environmental media and transport mechanism,
- a point of exposure,
- a route of exposure, and
- a 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).

Intermediate Exposure: Any chemical exposure that has occurred for more 14 days but less than one year (365 days).

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: Lowest Observed Adverse Effect Level. 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: Minimal Risk Level. 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.

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 could cause someone to become ill.

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.

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

- Urgent Public Health Hazard
- Public Health Hazard
- Indeterminate Public Health Hazard
- No Apparent Public Health Hazard
- 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 not likely to cause harm to people.

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

Breathing (inhalation)
Eating or drinking (ingestion)
Getting something on the skin (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 not likely to cause harm to people.

SARA: The Superfund Amendments and Reauthorization Act 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 (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.

NPL: The National Priorities List. (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: No Observed Adverse Effect Level. 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 as used in ATSDR's Public Health Assessment documents for sites where there is no evidence of exposure to site-related chemicals.

PHA: Public Health Assessment. 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). 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 are examples of points of exposure.

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

PRP: Potentially Responsible Party. 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 as 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.

1.0 SUMMARY

The gated entrance to the Nocatee Hull Creosote site is on the west side of Hull Avenue, 1.8 miles south of the intersection of Hull Avenue and U.S. 17, in DeSoto County, Florida. Grassy fields cover much of the flat eastern half of the 98-acre site. The western half of the site is mainly trees in the Peace River flood plain. Charlotte Harbor & Northern Railway Company and later the Seaboard Railroad preserved railroad ties and timbers on the original 22.4-acre site from 1913 to 1952. Their process wastes included steam and vacuum vapor condensate from the pressure-treatment cylinder, drippings, and sludge. Site investigators estimate wood-treating operations could have produced 5,000 gallons of condensate per day. Workers separated the condensate into oil and water fractions in two sumps and piped the water fraction to a borrow pit west of the cylinder. CSX Transportation, Inc.(CSXT) (present site owners) purchased additional acreage in 1996 when site investigations found wood-treating chemicals in soil, sediments and groundwater west of the original site. Site investigations also show creosote components and arsenic in soil and groundwater in the former timber processing and drying areas. A culvert under Hull Avenue conveys surface water runoff from the site to Oak Creek via a drainage area through Oak Creek Estates. Creosote components and arsenic are found in sediments, soil, and groundwater near this drainage area in the Oak Creek Estates neighborhood east of the site.

Community members have asked if chemicals from the site could have harmed them. Florida Department of Health (DOH) staff are not aware of any residents who are currently exposed (or who were exposed in the past) to site-related contaminants at levels likely to cause increased risk of illness. One private well east of the site contains low levels of benzene. This well has a filter supplied and maintained by Florida Department of Environmental Protection (DEP) that removes benzene and other chemicals from the water. We do not expect an increased risk of illness for the people using this well due to the low level (two micrograms per liter of benzene), and the short period of time (at most 13 months) exposure could have occurred. The staff of DeSoto County Health Department and/or the staff of CSXT's consultant, Gannett Fleming, samples this well and other nearby private wells every three months. At this time, no other private wells have shown chemicals above the primary drinking water standards. CSXT installed a six-foot, chain-linked fence to restrict access to areas of off-site impacted soil in January 2001. In the past, contact with off-site soil contaminants could have come from digging or gardening. However, trees and grass generally provide dense ground cover in the Hull area; therefore, past ingestion of, or skin contact with sufficient levels of chemicals in off-site soil to cause illness are unlikely. If children did have daily contact with soil and accidentally ingested soil with the highest levels of arsenic found off-site for a year or longer, they would be at slight increased risk of skin and/or lung cancer.

CSXT cleared deed restrictions with DEP but has yet to enter them on county property records. Unless the soil and groundwater are decontaminated, CSXT should enter deed restrictions onto the county property records to prevent future residential use of this site and the use of site groundwater as a source of drinking water. CSXT should control dust generation during any future cleanup activities that remove surface vegetation or disturb soil both on and off the site.

DOH recommends that the United States Environmental Protection Agency (EPA) staff continue to require quarterly sampling and analysis of the water from private wells within the area of off-site contaminated groundwater for creosote components and arsenic). If EPA should discontinue this

sampling requirement, DOH recommends filters be installed on the wells within the area of groundwater contamination. The six foot high chain-linked fence should restrict area residents access to contaminated soil. DOH and DEP staff will inform nearby residents about the public health threats at this site and will discuss any health concerns that they may have.

2.0 PURPOSE AND HEALTH ISSUES

In the fall of 1999, the United States Environmental Protection Agency (EPA) asked DOH if chemicals from the Nocatee Hull Creosote site were a public health threat. This is the first assessment of this site by either the DOH or the Agency for Toxic Substances and Disease Registry (ATSDR).

In this health assessment, we evaluate people's past, current, and future potential for exposures to chemicals at and near the Nocatee Hull Creosote hazardous waste site. We then discuss the likelihood of these exposures to cause illnesses.

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

CSXT, the present owners of the site, signed an Administrative Order of Consent with EPA on August 6, 1999 that required CSXT to perform a Streamlined Remedial Investigation/Focused Feasibility Study of the site. These activities will determine the nature and extent of contamination, and develop feasible clean-up alternatives. This site is a National Priorities List-equivalent site.

3.0 BACKGROUND

3.1 Site History

Charlotte Harbor & Northern Railway Company, and later Seaboard System Railroad, preserved railroad ties and timbers using the "open steaming" process on the original 22.4-acre Nocatee Hull Creosote site. Operations began in 1913 and ended in 1952. In the "open steaming" process, wood was steamed in a large cylinder to reduce its natural moisture content and to increase its ability to soak up creosote. Next, heated coal-tar creosote was pumped into the cylinder. The heated cylinder was pressurized to force creosote preservative into the wood. At the end of the treating cycle they released the pressure and discharged the steam condensate

(liquid) formed in the cylinder. A vacuum was applied to the cylinder for three hours to remove any remaining water or excess creosote (Environmental Sciences and Engineering (ESE), 1984).

In addition to steam condensate from the treating process, wood treatment waste sources included cylinder drippings, contaminated rainwater, and condensed vapors collected from the vacuum cycle. ESE estimated that one cylinder could discharge 5,000 gallons of waste water per day (ESE 1984). Oil and water were only minimally separated from the wastewater before it was discharged to a 4.5-acre borrow pit (ESE 1984, Figure 1, Appendix B). This pit drains to the northwest, into an unnamed tributary of the Peace River. Creosote drips and spills from the cylinders and wood drying racks stuck to dirt and bark, forming sludges in the waste waters.

According to the available historic air photos, the area east of the site was not populated when the wood treatment plant was operating (EPA 1998). Since at least 1943, citrus groves have been located northwest and south of the site. During operations, the treatment cylinder was in the center of the original 22.4-acre site surrounded by three storage areas for wood, four above ground storage tanks, and a borrow pit for liquid wastes (EPA 1998). All were close to Hull Avenue. Other site features included a plant office building and a second, smaller open waste pit. The facility was largely dismantled by 1958 (one storage tank remained).

Between 1952 and 1958, three buildings (possibly two homes and one business) were built on the east side of Hull Avenue, across from the site. Between 1958 and 1968, the first commercial building and one of the houses were torn down and a new business was built. On the site, the borrow pit was cleared and backfilled between 1958 and 1968, but trees grew back in it again by 1978. Between 1968 and 1972, a travel-trailer park was built east of Hull Avenue; it was gone by 1978. Oak Creek Road was constructed between 1972 and 1978, but due to poor photo quality we don't know if there were homes located along it at that time (EPA 1998).

The Department of Environmental Regulation (DER), South District—now the Department of Environmental Protection (DEP)—first investigated the site in 1982. They found polynuclear aromatic hydrocarbons (PAHs), a component of creosote, in on-site surface water. In 1983, Seaboard Systems Railroad still owned the site. Their consultant, NUS Corp., found boron, used in wood-treating as a fire-retardant, at levels above the DEP guidance level for systemic toxicants in an on-site drinking water well. NUS also found PAHs and metals in the soil (NUS 1983). At DER's request, Seaboard System Railroad secured the contaminated area, removed creosote from sumps and tanks, and began installing monitoring wells. Seaboard System Railroad entered into a consent order with DER in 1986.

Between 1986 and 1997, Seaboard System Railroad, later CSX Transportation, Inc. (CSXT), analyzed soil and groundwater samples from this site and nearby private wells. In 1995, DEP approved CSXT's deed restrictions for future site use. Early soil and sediment samples showed that the surface soil and sediments west of the borrow pit were contaminated. As a result, CSXT purchased this area, part of "the Hill Property," in 1996, increasing the site total acreage to 98. In 1997, a citizen complained of creosote in a drainage ditch east of the site. DEP sampled this area, finding other areas with creosote. In late 1997, DEP also found benzene in a private well

east of the site. They installed a filter on this well in early 1998. From 1998 to 2001, consultants for CSXT collected and analyzed additional soil and groundwater samples.

3.2 Site Description

This site is in the community of Hull in rural southwestern DeSoto County, about four miles southwest of the town of Nocatee. The site is on the west side of Hull Avenue, directly across from Oak Creek Acres, a trailer park (Figure 1, Appendix B). While Hull has several dozen residences, much of the area is wetlands and citrus groves. The east side of the site is flat and the west side slopes toward the Peace River. Much of the eastern part of the site is a grassy field, with a few large live oaks, pines, and palms. In the grassy area, the only physical reminders of the site's wood-treating past are patches of asphalt-like material, monitoring wells, and the tree-filled borrow pit. The western half of the site has dense wetlands vegetation; it is in the flood plain of the Peace River.

3.2.1 Demographics. In 1990, about 119 people lived within a mile of the site. About 23 percent were 19 years old or younger. Approximately 9% were black, 85% were white, and 6% were Hispanic. The average per capita income was $10,494; 16.8% (20 people) were below the poverty level (Bureau of Census 1990).

3.2.2 Land Use. The areas north and south of the site are citrus groves. The Peace River flood plain (west), and the areas near Oak Creek (east) have thick wetlands vegetation. North, east, and south of the site are single family homes (Figure 1, Appendix B).

3.2.3 Natural Resource Use. The surficial aquifer is used as a drinking water source by nearby residents (ESE 1984). In this area, the surficial aquifer consists of 60 feet of very fine-grained sand. In 1999, CSXT's consultants found 44 potable wells, including four that served multiple homes and two church wells within one mile of the site (Gannett Fleming 1999). Depth information is only available for six of these wells. They report the shallowest well as 12 feet deep. The next shallowest well is 70 feet. On the site, the water table is 16 feet or less below the land surface.

Below the surface sand layers are phosphatic limestone, dolomite, and clay layers that together make up the Floridan Aquifer. The Floridan Aquifer is artesian here; there is a flowing irrigation well on the site (ESE 1984).

DOH does not know if hunting or fishing occurs on or near the site.

3.3 Site Visits

On November 30, 1999, Connie Garrett, DOH, visited the site. She met Jamey Watt, EPA, and Ron Leins, Gannett Fleming, on the site. Appendix B has site visit photos. Photos 1-7 are of the site and photos 8-12 are of the nearby neighborhoods. Photos 11 and 12 show the ditch east of Hull Avenue.

The site was fenced and the entry gate was locked. The gate had a large "No Trespassing" sign on it (Photo 1, Appendix B). Although the soil has some bare patches (chunks of creosote sludge), vegetation on the site prevents heavy soil erosion. Photo 3 (Appendix B) shows some of the patches of sludge where vegetation is not growing. Photo 5 shows a dirt road on the site. Photo 6 shows the sediments/soil (depending on the weather conditions) in the borrow pit. No physical hazards were found on the site.

On August 27, 2001, Connie Garrett revisited the site with Beth Copeland, Superfund Site Health Educator and Community Involvement Coordinator, Bureau of Environmental Epidemiology, DOH. They met Bill Denman and Archie Lee, EPA, Ron Leins from Gannett Fleming, and Keith Brinker, CSXT. Appendix B has Photos (Appendix B) of the fenced off-site sediment containment facility installed since the previous visit to limit off-site chemical exposure. Other photos taken that day are 13 and 14, the fencing east and west of Oak Creek Road (facing south); photo 15, the fencing flanking Oak Creek Road where the culvert that drains the site crosses beneath it; and photos 16 and 17 that show the sediment control structure.

4.0 DISCUSSION

This section reviews the available groundwater and soil data from the site to determine (1) what chemicals may have been released to soil or water and the levels currently measured there; (2) how people may have come in contact with the chemicals in the past and how they might come in contact with these chemicals now and in the future; and (3) if these chemicals are likely to affect the public health.

The public health assessment process has inherent uncertainties. However, these uncertainties are moderated by using worst-case assumptions when estimating or interpreting health risks. Also, conservative safety margins are used when health-related threshold values are established. This is done so that the assumptions, interpretations, and recommendations made throughout this public health assessment process will assure public health protection.

4.1 Environmental Contamination

In this section we review the environmental data collected at and near the site since the early 1980s, we evaluate sampling adequacy, and we select contaminants of concern. In the appended tables we list the maximum concentration and detection frequency for the contaminants of concern in the various media (water and soil; no quantitative air data were available). We select contaminants of concern by considering the following factors:

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

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

Community health concerns.

Comparison of maximum concentrations with published ATSDR standard comparison values for media providing complete and potential exposure pathways. ATSDR's published standard comparison values are media-specific concentrations used to select contaminants for further evaluation. They are not used to predict health effects nor to set cleanup levels. Contaminants with media concentrations above an ATSDR standard comparison value do not necessarily represent a health threat, but are selected for further evaluation. Contaminants with media concentrations below an ATSDR standard comparison value are unlikely to be associated with illness and unless the community raises a specific concern about the contaminant, are not evaluated further.

Comparison of maximum concentrations with toxicological information published in ATSDR toxicological profile documents, for complete and potential exposure pathways. These profiles are chemical-specific and summarize toxicological information found in scientific literature.

We used the following ATSDR standard comparison values (ATSDR 1992a), in order of priority, to select contaminants of concern:

The Environmental Media Evaluation Guide (EMEG) is derived from ATSDR's Minimal Risk Level (MRL) that uses 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 likely to be without an appreciable risk of noncancerous illnesses, generally for a year or longer.

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

The Reference Dose Media Evaluation Guide (RMEG) is derived from 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.

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

Using the components and criteria listed above, we selected eight chemicals as contaminants of concern. These chemicals are arsenic, benzene, boron, carbazole, dibenzofurans, naphthalene, polynuclear hydrocarbons (PAHs), and pentachlorophenol.

We use ATSDR standard comparison values to select contaminants of concern for further consideration. Identification of a contaminant of concern serves to narrow the focus of the public health assessment to those contaminants most important to public health. However, it does not necessarily mean that exposure to that contaminant will cause illness. When a contaminant of concern in one medium is identified, that contaminant is reported in all other media. Contaminants of concern are individually evaluated and and estimates of whether exposure is likely to cause illness is reported.

Contaminated soil and sediments are found on and off the site. The direction of site groundwater movement is westward, indicating the possibility that contamination has spread to the west. In 1997, creosote components were found east of the site in Oak Creek Estates. While digging a ditch to divert flooding from an area of surface runoff that enters Oak Creek, workers noticed a creosote smell and sheen in the sediments. These chemicals have in the past and still continue to seep into the groundwater indicting that groundwater hydraulically up gradient of the site is also contaminated. While on-site surface water contains wood-treating chemicals, the off-site surface water (Oak Creek) does not.

4.1.1 On-site Contamination. For this public health assessment, "on site" is define as the area within the Nocatee Hull creosote property boundaries as shown in Figure 1, Appendix B.

4.1.1.1 On-site Groundwater. Between March 1982 and November 1999, DEP, EPA, and various consultants collected 55 groundwater samples from 25 on-site monitoring wells (Gannett Fleming 2000; Black and Veatch Special Projects 1998; Water and Earth Sciences 1995; Environmental Science and Engineering 1984; NUS 1983; FDER 1982). The results of these tests are summarized in Table 1, Appendix C. For the purposes of this public health assessment, on-site groundwater has been adequately tested. Although few groundwater contamination samples have been collected from the western part of the site, this area of the site is flood plain (wetlands) for the Peace River, and as such, is not likely to ever have wells drilled or bored there.

4.1.1.2 On-site Surface Soil. Between January 1983 and November 1999, DEP, EPA, and various consultants collected 177 on-site surface soil samples (Gannett Fleming 2000; Black and Veatch Special Projects 1998; Water and Earth Sciences 1995, Environmental Science and Engineering 1984, NUS 1983, FDER 1982). Soil testing results are summarize in Table 2, Appendix B. On-site surface soil has been adequately tested.

4.1.1.3 On-site Air. Site visits and other available information about this site do not indicate that air monitoring is necessary.

4.1.1.4 On-site Surface Water. Between September1986 and October 1990, ESE and Water and Earth Sciences took nine surface water samples on the site; the results of these samples are

summarized in Table 3, Appendix C. For this public health assessment, on-site surface water has been adequately tested.

4.1.2 Off-site Contamination. For this public health assessment, "off site" is defined as the area outside the Nocatee Hull creosote site boundaries (Figure 1, Appendix B).

4.1.2.1 Off-site Groundwater. From March 1982 to September 1999, 43 groundwater samples from 17 off-site private wells, and 13 samples from 13 off-site monitoring wells were collected by DEP, EPA, and various consultants (Gannett Fleming 2000; Black and Veatch Special Projects 1998; Water and Earth Sciences 1995; Environmental Science and Engineering 1984; NUS 1983; FDER 1982). Some of these private wells may have been sampled by more than one of the agencies and consultants, but due to inconsistent sample labeling, duplicate wells among the samples cannot be matched. These samples were analyzed by various laboratories for metals, creosote components, herbicides, and pesticides.

Off-site groundwater tests are summarize in Table 4, Appendix C, and in Figures 2 and 3. Figure 2 shows the approximate locations of the private wells (the filtered well location is also indicated). Figure 3 shows approximate locations of the monitoring wells. Monitoring wells are shallower than drinking water wells and therefore might show contaminants when drinking water wells in the same area do not. Figure 3 shows monitoring wells with benzene and PAHs (toxicity equivalent totaled to benzo[a]pyrene, TEBaP) while the adjacent private wells (in these immediate areas) have shown neither benzene nor PAHs.

The extent of off-site groundwater contamination has only recently been determined. CSTX's contractor installed three new monitoring wells east and west of the northern part of Oak Creek Road. One of the new wells is south of the culvert/drainage ditch east of Hull Avenue. A second new monitoring well is east of Oak Creek Road and a third is north of the drainage area. Data for these new monitoring wells has not been released, but staff from Gannet Fleming, CSXT's contractor, told DOH that these new wells did not show contamination. Therefore, the area of groundwater contamination is now known to be within the area encompassed by the new monitoring wells and the existing off-site monitoring wells that did not show contamination in the past.

4.1.2.2 Off-site Surface Soil. In April 1996 and November 1999, consultants for EPA and CSXT collected 30 off-site soil samples (Gannett Fleming 2000; Black and Veatch Special Projects 1998). Some parts of the drainage area that they sampled had a sheen on the surface water and a creosote odor. In about half the samples, odor and sheen were first detected at 6 or more inches below the land surface (DEP 1996).

DEP collected two soil samples north of the borrow pit in the Boggess Orange Grove in 1997. These samples did not show contamination.

Soil results are summarize the in Table 5, Appendix C, and in Figure 4. Off-site surface soil has been adequately tested to determine the presence of elevated PAHs (EPA requires the testing of

one foot of soil in their "surface" sample criteria). Because data from soil samples taken at depths from 0-12 inches deep, exposures may have been overestimated; people are likely to be incidentally exposed to soil 0-3 inches deep.

4.1.2.3 Off-Site Air. In 1998 and 1999, consultants for CSXT used portable air monitors to detect vapors coming from drainage ditch sediments near the culvert under Hull Avenue in order to decide where to collect sediment samples. Because this portable air monitoring data did not identify individual contaminants, these measurements cannot be used to estimate exposures or predict the likelihood of illness.

4.1.2.4 Off-site Surface Water. Consultants for CSXT took one surface water sample from Oak Creek (Gannett Fleming 1999); results for this sample are summarized in Table 6, Appendix C. Off-site surface water has been adequately tested for the purposes of this assessment.

4.1.3 Quality Assurance and Quality Control. Existing environmental data was used in preparing this public health assessment. Government consultants or consultants overseen by government agencies collected these samples. Therefore, it is assumed these data are valid and that adequate quality assurance and quality control measures were taken concerning chain-of-custody, laboratory procedures, and data reporting.

The completeness and reliability of the referenced information determine the validity of the analyses and conclusions drawn for this public health assessment. In each of the preceding on- and off-site contamination subsections, we evaluated the adequacy of the data to estimate exposures. We assumed that estimated data and presumptive data were valid. This errs on the side of public health by assuming that a contaminant exists when it may not exist.

4.2 Physical Hazards

No physical hazards on the site were noted during the November 30, 1999 visit.

4.3 Pathways Analyses

Chemical contaminants in the environment can harm people's health only if there is contact with those contaminants. Determining or estimating the contact people have with hazardous substances is essential to assessing the importance for public health. This means by which this contact is made is called the exposure pathway.

An exposure pathway has five parts: (1) a source of contaminants; (2) an environmental media like groundwater or soil that can hold or move the contamination; (3) a point where people contact contaminated media, like a drinking water well or a garden; (4) an exposure route such as drinking contaminated water from a well or eating contaminated soil on homegrown vegetables, and (5) a population who may contact the contaminants.

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

Before 1953, workers at this site may have been exposed to wood-treating chemicals by inhalation, incidental ingestion, and/or skin absorption. However, because data do not exist for that time, worker exposure to these chemicals cannot be estimated.

4.3.1 Completed Exposure Pathway. The following human exposure pathway is considered complete for the Nocatee Hull Creosote site (Table 7, Appendix C):

4.3.1.1 Private Well Water. Sometime between January 1997 and February 1998, residents in one home east of the site used well water with very low levels of benzene. Although the residents could have been exposed to benzene in their well water by drinking it, by inhaling vapors from the water, and by absorbing it through their skin, the level was so low we believe illness from such exposures to be very unlikely. The source of the benzene is not known. In addition to this private well, benzene has been detected in one off-site monitoring well, and in four of the 35 monitoring wells on the site.

4.3.2 Potential Exposure Pathways. We consider off-site private wells, future off-site wells and off-site surface soil as potential exposure pathways (Table 8, Appendix C). These pathways are currently incomplete (there are no known current exposures), but are possible in the future.

4.3.2.1 - Private Wells. In the future, contaminated groundwater could reach about 12 existing off-site private wells east of the site. Ingestion, inhalation and dermal contact with groundwater contaminants from tap water are potential routes of exposure (Table 8, Appendix C). While possible, such pathways are likely to be temporary because these wells are being sampled every three months by the DeSoto County Health Department and/or CSXT's consultant. DEP has a program to supply filters to anyone with chemicals above the Maximum Concentration Levels (MCLs) in private well water that supplies drinking water.

4.3.2.2 On-Site Surface Soil and Contaminated Dust. There is no on-site population and because the site is fenced and inactive, direct contact with on-site soil is currently of minimal exposure concern.

4.3.2.3 Off-Site Surface Soil and Sediments. Before CSXT's consultants fenced the area of impacted soil, it is possible residents from 10-20 nearby homes could have accidentally eaten small amounts of contaminated soil. Although such exposure was possible, DOH does not believe it to be probable, due to the highly vegetated nature of this drainage area.

4.3.3 Eliminated Exposure Pathways

4.3.3.1 On Site Private Wells. The one contaminated well on the site has been sealed and is no longer used. Although there is an on-site artesian (free-flowing) irrigation well, the fact that it is artesian means that it is sealed off from the aquifer above it and under elevated water pressure from a distant recharge source. Therefore, water from this well probably does not contain site-related chemicals.

4.3.3.2 Surface Water. Surface water sample analyses do not show the surface water in Peace River or Oak Creek to be contaminated at this time. While surface water samples have not shown chemical contamination, surface water may be the conveyance media for the contaminated sediments mentioned in the potential exposure pathway above.

4.4 Public Health Implications

A discussion of exposure levels and possible health effects that might occur in people exposed to the contaminants of concern at the Nocatee Hull Creosote site follows.

4.4.1 Toxicologic Evaluation. Using standard default assumptions of frequency and duration of use, the likely child and adult doses following ingestion of groundwater and soil containing the maximum on- and off-site contaminant concentrations are estimated. Also in this subsection, general ideas such as the risk of illness, dose response and thresholds, and uncertainty in public health assessments are discussed.

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

> "...all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus the amount of a chemical a person is exposed to is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they must consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant."
>
> Thus instead of using the amount that is administered or to which an organism is exposed, it is more realistic to use the amount per weight of the organism. Thus 1 ounce administered to a 1-pound rat is equivalent to 2000 ounces to a 2000-pound (1-ton) elephant. In each case, the amount per weight is the same: 1 ounce for each pound of animal.
>
> This amount per weight is the dose. We use dose in toxicology to compare the toxicity of different chemicals in different animals."

In expressing the daily dose, units of milligrams of contaminant per kilogram of body weight per day (mg/kg/day)is used. A milligram is one-thousandth of a gram (a gram weighs about what a raisin or paperclip weighs), a kilogram is about two pounds.

To calculate the daily dose of each contaminant, standard assumptions about body weight, ingestion and inhalation rates, exposure time length, and other factors needed for dose calculation were used. (ATSDR 1992a, EPA 1997). In calculating the dose, we assume people are exposed to the maximum concentration measured for each contaminant in each medium. Tables 9-12, Appendix B, summarizes the maximum estimated exposure doses for all eight contaminants of concern.

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

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

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

The contaminants of concern were all used to treat wood. Arsenic, a metal, and pentachlorophenol, a man-made chemical, are wood preservatives. Boron, a semi-metal, is a fire retardant used to prevent treated wood from burning. The other chemicals—benzene, carbazole, dibenzofuran, naphthalene, and PAHS—are some of the nearly 200 chemical components of coal tar creosote oil that is also used to preserve wood.

4.4.1.1 Arsenic. Doses calculated for the highest levels of arsenic found in soil and groundwater on and off the site were below levels causing noncancer health effects, even for daily, long term exposure (Appendix C, Tables 9-12). However, people who might daily drink contaminated shallow groundwater on the site (at the highest levels found) for a period of one year or longer could be at a moderate increased risk for developing skin cancer (basal or

squamous cell cancer) (ATSDR 1999). DOH assumes an adult will drink two liters of water per day and a child will drink one liter of water a day. Patients with arsenic-induced skin cancer have developed other internal tumors—bladder, kidney, liver, lung, and prostate—but DOH cannot calculate a statistical risk of increase for these other cancer types because EPA has no slope factor or unit risk linking these cancers with levels of arsenic exposure (ATSDR 2000a). At this time, elevated arsenic levels in on-site groundwater have been detected only in monitoring wells. Arsenic levels in monitoring and private wells off site are lower and only the levels found in off-site monitoring wells could be associated with a low increased cancer risk.

The dose estimates for soil on the site show that children could be at low increased risk for skin cancer if they ate soil daily (two postage stamps weigh about 200 milligrams) for a year or longer. However, because access to the site is restricted, this amount of exposure for children is unlikely. The highest level of arsenic measured in off-site soil was found in the easternmost part of the drainage ditch, which is densely vegetated. Daily ingestion of soil from this location (Photo 12, Appendix B) would give a statistical increase in cancer risk of seven in 100,000—a level which ATSDR qualitatively defines as within a category of "no apparent" increased risk. It is unlikely that a child would accidentally eat 200 milligrams of soil from this area every day for a longer period of time than one year. Most other offsite areas have less arsenic in the soil and are well-vegetated, making daily incidental ingestion of soil less likely. Estimated contaminated-soil ingestion levels for adults are below the levels linked with increases for cancer risk.

Child and adult estimated doses for skin contact with groundwater and soil, and also inhalation of dust are not likely to cause illness, even with assumptions of lifelong, daily exposure.

4.4.1.2 Benzene. Calculated doses for the highest levels of benzene found in groundwater on and off the site were below levels that could cause noncancer health effects, even for daily, long term exposure (Appendix C, Tables 9-12, ATSDR 1997). People using shallow groundwater (meaning levels found in monitoring wells, not private wells) as a daily, long term source of water for drinking and other household uses would also have little increased risk of cancer. The type of cancer associated with benzene exposure is acute myelocytic leukemia, a cancer of the red blood cells. This is type of cancer very rare and is usually associated with workers who have elevated exposures to benzene (ATSDR 1997).

Doses estimated for skin contact with the highest benzene levels in groundwater and inhalation of vapors from the same are not likely to cause illness, even with assumptions of lifelong, daily exposure (ATSDR, 1997).

The level of benzene found in the private well off-site was two micrograms per liter, or two parts per billion. Two parts per billion equals two seconds in 32 years; a very low level. Our dose calculation showed that someone drinking, showering and having skin contact with this water for 30 years would have little increased risk of cancer. We estimate the residents could have been drinking well water with this level of benzene for 13 months or less. We would not expect an

increase in the risk of cancer (acute myelocytic leukemia) for exposure to this very low level of benzene for this short duration.

4.4.1.3 Boron. The calculated dose for the amount of boron found in an on-site drinking water well in 1983 (the highest level found) is 2,520 times less than the dose associated with vomiting and diarrhea in infants (the health effect occurring at the lowest dose) (ATSDR 1992b). Studies have not linked boron with any cancer types. Other illnesses from long-term daily exposure are seen only at much higher levels. Therefore, it is unlikely that use of on-site, boron-contaminated groundwater would have caused illness. The well in which boron was found is no longer used.

4.4.1.4 Carbazole. Calculated doses for the highest levels of carbazole found in on-site groundwater and in soil both on and off the site were below levels causing noncancer health effects, even for daily, long term exposure (Appendix C, Tables 9-12) (ATSDR 1996a). Carbazole is not classifiable as a human carcinogen and only limited studies have looked at its carcinogenicity in animals.

4.4.1.5 Dibenzofurans. Dibenzofurans were only identified above screening values in one shallow groundwater monitoring well (MW-8) on the western side of the site. Calculated doses for children and adults are greater than the short (1 to 14 days) and intermediate (15 to 364 days) duration doses associated with illness. Dibenzofuran-related illnesses include skin and eye irritation, especially severe acne, darkened skin color, and swollen eyelids (with discharge). Dibenzofurans are linked only with cancer (liver, lung, trachea and bronchus) through oral (ingestion) exposure (ATSDR 1994). At this time, illnesses from dibenzofurans are unexpected because there are no known exposures.

4.4.1.6 Naphthalene. Naphthalene, 1-methyl-naphthalene and 2-methyl-naphthalene were all found on and off the site. Unmethylated naphthalene is more toxic than the methylated varieties and it was generally found in higher amounts. Therefore, we evaluated unmethylated naphthalene. Neither naphthalene, 1-methyl-naphthalene nor 2-methyl-naphthalene has been associated with cancer in humans or animals. The amounts of naphthalene found in soil on and off the site are below health screening values.

DOH evaluated the risk of illness if an exposure pathway was completed at the highest levels found in groundwater on and off the site. The highest calculated on-site dose is 13 times less than the lowest dose associated with decreases in Blood Urea Nitrogen (BUN) in animals. BUN decrease indicates that naphthalene may inhibit protein breakdown or may inhibit the use of nitrogen in the body. Although naphthalene was found in a private well off the site (this well now has a filter due to benzene contamination), the level there was 265 times less than the lowest dose associated with BUN decrease in animals. Therefore, DOH believes it is unlikely that the levels of naphthalene or methylated naphthalene in groundwater would cause (or could have caused) illness (ATSDR 1995a).

4.4.1.7 Polynuclear Aromatic Hydrocarbons (PAHs). Although PAHs in on-site and off-site groundwater and soil occur above health-based screening values, they are "point of contact"

carcinogens (not easily or extensively absorbed into the body). The mechanism of skin damage and tumor promotion seen in mouse skin seems different from that of humans. Mice are very sensitive to tumor promoters and humans tend not to be. Coal tar shampoos and ointments containing coal tar have long been used for the treatment of various skin disorders. Studies that link the statistical significance of human health effects and use of these products have generally been unable to find any evidence of increased skin tumors, or any other tumors (Alan Susten, ATSDR Toxicologist, personal communication, 6/28/00).

Of the individual chemicals that make up the PAH group, only 15 are associated with cancer in animals or humans and some are much less toxic than others. Relative toxicity is calculated using factors that compare toxicity of individual PAHs to benzo[a]pyrene (B[a]P). We multiplied the individual PAH amounts detected by this factor, then added the relative amounts to a total amount (equivalent to benzo[a]pyrene's toxicity).

PAH	Toxicity Equivalency Factor
Dibenz[a,h]anthracene	5
Benzo[a]pyrene	1
Benzo[a]anthracene	0.1
Benzo[b]fluoranthene	0.1
Benzo[k]fluoranthene	0.1
Indeno[1,2,3-c,d]pyrene	0.1
Anthracene	0.01
Benzo[g,h,i]perylene	0.01
Chrysene	0.01
Acenaphthene	0.001
Acenaphthylene	0.001
Fluoranthene	0.001
Fluorene	0.001
Phenanthrene	0.001
Pyrene	0.001

Source: ATSDR 1995b.

Off-site, PAHs have been found in soil and in groundwater taken from shallow monitoring wells. PAHs have not been found in water from private wells. If people were to eat soil or drink water with PAHs at the highest levels found, the only health effects we might see with daily, long term exposure could be a low to moderate increase in the risk of stomach cancer (ATSDR 1995b). Because private wells near the site are tested every three months, it is unlikely people will drink PAH-contaminated water. Again, DEP has a program to supply filters for people who have drinking water wells with chemicals above the state drinking water standards. People may have limited opportunity for hand-to-mouth contact with PAH-contaminated soil because much of the area east of the site has thick vegetation. With little expected exposure to PAHs in soil and no known use of PAH-contaminated water, we would not predict an increase in stomach cancers for nearby residents from PAHs.

On-site, the PAH levels are higher in water and soil than off-site and would therefore present a greater cancer risk, especially in water exposures. However, on-site exposure is unlikely at this time because there are no residents or drinking water wells.

Calculated inhalation and dermal doses for potential on- and off-site soil and groundwater exposure are much less than levels likely to cause illness in people. Generally, adverse respiratory effects and skin cancers are only associated with daily inhalation or direct contact at high workplace levels.

4.4.1.8 Pentachlorophenol. Pentachlorophenol has been detected at levels above health screening values in groundwater and soil on the site. These levels would not produce elevated doses like those for workers, from which we get most of our human health effects information (ATSDR 2000b). Because information on low-level exposures in humans is not available, we estimate human health effects from studies of low-level exposures in animals. In animals, long-term, daily exposures to low levels of pentachlorophenol has caused increases in a relatively rare type of liver and spleen cancers (hemangiosarcomas), and tumors and cancers of the adrenal glands. The major organs and systems of animals affected by long-term exposure to low pentachlorophenol levels are the liver, kidney, endocrine system, nervous system, and immune system. The doses calculated for the highest level of on-site pentachlorophenol are much lower than those that increased cancers in animals.

Because of the relatively low calculated doses and the lack of known exposures, illness resulting from pentachlorophenol in soil or groundwater on the site is not expected.

4.4.2 Risk of Illness, Dose Response/Threshold, and Uncertainty. In Appendix D limitations on estimating the risk of illness, the theory of dose response and the idea of thresholds are discussed. Also, the sources of uncertainty inherent in public health assessments are discussed.

4.5 Children and Other Unusually Susceptible Populations

Children

In this health assessment, a child, or children, describes the developing person from its point of conception to maturity at 18 years of age. This is the period of life when humans are developing all biological systems. Before birth, children are forming the body organs that need to last a lifetime, and in some instances, exposure of the mother can lead to exposure of the fetus across the placental barrier (ATSDR 1997a). Injury during certain periods of fetal growth and development may lead to malformation of organs (teratogenesis), disruption of function, and possibly premature death.

After birth, children may be at greater risk than adults from exposure to hazardous substances. Their developing body systems can sustain permanent damage if toxic exposures occur during this critical growth stage. Children are more likely exposed because they play outdoors and because they may bring food into contaminated areas. They are shorter than adults, and therefore breathe dust, soil, and heavy vapors close to the ground. Pound for pound of body

weight, children drink more water, eat more food, and breathe more air than adults. In addition, children may accidentally wander or deliberately trespass onto restricted locations. The obvious implication for environmental health is that children can have much greater "doses" than adults to contaminants that are present in soil, water, and air (ATSDR 1998). Small children may have an immature immune system that cannot help in decreasing or preventing susceptibility to toxicity and disease after exposure to environmental contaminants. For these reasons, we specifically consider children's health in this assessment. Children's increased susceptibilities to the chemicals of concern follow.

Arsenic: The association between prenatal arsenic exposure and birth defects has not been fully established, but in light of arsenic's ability to cause damage to developing fetuses in other mammals, humans may also be sensitive to these affects.

Benzene: Children may be at increased risk to benzene exposure when compared to adults because the numbers of cells that form their blood are increasing. Developing cells are at greater risk of damage due to benzene exposure than mature cells.

Boron: Children are more susceptible to the effects of boron exposure than adults; however, these effects are not known at the dose we calculated for ingestion of on-site groundwater.

Dibenzofurans: ATSDR (1994) located no information on populations that may be susceptible to dibenzofurans.

Naphthalene: Children may be more sensitive to the effects of naphthalene than adults because their metabolic pathways (how the body detoxifies chemicals) are less well-developed. Because of this, naphthalene's ability to slow protein breakdown or slow the use of nitrogen in the body may occur at lower levels of exposure in children.

PAHs: Developing fetuses are susceptible to the toxic effects produced by maternal exposure to PAHs. Chemicals pass more readily through children's blood-brain barrier than adult's. Their developing livers are also less able to metabolize chemicals.

Pentachlorophenol: There is some evidence that young children are more susceptible to the toxic effects of pentachlorophenol than older children or adults. In exposures to pentachlorophenol in log homes, children from 8 to 18 years of age showed immune system suppression.

Unusually Susceptible Populations Other Than Children

A susceptible population has different or enhanced responses to a toxic chemical than will most persons exposed to the same levels of that chemical in the environment. Reasons may include genetic makeup, age, health, nutritional status, and exposure to other toxic substances (like cigarette smoke or alcohol). These factors may limit that person's ability to detoxify or excrete harmful chemicals, or may increase the effects of damage to organs or systems in the body. This is not an exhaustive list and reflects only the currently available data, further research may target more subsets of the population.

Arsenic: No studies were found regarding unusual susceptibility of a human subpopulation to arsenic.

Benzene: In people with exposure to ethanol (alcohol) the blood-toxic effects of benzene may be enhanced. Because benzene reduces the numbers of red and white blood cells and platelets, patients with viral hepatitis may see a faster onset of aplastic anaemia. Aplastic anaemia is a condition of too few red blood cells due to incomplete, slowed or defective development of these cells.

Boron: ATSDR (1992b) did not locate any information on subpopulations that may be susceptible to boron.

Dibenzofurans: ATSDR (1994) did not locate any information on subpopulations that may be susceptible to dibenzofurans.

Naphthalene: Some people might be especially susceptible to the effects of naphthalene because of lower than normal methylation capacity in the liver. Reduced liver methylation (how the body detoxifies naphthalene) could result from dietary deficiencies in choline (a B vitamin) or methionin (an essential amino acid). Reduced liver methylation could also result from other individual factors which may affect methylation capacity among individuals.

When ingested (eaten or drunk), naphthalene also causes the breakdown of red blood cells and releases hemoglobin into the blood stream. Subpopulations from Asia, the Middle-East, and Africa can be deficient in a blood enzyme (G6PD) which can cause them to be more sensitive to the breakdown of red blood cells by naphthalene.

PAHs: People with a history of excessive sun exposure and people with liver and skin diseases may be more susceptible to the toxic effects of exposure to PAHs. People may become affected when exposure occurs in conjunction with exposure to particulates (airborne dust). This enhanced effect results from the adsorption of PAHs onto the dust particles. When inhaled, the particles may move into cells and become distributed in tissues. Particulates that do not move into tissues may be carried to the stomach because of clearance from the lungs. This clearance has been associated with stomach cancer in people inhaling PAHs on particulate matter.

Pentachlorophenol: Groups possibly at greater-than average risk of suffering from the toxic effects of pentachlorophenol include people working in hot environments, people with an inability or decreased ability to disperse body heat, the oldest and youngest members of the population, pregnant women, and those who are malnourished. People with impaired liver and kidney function are likely to be susceptible to the toxic effects of any chemical or product that is metabolized and or excreted by these organs and, therefore, may be unusually susceptible to the toxic effects of pentachlorophenol.

5.0 COMMUNITY HEALTH CONCERNS

On September 14 and 15, 1999, EPA conducted community interviews for the Nocatee Hull Creosote Site. Local public officials and residents shared their opinions and concerns about past, current, and future site activities.

Health Concern: Many people that live near the site are concerned that potential contamination from the site is causing an increased rate of deaths due to cancers and tumors.

Response: The levels of contamination found off-site in tests of groundwater and soil are unlikely to cause illness because people probably are not exposed to them. The contaminants in off-site groundwater are benzene, naphthalene and PAHs; however, the highest levels have been seen in monitoring wells, not private drinking water wells. People do not have access to the water from monitoring wells and naphthalene and PAHs have not been found in private drinking water wells at levels of concern for health. The one private drinking water well that contains benzene has a filter that will remove this and other chemicals. DEP operates and maintains this filter.

Off-site soil contaminants are arsenic and PAHs. Dose estimates for children eating 200 milligrams of soil (about the weight of two postage stamps), daily, from the area with the highest arsenic would be at increased risk for skin cancer if this exposure occurred for a year or longer. Daily ingestion of, or skin contact with PAH-contaminated soil would have to continue for long periods of time for people to be at increased risk of skin or stomach cancers. The contaminated soil is in a drainage area. The soil in this area can be wet and it tends to have dense vegetation, make daily exposure to it less likely.

We cannot address the likelihood of illness to any exposures that occurred before 1982 because we do not know what chemicals nor at what amounts of these chemicals people could have been exposed. Off-site groundwater data goes back to 1982. Off-site soil data dates from 1997.

Health Concern: Many people who live near the site are afraid to drink the water from their private wells. They use water from other sources to drink. They feel that the Nocatee Hull Creosote site is likely contributing to the bad taste and odor.

Response: The water samples from most of the private wells near the site have levels of iron above the drinking water secondary standard of 0.3 mg/l. Secondary standards are generally based on odor or taste considerations, and are not enforceable standards. Iron can give the water a metallic odor and taste and may affect the flavor of brewed coffee and tea.

DEP's ambient (background water quality) monitoring network shows high levels of iron are naturally occurring in this area. DEP has 19 surficial monitoring wells in the Caloosahatchee River hydrologic unit (which includes this site). The private drinking

water wells near the site are probably screened into the surficial aquifer or are screened just below it. The screen is the perforated portion of the well (usually near the bottom) through which groundwater is pumped from the aquifer. The average total iron for DEP's 19 monitoring wells is 3.4 mg/L, and the average value for the private wells near the site was 1.65 mg/L for the samples taken in December 2000.

EPA project manager for the site, Jamey Watt, asked DOH to address the aluminum levels for the surficial aquifer. The secondary standard for aluminum in Florida is 0.2 mg/L. The average level for DEP's 19 ambient surficial monitoring wells is 0.085 mg/L, and the average for the data we have available (five private wells sampled in November 1997) is 0.031 mg/L. This level in private wells is far below the average for the ambient surficial monitoring wells in the area, as well as the secondary drinking water standard. The aluminum levels in monitoring wells for this site are much higher than these levels.

The difference between the levels of aluminum in the private wells, in DEP's ambient water quality monitoring wells, and the monitoring wells on the site most likely has to do with the amount of clay in the water. When a well is used daily, the smallest particles, such as clay, are flushed out of the aquifer by the pumping of the well. Monitoring wells are not used daily, they are usually emptied four or less times a year. Clay particles are made up of aluminum and silicon; these clay particles are dissolved by strong acids when the sample is analyzed. Therefore, the presence of dissolved clay particles probably resulted in high aluminum readings for the monitoring wells but not private wells because the amount of clay is lower around the screens at the bottom of private wells. Again, this is what we see for the site, aluminum levels from on- and off-site monitoring wells are much higher than the levels seen in private wells.

DOH reviewed all of the available private well analytical data. The levels of chemicals we reviewed are <u>not</u> likely to cause illness. One private well was sampled 13 months prior to the time that benzene was detected above the Florida Maximum Concentration Levels (MCLs are enforceable water quality levels), and at that time the water sample did not exceed any of the MCLs. This well has had a filter on it since March 1998 to remove benzene and naphthalene in the water. Because the DeSoto County Health Department or CSXT's consulting firm (Gannett Fleming) staff samples the water from the nearest private wells every three months, we believe that no one in the area is now nor, in the future, will be drinking contaminated ground water.

Health Concern: Some people who live near the site are concerned about the potential effects that surface water runoff from the site might have on nearby vegetation.

Response: Available data has not identified contaminants in the surface water off the site. This does not mean that surface water never contains contaminants, but it is more likely that the contaminants are moving off the site in sediments. CSXT fenced the off-site area with elevated PAHs and arsenic and installed sediment traps in the ditch leading to Oak Creek in February 2001 in an attempt to limit the movement of these sediments.

PAHs and arsenic are not known to accumulate in plant tissue. If people were exposed to off-site contamination through vegetation, it would likely be from soil on the roots or dust on the leaves. At the time of the first site visit, DOH observed thick plant growth in the area of elevated wood-treating components.

On August 28, 2001, the DOH held a Public Availability Meeting at the Methodist Church in Ft. Ogden to discuss the findings of the Nocatee/Hull Creosote site Public Health Assessment and to gather additional community health concerns. Beth Copeland and Connie Garrett from the Superfund Site Assessment and Education Section of DOH hosted the meeting. Archie Lee attended from the U.S. Environmental Protection Agency, Jeff Gould and Charlie Mesella attended from the Ft. Myers DEP Office, and Dennis Jackson, Environmental Health Director, attended from the DeSoto County Health Department in Arcadia.

Additional community health concerns brought up at this meeting and gathered in response to our fact sheet mail-out follow.

Health Concern: In response to DOH's fact sheet and Public Availability Meeting announcement (a mail-out), a man who lives on Southwest Magic Road near the site asked to have his well tested.

Response: Recently, CSXT's contractor installed more off-site monitoring wells. They found the area of off-site groundwater contamination is not large and is mainly in the northern part of Oak Creek Road. Although Southwest Magic Road is outside the area of groundwater contamination, this man can still have his water tested if he thinks his water might have other chemicals or bacteria in it (maybe from farm chemicals or from a septic tank). To have his water tested he needs to call Dennis Jackson at DeSoto County Health Department (893/993-4601).

Health Concern: In response to DOH's fact sheet and Public Availability Meeting announcement (a mail-out), a woman who lives on Hill Road near the site asked to have her well tested. At the Public Availability Meeting she asked about soil contamination on her property from a sheen she observed on sheet flow after a heavy rainstorm in 1995 or 1996. Because her neighbors and ex-husband have mowed the site in the past, she also asked about the potential for adverse health effects from exposure to dust on the site.

Response: DOH addressed these questions separately in the following paragraphs.

Well water quality. CSXT's consultant sampled the well on this woman's property in August 1999. Their lab analyzed the samples for base/neutral and acid extractable compounds (PAHs, naphthalene), the purgeables (benzene, toluene, etc.,) and eight primary metals (including arsenic). None of these were present above the method detection levels. Because her well is very shallow and the neighboring property is irrigated, DOH also referred her to the DeSoto County Health Department to have her well retested for farm chemicals and bacteria.

The possibility that off-site soil north of the site has site-related contamination. In 1996, CSXT's consultant tested off-site soil down gradient from, and north of the borrow pit. Two areas were sampled where water appeared to have flowed into the orange grove from the site. Neither soil sample showed contamination. Since her property is farther away from any areas with highly contaminated surface soil, it is unlikely her soil has significant contamination from storm water runoff.

Health risks from on-site dust exposure. The greatest risk for on-site exposure comes from the potential that someone might consistently drink contaminated groundwater. Next is the likelihood of daily ingestion of soil. As we discussed above, our dose calculations assume that a person will accidentally eat the weight of one postage stamp (100mg) of soil, every day, for thirty years (at the highest level of contamination found). Inhalation and dermal exposures gave much lower levels of risk. Nevertheless, site workers can protect themselves from incidental inhalation, ingestion, or dermal contact by wearing a dust mask, by not eating or drinking on the site (to avoid ingestion of dirt on their hands), and by showering and changing clothes when they leave the site.

Health Concern: A man who attended the evening session expressed concern about the water quality in a private well at the north end of Oak Creek. He had lived in a trailer there that had a sheen on the water in the toilet in the morning.

Response: In January 1997, DEP sampled this well for semi-volatiles (which would have detected PAHs). None were detected. We recommend that this well be sampled again, with the next round of private well samples so we will have data on metals and volatiles.

6.0 CONCLUSIONS

We classify the Nocatee Hull Creosote site as "no apparent" public health hazard. The most frequent occurrences and highest levels of contamination are in on-site soil and groundwater. Because no one is living on the site, it is unlikely that anyone is currently exposed to the on-site contaminants. Deed restrictions should prevent people from living on the site, prevent future use of on-site groundwater for drinking water, and prevent contact with contaminated soil prior to the time when the site is cleaned. We are unaware of any current exposures to offsite contamination.

Although we have no evidence that people are coming in contact with site-related contaminants, we evaluated the available data and have reached the following conclusions:

1. People drinking shallow groundwater from the site could become ill. Monitoring Well #8 on the western part of the site contained dibenzofurans in 1997 at a level that could cause illness with short-term exposure (adults drinking two liters of water a day or children drinking one liter of water a day, for 14 days or less).

   People using groundwater contaminated with chemicals other than dibenzofurans (on and off the site) as a long-term source of water for drinking and other household uses could be at increased risk for specific illnesses (see sections 4.4.1.1 - 4.4.1.8). Nearby residents use private wells, but because of the high iron content, some people do not drink the water. Currently, staff from the DeSoto County Health Department or CSXT's consulting firm (Gannett Fleming) sample the private wells nearest the site every three months for arsenic, other metals, and creosote components. Groundwater from one of the nearby private wells contains benzene above the state drinking water standard. This well has had a filter on it since March 1998 that removes benzene and other contaminants. DEP installed this filter and are responsible for maintaining it.

2. People accidentally eating or having skin contact with chemicals in surface soil on the site (incidental ingestion or dermal absorption), on a daily and long term basis, could be at increased risk for specific illnesses (see sections 4.4.1.1 - 4.4.1.8). Offsite soil in a drainage area (which begins at a culvert east of the site) also contains PAHs and arsenic. Because much of this off-site area is densely vegetated, soil exposure in the past was unlikely. Nevertheless, we evaluated the highest levels found for health effects for people who might have eaten, touched, or inhaled dust from this soil daily, for long periods of time. Daily, longer-term ingestion of soil with the highest chemical levels could increase people's risk of skin and other specific cancers (see sections 4.4.1.1 - 4.4.1.8). Currently, this off-site area of impacted soil is fenced with a six-foot chain-linked fence. CSXT is also preventing additional contaminants from leaving the site with sediment traps on the culvert.

3. Future site cleanup that removes surface vegetation or disturbs soil could raise dust that contains arsenic, PAHs, and pentachlorophenol on the site. Depending on the chemical

levels in this dust, the amount of dust nearby residents might breathe, and the length of time for cleanup operations, residents exposed to this dust could have an increased risk of specific illnesses.

7.0 RECOMMENDATIONS

1. Prevent use of contaminated groundwater on and off the site. Unless/until on-site groundwater is cleaned up, CSXT should enter the agreed on deed restrictions in the county property records to prevent future on-site contaminated groundwater use. CSXT will continue to characterize the extent of groundwater contamination as indicated in their Draft Field Sampling Plan Addendum. Until the off-site groundwater is cleaned up, the DeSoto County Health Department or CSXT's consulting firm (Gannett Fleming) staff should continue quarterly sampling of nearby private drinking water wells. If EPA decides to discontinue this sampling requirement, DOH recommends they install filters on the wells within the area of groundwater contamination. DEP should continue maintaining the already filtered well and should also continue reviewing the analytical results for this well to assure that the filter continues to function properly. DEP should also add the areas of groundwater contamination to their list of "delineated areas". In response to public health concerns expressed to us during the Nocatee/Hull Public Health Assessment Public Availability Meeting, we also recommend that an additional well on the northern end of Oak Creek Road be included in the next round of well samples. This well was reported to develop a sheen on well water that was left to stand overnight.

2. Prevent long term contact with contaminated surface soil on and off the site. Unless/until the soil is decontaminated, CSXT should continue to restrict access to impacted soil, and enter the agreed-on deed restrictions in the county property records to prevent future residential use of this site.

3. Control dust generation during any future cleanup that removes surface vegetation or disturbs soil on or off the site.

8.0 PUBLIC HEALTH ACTION PLAN

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

1. DOH, Bureau of Environmental Epidemiology staff will inform and educate nearby residents about the public health threats associated with this site and discuss health concerns they might have.

2. DOH, Bureau of Environmental Epidemiology staff will recommend DEP and the Southwest Water Management District add this site to their list of delineated areas.

3. DOH, Bureau of Environmental Epidemiology staff will continue to work with EPA and DEP to assure that the site is monitored or cleaned up to protect public health.

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

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CERTIFICATION

The Florida Department of Health, Bureau of Environmental Epidemiology prepared the Nocatee Hull Creosote Public Health Assessment under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It followed approved methodology and procedures existing at the time it began.

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

for Richard Gillig
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APPENDIX A. SITE SUMMARY

Charlotte Harbor & Northern Railway Company and later Seaboard System Railroad treated railroad ties on the original 22.4-acre site. They stacked treated lumber on the east and south sides of the site to dry and pumped liquid wastes to a borrow area on the west side of the site. This borrow area drains to the northwest, to a tributary that enters the Peace River. These past treating, drying, and waste-handling practices from wood preserving operations released PAHs and other volatile and semi-volatile chemicals to the soil and surface water on the site. Surface water runoff and site drainage carried chemicals in water and sediment west of the site via borrow pit runoff and apparently east of the site via an underground pipe, a culvert under Hull Avenue and two ditches. Chemicals can move to groundwater from soil, sediments and surface water. Recent site investigations identified chemicals related to treating railroad ties in on-site and off-site soil, sediments, groundwater, and on-site surface water. We list events related to releases of chemicals and cleanup efforts chronologically below.

Nocatee Hull Creosote Site (NHC) Releases and Interim Developments

Early History, 1913 - 1952: Charlotte Harbor & Northern Railway Company, a subsidiary of the American Agricultural Chemical Company, constructed the creosoting plant in 1913. Seaboard System Railroad, Inc. (Seaboard) operated the facility sometime later.

Notes from inspection of site air photos from 1943 - 1978:

1943: 1952: The creosoting facility operated in the center of the site. Its infrastructure included a coal tar creosote plant, three storage areas for stacks of railroad ties, four vertical storage tanks, and a liquid waste pit.

1952: 1958: By 1958, coal tar creosote plant, three railroad tie storage areas, and three of the four vertical storage tanks had been dismantled.

1968: The liquid waste pit was cleared of vegetation.

1972 - 1978: Vegetation in the liquid waste pit was coming back. Oak Creek Road is extended from Hull Avenue to the south. Southernmost property on this street backs up to Oak Creek on the east.

1982: March 11: South DER district employee Stuart Bradow inspected the abandoned creosote site, noted lack of vegetation in area with asphalt-like material on soil, requested sampling of **one private well** (Mr. Yeats) and **one surface water location** on the site. The well was 600 feet from the former location of the creosote plant and could have been as little as 60 feet deep.

April 21: FDER sampled surface water from the sump; it showed 3.57 μg/L TEQ PAHs and Mr. Yeats private well did not show any organics.

1983: January 24: NUS sampled the site for EPA (sampling results below in June 1983).

February: DER asked Seaboard to remove all creosote from the sumps, tanks and ground, and fill the old containers with dirt. Seaboard was also asked to secure the site and the adjacent disposal site to prevent trespass by unauthorized persons, and to install monitoring wells to find contamination.

June: EPA's consultant NUS reported the results of January samples of **one surface water, groundwater from two private wells and two surface soil locations** on and near the NHC site. Surface water from a waste pit contained PAHs, phenols, and other traces of organics. Soil and drainage area sediments contained PAHs, toluene and ethylbenzene, and boron. A down-gradient private well also showed boron, lead above the current MCL, and < 5 μg/L toluene. An up gradient well showed nearly the same level of lead (lead could be related to plumbing and not groundwater as this up-gradient well showed no other contaminants).

October: FDER tested **leachate contaminated wastewater and sediment by bioassay** (water fleas and bannerfish shiners) **and elutriate bioassay** (bannerfish shiners) and found neither to be acutely toxic although many water fleas died at low wastewater concentrations.

1984: May: NUS reported results of October sampling of **Mr. Yeat's private potable well, one surface and one subsurface soil location, five surface water and five sediment locations**: they show contaminant migration from the site in surface water and sediments. They detected phenols in all of the soil/sediment samples collected from the site, along the drainage ditch and in the Peace River. They also detect PAHs and other organics in surface water on the site and in the drainage ditch.

June: Environmental Science and Engineering, Inc. prepares an Environmental Assessment of the Nocatee Hull Site for Seaboard System Railroad, Inc. The report contains a summary of what could be on the site (based on their past studies of such sites). The number of on- and off-site samples for soil, surface water and groundwater were limited but they identified the borrow pit and its discharge area as areas of creosote contamination. They gave sample results for the following: **a geophysical survey, 25 piezometers, 40 shallow and 60 deep samples from upland soils, 126 soil samples in the borrow area, seven surface samples along the creek bed flowing from the borrow area, one upstream and three downstream samples on the Peace River, seven monitoring wells on-site and six private wells.**

September: E.C. Jordan performed a Potential Hazardous Waste Site Preliminary Assessment for EPA for DER.

December: ESE removed several concrete sumps used to store, separate and recycle creosote from the site and the creosote-like wastes in the sump pits were disposed of in a licensed out-of-state hazardous waste disposal facility.

1986: May: DER entered into a Consent Order with Seaboard System Railroad **requiring the sampling of groundwater** for PAHs, arsenic, and chromium. Wells to be sampled included: **MW6R and MW8 (on-site monitoring wells - sampling schedule was for two years, four times a year, then once per year for three additional years or until such a time as the data confirm that site related compounds were not migrating in hazardous concentrations)**, and **seven private water supply wells (to be sampled once a year for five years).**

October: ESE began quarterly monitoring of two on-site monitoring wells, and annual sampling of seven residential wells and one surface water location at the borrow pit outlet. They continued this sampling for five years, except when the borrow-area outlet creek was dry (they sampled 8 private wells in 1986, and 6 in 1987).

1990: January: Water and Earth Sciences (WES) collected **groundwater samples from five on-site monitoring wells.**

March: WES conducted a house to house survey, **sampled 4 private wells and two on-site monitoring wells, (braided stream was dry).**

October: DEP sampled **soil and groundwater from the locations of two temporary monitoring wells in the braided stream west of the borrowed area**, they split samples with WES.

December: WES documented their sampling in: "Results of Soil and Groundwater Sampling at the CSXT Nocatee/Hull Site" .

1991: September: December: CSXT fulfilled the terms of consent order, they agreed (with DEP) to: build a fence with gates at each end of the site, give DEP gate keys, post "No-Trespassing" signs around the perimeter and 4 interior signs, place a notice in DeSoto Co. public records, provide DEP with property boundary map, and maintain the existing on-site wells.

1992: January: DEP received the "Report on Final Annual Sampling at CSXT Hull, Florida facility" by WES.

May-August: A DEP site inspection and follow-up letter to CSXT reported the site was not secure, "No Trespassing" signs around the perimeter and 4 interior signs had not been posted; DEP had not received the map of the property boundary. They also requested an issue of deed restrictions, which CSXT sent them in November.

1993: April: DEP reviewed CSXT's activities in a file memorandum. DEP had not received gate keys, they needed to verify that CSXT had posted interior signs and "No Trespassing" signs, they needed to evaluate the fence on the west side of the property, they still needed a map of current property boundaries, and they needed a response from CSXT regarding comments on deed restrictions.

1994: March: CSXT resubmitted a draft deed restriction and property map.

July: DEP responded that CSXT has not addressed their comments of Feb. 16, 1993 on the deed restriction.

1995: July: DEP's letter to CSXT, said that CSXT had not responded to DEP's July 5, 1994-letter, the property map submitted was not accurate, CSXT dis not appear to own all property on which contamination has been identified.

September: DEP met with CSXT to discuss: 1) concerns the grove owner north of the site, Calvin Boggess, had about flooding and migration of contaminants, 2) an unresolved deed restriction issue, 3) issues pertaining to CSXT not owning all the contaminated property, and 4) DEP's recommendation that Parcel B and additional sampling in the braided stream area be surveyed.

November: August 1996: WES took 56 soil samples 0 - 6" deep.

December: DEP wrote a letter to CSXT , asking CSXT to survey Parcel B area, and take soil samples along Mr. Boggess's citrus grove.

1996: April: DEP visited the site to observe surveying and soil sampling along Mr. Boggess's citrus grove. The Boggess samples did not show soil contamination. Black and Veatch (B&V) did a site inspection to prioritize site cleanup.

September: The soil sampling results were forwarded to Mr. Boggess's attorney; no contaminants of concern had been detected.

October: CSXT informs DEP that they have purchased entire Hill property west of the site.

December: DEP received a complaint that the culvert on Oak Creek Road contains creosote in sediments, DEP investigated the complaint, and confirmed the presence of creosote by visual observation.

1997: January: DEP informed CSXT of the creosote discovery on Oak Creek Road. CSXT and their consultant, Eder Associates, met with DEP to discuss the complaint on Oak Creek Road, and CSXT's survey and soil analyses for the braided flow area. DEP plans

to sample contaminated soil and residential wells. DEP sampled **8 residential wells and 2 soil locations in the Oak Creek tributary east of Hull road** on January 21, 1997.

February: DEP received a report "Results of Soil Sampling at the CSXT Transportation Hull/Nocatee Site; DeSoto County, Florida (WES - this report may have been the basis for CSXT's purchasing of Mr. Hill's property).

October: The Final Expanded Site Inspection Work Plan was submitted by B&V Special Projects Corp., for EPA.

November: DEP performed sampling work for Superfund Site Screening; also B&V Special Projects Corp., sampled site media for EPA; they sampled soil, sediment, groundwater and private potable wells .

February: DEP Superfund Site Screening section identified benzene, ethylbenzene, xylene, and naphthalene in a private well east of the site. They provided bottled water and a granulated activated carbon filter (3/11/98) to the residents. DEP (Ft. Myers branch office) followed up on their earlier work showing that the culvert under the road could be the conduit that transports creosote to the east **(they analyzed two soil samples).**

March: Soil Cleanup Target Levels (SCTLs) draft published by DEP for the state of Florida became available.

May: EPA Region IV, had an Aerial Photographic Analysis done for the Nocatee/Hull Creosote Site. The earliest photo was from 5/13/43, the latest was from 2/23/78, these aerials show changes in land use and changes in infrastructure on the site.

June: B&V Special Projects Corp. submitted the Expanded Site Inspection Report that included the results of **14** groundwater samples, **13** surface soil samples, 4 subsurface soil samples and **11** sediment samples. **Boron**, PAHs, dioxins, and furans are identified in soil. **B&V analyzed nine surface soils, one subsurface soil and three sediment samples for dioxins and furans.**

August: Gannet Fleming (GF) installed **three** shallow and **three** deep monitoring wells to decide the direction of **groundwater** flow in the surficial and intermediate aquifers, they analyzed samples from these wells to decide water quality, they also conducted an organic vapor survey of drainage ditch **sediments**. They took and analyzed **four** ditch sediment samples. Culvert sediments on the west side of Hull Road contained degraded creosote, while east side culvert sediments contain degraded creosote and a heavy petroleum-related product.

January: GF submitted a "Streamlined Remedial Investigation and Focused Feasibility Study Work Plan". In it, they proposed installing **21** on-site and off-site **monitoring**

wells for groundwater samples, the continued sampling of nearby **potable wells (five)**, collecting **25 soil** samples for analysis (**seven** from the former creosote plant, **six** from the sump area, **four** from the borrow pit, and **eight** for the drainage area east of Hull Avenue) collecting **five surface water samples** (from the braided stream, and Peace River locations: upstream, down stream, at the confluence, and west of the confluence), and **18 sediment samples** (**eight** from the braided stream and **10** from the Oak Creek Tributary and Oak Creek).

June: GF submitted a potable well survey for the area, 44 were identified, with two wells not used for drinking purposes due to contamination (according to information from the residents).

September: GF submitted the results of their third-quarter well sampling.

December: EPA released the "Community Relations Plan for the Nocatee-Hull Creosote Superfund Site in Hull, DeSoto County, Florida".

2000: March: GF submitted the "Streamlined Remedial Investigation Data Summary" which contained analytical results from their 1999 sampling and previous available data.

July: GF submitted their "Oak Creek Area Control Measures Plan"

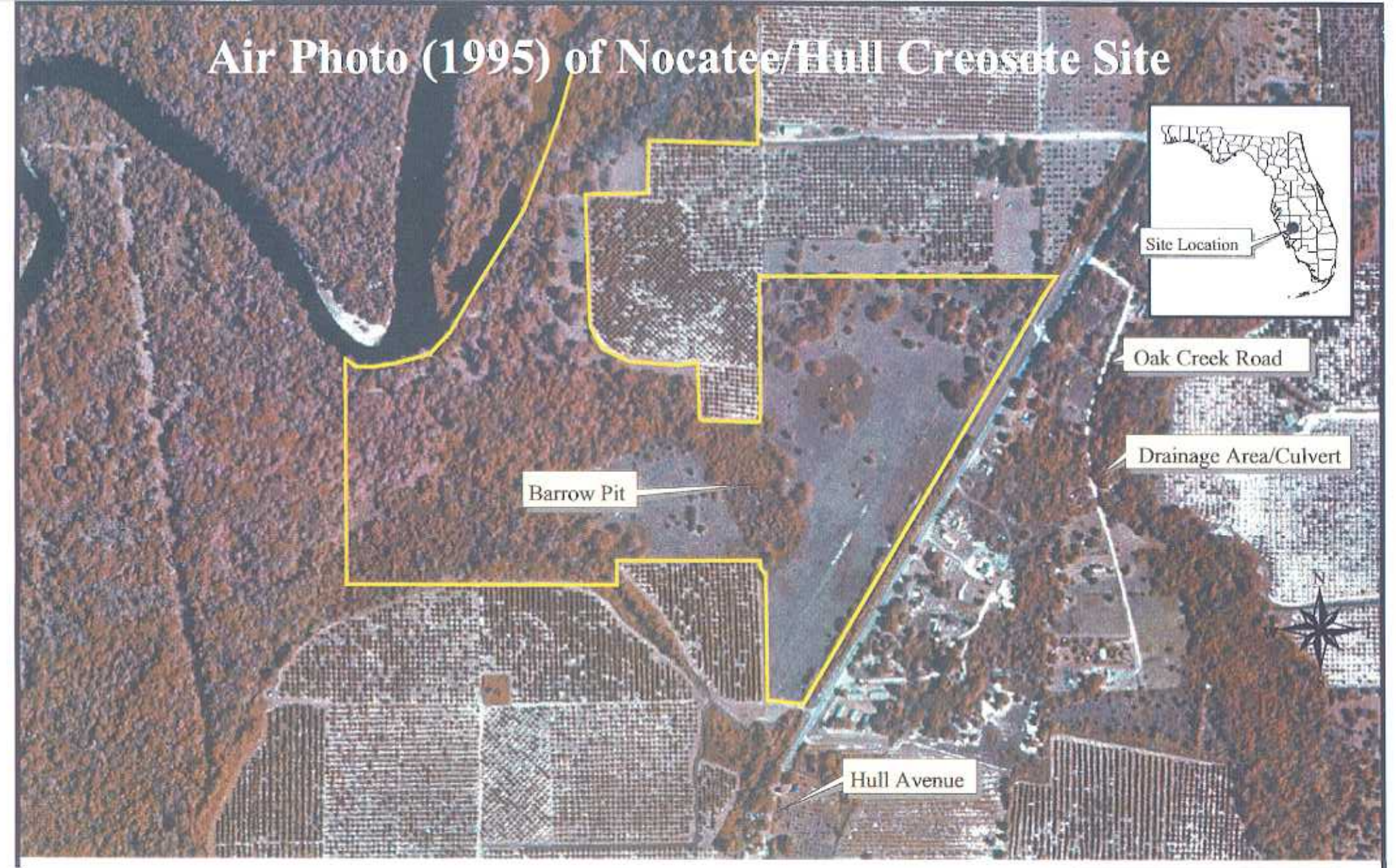
2001: January: February: GF installed the Fence and Sediment trap for the Oak Creek Area Control Measures.

October: GF submitted the four-volume "Streamlined Remedial Investigation".

2002: January: DOH made comments on the "Streamlined Remedial Investigation" document in 2002.

APPENDIX B. FIGURES and PHOTOGRAPHS

Air Photo (1995) of Nocatee/Hull Creosote Site



Bureau of Environmental Epidemiology

FLORIDA DEPARTMENT OF HEALTH

Figure 1

0 0.06 0.12 0.18 0.24 0.3 Miles

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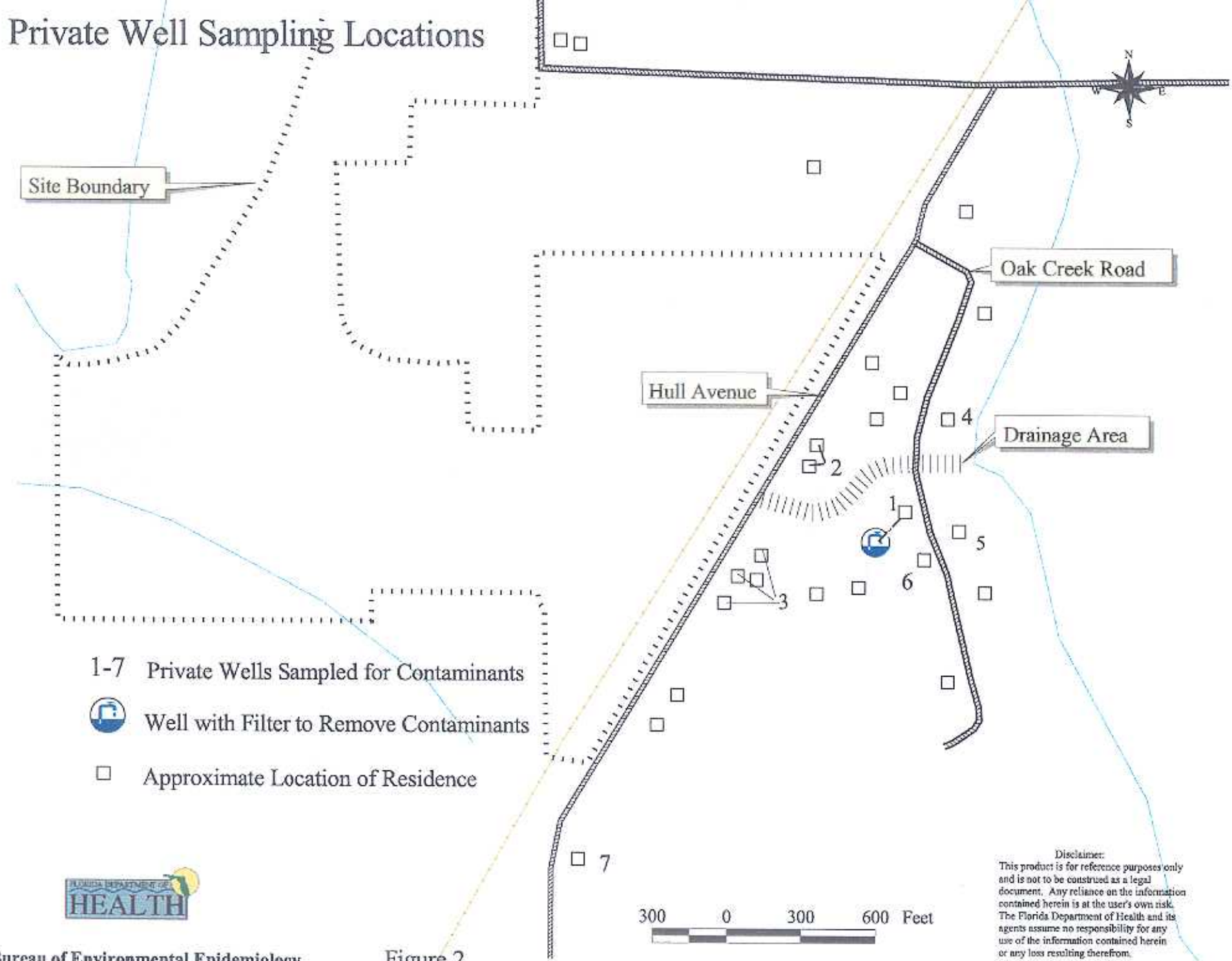
Private Well Sampling Locations



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FLORIDA DEPARTMENT OF HEALTH

Bureau of Environmental Epidemiology

Figure 2

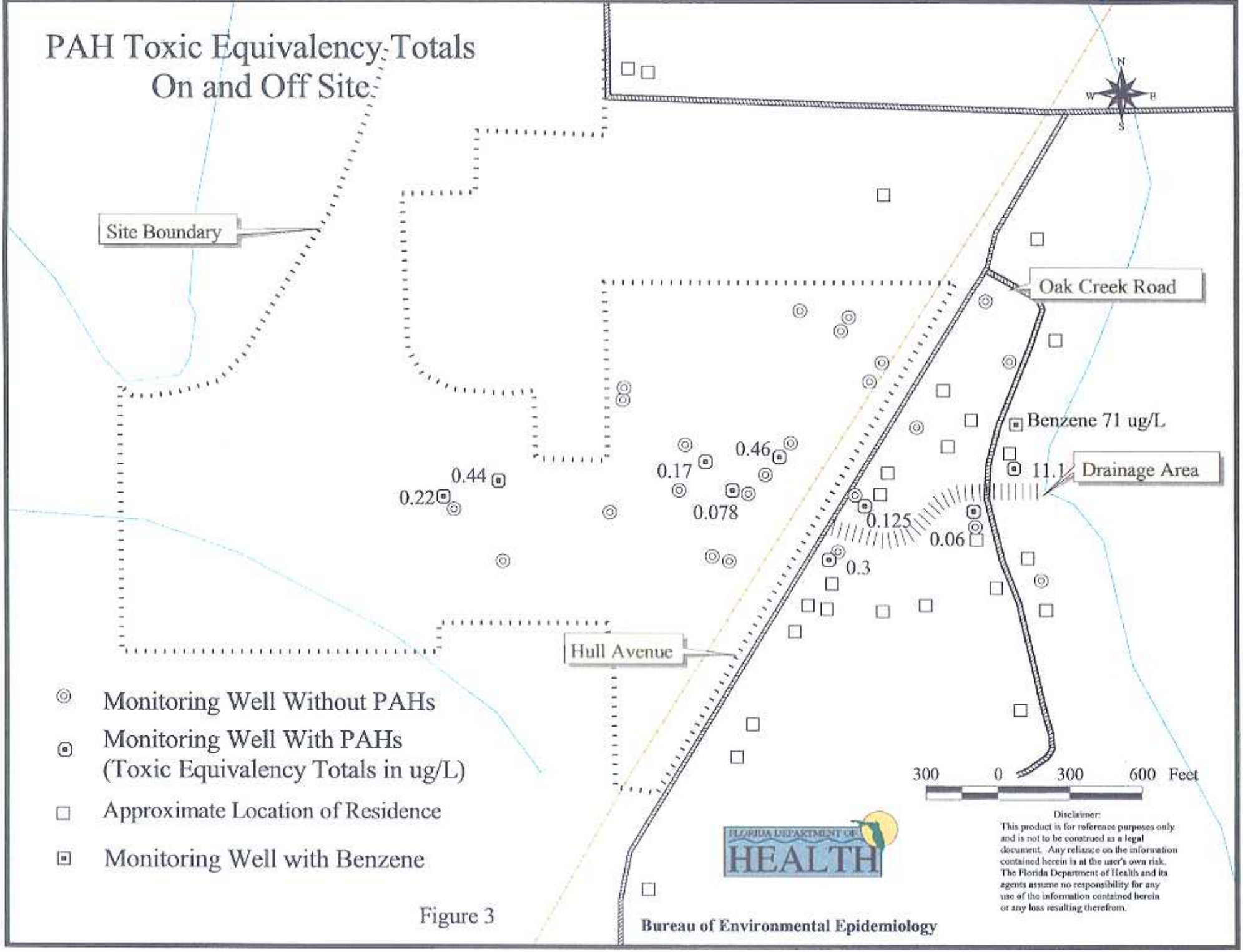
PAH Toxic Equivalency Totals
On and Off Site
Site Boundary
Oak Creek Road
Benzene 71 ug/L
11.1
Drainage Area
0.46
0.17
0.44
0.22
0.078
0.125
0.06
0.3
Hull Avenue
Monitoring Well Without PAHs
Monitoring Well With PAHs
(Toxic Equivalency Totals in ug/L)
Approximate Location of Residence
Monitoring Well with Benzene
300 0 300 600 Feet
FLORIDA DEPARTMENT OF HEALTH
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Figure 3

Approximate Offsite Locations of Soil and Sediments with Elevated Toxicity Equivalent Totals for PAHs; Arsenic Level is given in parenthesis if above Florida Soil Target Cleanup Levels (units for both are mg/kg)

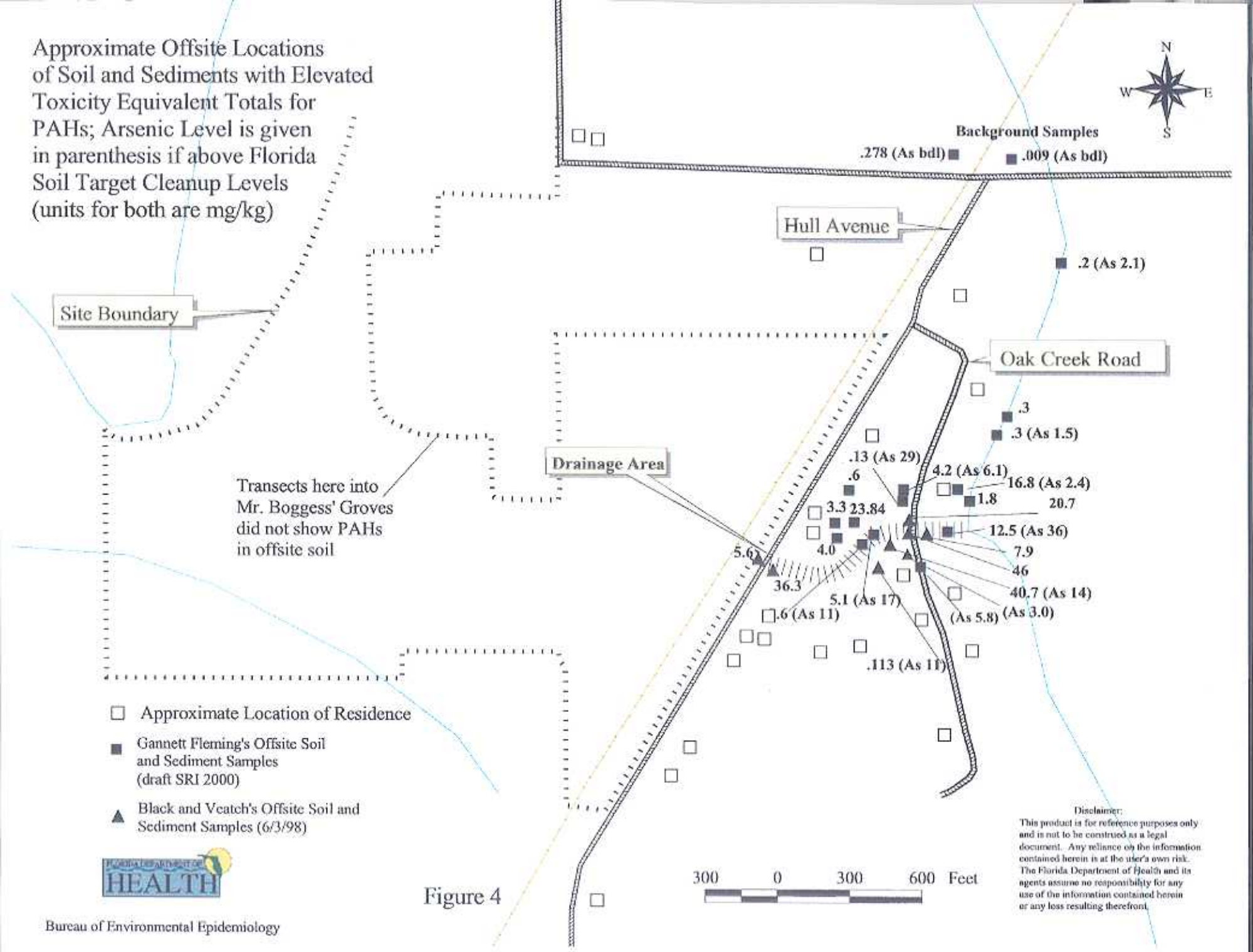

Figure 4

Bureau of Environmental Epidemiology

Photo 1: Locked fence at the site entrance, looking west.

Photo 2: Northern part of the site looking north, the gate is visible on the right side of the photo.

Photo3:Looking north from the center of the eastern portion of the site. Bare patch in the center possible creosote sludge.

Photo 4: Same location as photo 3, looking south.

Photo 5: Looking south at citrus grove south of the site.

Photo 6: Closeup of the Borrow pit.

Photo 7: West side of site, looking at floodplain vegetation.

Photo 8: Center of eastern part of the site, monitoring wells inside stakes.

Photo11: Dense vegetation along drainage area between Oak Creek Road and Hull Avenue

Photo 12: One of the homes on Oak Creek Road that has had its well sampled. Note the dense vegetation.

Photo13: View east, from Oak Creek Road. Looking at the straight part of the drainage area that joins Oak Creek. Black area is water.

Photo 14 Fenced off-site soil east of Oak Creek Road, north of the culvert.

Photo 15 Fenced off-site soil west of Oak Creek Road, north of culvert.

Photo16 Oak Creek Road, looking south from north of the culvert. People in photo are east of the sediment trap.

Photo16 Oak Creek Road, looking south from north of the culvert. People in photo are east of the sediment trap.

Photo 17 Fence in front of sediment trap, west of Oak Creek Road culvert.

Photo 18 Closeup of sediment trap.

APPENDIX C. TABLES

Table 1. Maximum Concentrations in On-Site Groundwater (All Depths)

Contaminants of Concern	Maximum Concentration (μg/L)	Location/Date	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value**	
				(μg/L)	Source
arsenic	73.9	MW-8 1987	22/55	50 (PDWS)	DEP 1999
benzene	23	DMW-11 1998	4/44	1 (CREG)	ATSDR 2000
boron	1100	Yeats 1983	1/1	900 (C_RMEG)	ATSDR 2000
carbazole	350	MW-6 1985	4/55	7.5 (DWG)	DEP 1999
dibenzofurans	140	MW-8 1997	2/34	24 (RBC_N)	EPA 2000
naphthalene	6,570	MW-8 1988	19/55	200 (C_RMEG)	ATSDR 2000
PAHs (TEBaP)	150	MW-2 1990	10/43	0.005 (CREG)	ATSDR
pentachlorophenol	1,000	MW-8 1985	4/55	0.3 (CREG)	ATSDR 2000

Sources: Gannett Fleming 2000, Black and Veatch Special Projects 1998, WES 1995, Environmental Science and Engineering 1984, NUS 1983

μg/L = micrograms per liter

TEBaP - toxicity equivalent totaled to benzo[a]pyrene.

*This column gives the reader a rough idea how many times the chemical was detected above the screening value out of the times it was analyzed for. The total number of analyses can vary. This could be because not all samples were analyzed for all chemicals. Often the raw data is not available, therefore a chemical will only be included in the data summary table if it is detected.

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

PDWS - Primary Drinking Water Standard - Enforceable Florida Standards

CREG - Cancer Risk Evaluation Guide for one in one million excess cancer (ATSDR)

C_RMEG - Reference Dose Media Evaluation Guide for Children

RBC_N - Risk-based Concentrations, N= Noncarcinogenic effects

DWG - Florida Drinking Water Guideline

C_EMEG - Environmental Media Evaluation Guide for Children

PAHs - Polynuclear Aromatic Hydrocarbons

Table 2. Maximum Concentrations in On-Site Surface Soils (0-12 Inches Deep)

Contaminants of Concern	Maximum Concentration (mg/kg)	Location/Date	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value**			
				(mg/kg)		Source	
arsenic	91	CP-SS-10	1999	4/51	20	(C_EMEG)	ATSDR 2000
benzene	NS	-		-	20	(CREG)	ATSDR 2000
boron	NS	-		-	5000	(C_RMEG)	ATSDR 2000
carbazole	5.7	ESE-14	1984	0/65	53	(R_SCTL)	DEP 1999
dibenzofurans	26	NH-SS-02	1998	0/8	310	(R_SCTL)	EPA 2000
naphthalene	9.1	ST-9	1996	0/103	1000	(C_RMEG)	ATSDR 2000
PAHs (TEBaP)	297	NH-SS-03	1997	58/177	0.1	(CREG)	ATSDR 2000
pentachlorophenol	34.1	SD01	1998	2/62	6	(CREG)	ATSDR 2000

Sources: Gannett Fleming 2000, Black and Veatch Special Projects 1998, Environmental Science and Engineering 1984, NUS 1983, DEP (DER) 1983

mg/kg = milligrams per kilogram
TEBaP - toxicity equivalent totaled to benzo[a]pyrene.
*This column gives the reader a rough idea how many times the chemical was detected above the screening value out of the times it was analyzed for. The total number of analyses can vary. This could be because not all samples were analyzed for all chemicals. Often the raw data is not available, therefore a chemical will only be included in the data summary table if it is detected.
** Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
C_EMEG - Environmental Media Evaluation Guide for Children
CREG - Cancer Risk Evaluation Guide for one in one million excess cancer (ATSDR)
C_RMEG - Reference Dose Media Evaluation Guide for Children
R_SCTL - Residential Soil Cleanup Target Level
PAHs - Polynuclear Aromatic Hydrocarbons
NA - Not Analyzed

Table 3. Maximum Concentrations in On-Site Surface Water

Contaminants of Concern	Maximum Concentration (µg/L)	Location/Date	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value**	
				(µg/L)	Source
arsenic	26.8	borrow pit outfall (ESE) 1987	0/9	50 (FSWC)	DEP 1999
benzene	NA	-	-		DEP 1999
boron	NA	-	-		DEP 1999
carbazole	NA	-	-		DEP 1999
dibenzofurans	NA	-	-		DEP 1999
naphthalene	6.0	borrow pit outfall (ESE) 1987	0/11	26 (FSWC)	DEP 1999
PAHs (TEBaP)	144.7	WTW-2 1990	10/11	0.031 (FSWC)	DEP 1999
pentachlorophenol	NA	-	-		DEP 1999

Sources: Gannett Fleming 2000, Environmental Science and Engineering1986, 1987, 1988, WES 1990.

TEBaP - toxicity equivalent totaled to benzo[a]pyrene.
µg/L = micrograms per liter
NA - Not Analyzed
*This column gives the reader a rough idea how many times the chemical was detected above the screening value out of the times it was analyzed for. The total number of analyses can vary. This could be because not all samples were analyzed for all chemicals. Often the raw data is not available, therefore a chemical will only be included in the data summary table if it is detected.
** Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
FSWC - Freshwater Surface Water Criteria 62-302
PAHs - Polynuclear Aromatic Hydrocarbons

Table 4. Maximum Concentrations in Off-Site Groundwater (All Depths)

Contaminants of Concern	Maximum Concentration (µg/L)	Location/Date	# Greater Than Comparison Value/ Total # of Samples *	Comparison Value**	
				(µg/L)	Source
arsenic	23	SMW-27 1999	0/19	50 (PDWS)	DEP 1999
benzene	71 2.0	MW -13 1999 PW-1 1998	2/19	1 (CREG)	ATSDR 2000
boron	NA	-	-	900 (C_RMEG)	ATSDR 2000
carbazole	NA	-	-	7.5 (DWG)	DEP 1999
dibenzofurans	ND	-	0/5	24 (RBC_N)	EPA 2000
naphthalene	305	PMW-2 1988	1/13	200 (C_RMEG)	ATSDR 2000
PAHs (TEBaP)	11.1	SMW-27 1999	2/13	0.005 (CREG) 0.1 (PDWS)	ATSDR/DEP
pentachlorophenol	ND	-	0/13	0.3 (CREG)	ATSDR 2000

Sources: Gannett Fleming 2000; Black and Veatch Special Projects 1998; WES 1990, 1991; Environmental Science and Engineering1984,1986, 1987,1988; NUS 1983

TEBaP - toxicity equivalent totaled to benzo[a]pyrene.
NA - Not Analyzed
ND - Not Detected
µg/L = micrograms per liter
*This column gives the reader a rough idea how many times the chemical was detected above the screening value out of the times it was analyzed for. The total number of analyses can vary. This could be because not all samples were analyzed for all chemicals. Often the raw data is not available, therefore a chemical will only be included in the data summary table if it is detected. An additional problem with combining the drinking water well and monitoring well results is that drinking water wells often are not contaminated, and in this case would not report analyzing for something that was not detected. In addition, probably only seven or eight drinking water wells (total) were sampled, but these same wells were possibly given two or three different labels.
** Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
PDWS - Primary Drinking Water Standard - Enforceable Florida Standards
CREG - Cancer Risk Evaluation Guide for one in one million excess cancer (ATSDR)
C_RMEG - Reference Dose Media Evaluation Guide for Children
DWG - Florida Drinking Water Guideline
C_EMEG - Environmental Media Evaluation Guide for Children
RBC_N - Risk-based Concentrations, N= Noncarcinogenic effects
PAHs - Polynuclear Aromatic Hydrocarbons

Table 5. Maximum Concentrations in Off-Site Surface Soils (0-12 Inches Deep)

Contaminants of Concern	Maximum Concentration (mg/kg)	Location/Date	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value**			
				(mg/kg)		Source	
arsenic	36	SD-07	1999	11/26	20	(C_EMEG)	ATSDR 2000
benzene	ND	-		0/15	20	(CREG)	ATSDR 2000
boron	NS	-		-	5000	(C_RMEG)	ATSDR 2000
carbazole	6.9	NH-SS-13	1998	0/5	53	(R_SCTL)	DEP 1999
dibenzofurans (TEQ)	0.13	NH-SS-09	1998	0/5	50	(C_RMEG)	ATSDR 2000
naphthalene	680	ES-10	1999	0/26	1000	(C_RMEG)	ATSDR 2000
PAHs (TEBaP)	46	SD-09	1997	20/26	0.1	(CREG)	ATSDR 2000
pentachlorophenol	NA	-		-	6	(CREG)	ATSDR 2000

Sources: Gannett Fleming 1998, 2000; Black and Veatch Special Projects 1998

TEBaP - toxicity equivalent totaled to benzo[a]pyrene.
mg/kg = milligrams per kilogram
*This column gives the reader a rough idea how many times the chemical was detected above the screening value out of the times it was analyzed for. The total number of analyses can vary. This could be because not all samples were analyzed for all chemicals. Often the raw data is not available, therefore a chemical will only be included in the data summary table if it is detected.
** Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
C_EMEG - Environmental Media Evaluation Guide for Children
CREG - Cancer Risk Evaluation Guide for one in one million excess cancer (ATSDR)
C_RMEG - Reference Dose Media Evaluation Guide for Children
R_SCTL - Residential Soil Cleanup Target Level
PAHs - Polynuclear Aromatic Hydrocarbons
NA - Not Analyzed
ND - Not Detected

Table 6. Maximum Concentrations in Off-Site Surface Water (All Depths)

Contaminants of Concern	Maximum Concentration (µg/L)	Location/Date	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value**	
				(µg/L)	Source
arsenic	ND	-	0/1	50 (FSWC)	DEP 1999
benzene	NS	-	-	71 .28 (FSWC)	DEP 1999
boron	NS	-	-	NA	DEP 1999
carbazole	NS	-	-	46.5 (FSWC)	DEP 1999
dibenzofurans	NS	-	-	67 (FSWC)	DEP 1999
1-methyl naphthalene	ND	-	0/1	95 (FSWC)	DEP 1999
2-methyl naphthalene	ND	-	0/1	30 (FSWC)	DEP 1999
naphthalene	ND	-	0/1	26 (FSWC)	DEP 1999
PAHs (TEBaP)	ND	-	0/1	0.031 (FSWC)	DEP 1999
pentachlorophenol	ND***	-	0/1	8.2annual average 30 maximum (FSWC)	DEP 1999

Sources: Gannett Fleming 2000.

NA - Not Analyzed
ND - Not Detected
TEBaP - toxicity equivalent totaled to benzo[a]pyrene.
µg/L = micrograms per liter
*This column gives the reader a rough idea how many times the chemical was detected above the screening value out of the times it was analyzed for. The total number of analyses can vary. This could be because not all samples were analyzed for all chemicals. Often the raw data is not available, therefore a chemical will only be included in the data summary table if it is detected.
** Comparison values used to select chemicals for further scrutiny, not for determining the possibility of illness.
*** Method Detection Limit Higher than screening value.
FSWC - Freshwater Surface Water Criteria 62-302
PAHs - Polynuclear Aromatic Hydrocarbons

Table 7. Completed Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Private Well	Wood Treatment Waste Discharge	Groundwater	Tap Water Use	Ingestion, Inhalation, and Dermal Absorption	Residents in one nearby home	This well is (and had been) tested periodically. The sample before the one with benzene in it was taken about 11 months earlier; bracketing groundwater samples were taken in January 1997 and November 1998.

Table 8. Potential Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Existing Private Wells	Wood Treatment Waste Discharge	Groundwater	Tap Water	Ingestion, Inhalation, Dermal Absorption	36-48 Residents in 12 Nearby Homes.	Future
New Private Wells	Wood Treatment Waste Discharge	Groundwater	Tap Water	Ingestion, Inhalation, Dermal Absorption	Residents or Workers Using Contaminated Groundwater	Future
On-site Surface Soil	Wood Treatment Waste Discharge	Soil	Future on-site homes	Incidental Ingestion	Future On-site Residents	Future
Off-Site Surface Soil	Off-Site Surface Soil	Soil	Drainage Areas East of Hull Avenue	Incidental Ingestion	About 10-20 Nearby Residents	Future

Table 9. Calculated dose (mg/kg/day) from residential use of on-site groundwater

Contaminant of Concern (maximum concentration) µg/L		Oral MRL (mg/kg/day)	Groundwater- Ingestion (mg/kg/day)		Groundwater- Dermal (mg/kg/day)		Inhalation MRL ppm	Groundwater- Inhalation mg/m^3	
			Child	Adult	Child	Adult		Child	Adult
arsenic	73.9	(chr.) 0.0003	0.005	0.002	0.000007	0.000005	none	-	-
benzene	23	none	0.002	0.0007	0.0001	0.0001	(acute) 0.05 (int.) 0.004	0.23	0.23
boron	1,100	(int.) 0.01	0.07	0.03	0.0001	0.00007	none	-	-
carbazole	350	none	0.02	0.01	0.00003	0.00002	none	-	-
dibenzofuran	140	none	0.009	0.004	0.01	0.008	none	1.4	1.4
naphthalene	6,570	(acute) 0.05 (int.) 0.02	0.4	0.2	0.2	0.1	(chr.) 0.02	65.7	65.7
PAHs (TEBaP)	150	none	0.01	0.004	0.2	0.1	none	1.5	1.5
pentachlorophenol	1,000	(acute) 0.005 (int.) 0.001 (chr.) 0.001	0.07	0.03	0.7	0.5	none	omb	omb

Scenario Time-frame: Future
Land Use Conditions: Residential
Exposure Medium: Groundwater
Exposure Point: On-site tap water
Receptor Population: Residents
These doses were calculated using Risk Assistant Software (Hampshire Research Institute) and accepted values for groundwater consumption, shower inhalation exposure, and dermal exposure parameters (EPA 1991).
*These levels were left in mg/m^3 (milligrams per cubic meter) to compare them with levels in ATSDR Toxicological Profile.
MRL - Minimum Risk Level
µg/L = micrograms per liter
mg/kg/day = milligrams per kilogram per day
Oral MRL values are presented as an oral dose (mg/kg/day)
Inhalation MRL values are presented as an air concentration (ppm)

N.D.- Not detected
N.A.- Not applicable
N.S.- Not significant
omb - outside model boundary

acute = exposure is 1- 14 days
intermediate = exposure is 15-364 days
chronic = exposure is 365 and longer

The above doses were calculated using the following values:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult water consumption-	2 liters/day	Child water consumption-	1 liter/day
Adult shower time-	0.2 hours	Child shower time-	0.2 hours
Adult skin surface area-	23,000cm^2	Child skin surface area-	7,200cm^2

Table 10. Calculated dose (mg/kg/day) from on-site residential exposure to soil

Contaminant of Concern (maximum concentration) mg/kg		Oral MRL (mg/kg/day)	Soil- Ingestion (mg/kg/day)		Inhalation MRL ppm	Soil - Inhalation mg/m^3	
			Child	Adult		Child	Adult
arsenic	91	(chr.) 0.0003	0.002	0.0001	none	0.000005	0.000005
benzene		none			(acute) 0.05 (int.) 0.004		
boron		(int.) 0.01			none		
carbazole	5.7	none	0.00008	0.000008	none	0.0000003	0.0000003
dibenzofuran	26	none	0.0003	0.00004	none	0.000001	0.000001
naphthalene	9.1	(acute) 0.05 (int.) 0.02	0.0001	0.00001	(chr.) 0.02	0.0000005	0.0000005
PAHs (TEBaP)	297	none	0.004	0.0004	none	0.00002	0.00002
pentachlorophenol	34.1	(acute) 0.005 (int.) 0.001 (chr.) 0.001	0.0005	0.00005	none	0.000002	0.000002

Scenario Time-frame: Future
Land Use Conditions: Residential
Exposure Medium: Soil and Dust
Exposure Point: Inhalation or Ingestion of Soil or Dust
Receptor Population: Residents
These doses were calculated using Risk Assistant Software (Hampshire Research Institute) and accepted values for groundwater consumption, shower inhalation exposure, and dermal exposure parameters (EPA 1991).
MRL - Minimum Risk Level, µg/L = micrograms per liter, mg/kg/day = milligrams per kilogram per day
Oral MRL values are presented as an oral dose (mg/kg/day)
Inhalation MRL values are presented as an air concentration (ppm)
Inhalation MRL values are presented as an air concentration (ppm)

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

acute = exposure is 1- 14 days
intermediate = exposure is 15-364 days
chronic = exposure is 365 and longer

The above doses were calculated using the following values:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult soil consumption-	100mg	Child soil consumption-	200 kg

Table 11. Calculated dose (mg/kg/day) from residential use of off-site groundwater

Contaminant of Concern (maximum concentration) µg/L	Oral MRL (mg/kg/day)	Groundwater- Ingestion (mg/kg/day)		Groundwater- Dermal (mg/kg/day)		Inhalation MRL ppm	Groundwater- Inhalation mg/m³	
		Child	Adult	Child	Adult		Child	Adult
arsenic 23	(chr.) 0.0003	0.002	0.0007	0.000002	0.000002	none	-	-
benzene 71	none	0.005	0.002	0.0005	0.0003	(acute) 0.05 (int.) 0.004	0.71	0.71
boron	(int.) 0.01	-	-	-	-	none	-	-
carbazole	none	-	-	-	-	none	-	-
dibenzofuran	none	-	-	-	-	none	-	-
naphthalene 305	(acute) 0.05 (int.) 0.02	0.02	0.009	0.009	0.006	(chr.) 0.02	3.05	3.05
PAHs (TEBaP) 11.1	none	0.0007	0.0003	0.01	0.009	none	0.1	0.1
pentachlorophenol	(acute) 0.005 (int.) 0.001 (chr.) 0.001	-	-	-	-	none	-	-

Scenario Time-frame: Future
Land Use Conditions: Residential
Exposure Medium: Groundwater
Exposure Point: On-site tap water
Receptor Population: Residents
These doses were calculated using Risk Assistant Software (Hampshire Research Institute) and accepted values for groundwater consumption, shower inhalation exposure, and dermal exposure parameters (EPA 1991).
*These levels were left in mg/m³ (milligrams per cubic meter) to compare them with levels in ATSDR Toxicological Profile.
MRL - Minimum Risk Level, µg/L = micrograms per liter, mg/kg/day = milligrams per kilogram per day
Oral MRL values are presented as an oral dose (mg/kg/day)
Inhalation MRL values are presented as an air concentration (ppm)

N.D.- Not detected acute = exposure is 1- 14 days
N.A.- Not applicable intermediate = exposure is 15-364 days
N.S.- Not significant chronic = exposure is 365 and longer

The above doses were calculated using the following values:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult water consumption-	2 liters/day	Child water consumption-	1 liter/day
Adult shower time-	0.2 hours	Child shower time-	0.2 hours
Adult skin surface area-	23,000cm²	Child skin surface area-	7,200cm²

Table 12. Calculated dose (mg/kg/day) from off-site residential exposure to soil

Contaminant of Concern (maximum concentration) mg/kg		Oral MRL (mg/kg/day)	Soil- Ingestion (mg/kg/day)		Inhalation MRL ppm	Soil - Inhalation mg/m^3	
			Child	Adult		Child	Adult
arsenic	36	(chr.) 0.0003	0.0005	0.0001	none	0.000002	0.000002
benzene		none			(acute) 0.05 (int.) 0.004		
boron		(int.) 0.01			none		
carbazole	6.9	none	0.00009	0.0002	none	0.0000004	0.0000004
dibenzofuran	0.13	none	0.000002	0.0000004	none	0.000000007	0.000000007
naphthalene	680	(acute) 0.05 (int.) 0.02	0.009	0.002	(chr.) 0.02	0.00004	0.00004
PAHs (TEBaP)	46	none	0.0006	0.0001	none	0.000003	0.000003
pentachlorophenol	NS	(acute) 0.005 (int.) 0.001 (chr.) 0.001			none		

Scenario Time-frame: Future
Land Use Conditions: Residential
Exposure Medium: Soil
Exposure Point: Inhalation of Dust and Ingestion of Soil
Receptor Population: Residents
These doses were calculated using Risk Assistant Software (Hampshire Research Institute) and accepted values for groundwater consumption, shower inhalation exposure, and dermal exposure parameters (EPA 1991).
MRL - Minimum Risk Level, µg/L = micrograms per liter, mg/kg/day = milligrams per kilogram per day
Oral MRL values are presented as an oral dose (mg/kg/day)
Inhalation MRL values are presented as an air concentration (ppm)
Inhalation MRL values are presented as an air concentration (ppm)

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

acute = exposure is 1- 14 days
intermediate = exposure is 15-364 days
chronic = exposure is 365 and longer

The above doses were calculated using the following values:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult soil consumption-	100mg	Child soil consumption-	200 kg

APPENDIX D
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 relying only 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 toxicologic studies in humans or animals is identification of the relationship between exposure to different doses of a specific contaminant and the chance of having a health effect from each exposure level. This dose-response relationship provides a mathematical formula or graph that we use to estimate a person's risk of illness. The actual shape of the dose-response curve requires scientific knowledge of how a hazardous substance affects different cells in the human body. There is one important difference between the dose-response curves used to estimate the risk of non-cancer illnesses and those used to estimate the risk of cancer: the existence of a threshold dose. A threshold dose is the highest exposure dose at which there is no risk of illness. The dose-response curves for non-cancer 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 also exists for the development of cancer.

Uncertainty

All risk assessments, to varying degrees, require the use of assumptions, judgments, 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. Because of the uncertainties described below, this public health assessment does not represent an absolute estimate of risk to persons exposed to chemicals at or near the site.

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

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

There are also data gaps and uncertainties in the design, extrapolation, and interpretation of toxicologic 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 underestimate the actual risk of illness. In addition, extrapolating from high-to-low doses and from animal-to-human populations introduces great uncertainties. Extrapolating from animals to humans is uncertain because of the differences in the uptake, metabolism, distribution, and body organ susceptibility between different species. Human populations are also variable because of differences in genetic constitution, diet, home and occupational environment, activity patterns, and other factors. These uncertainties can result in an over- or underestimation of risk of illness. Finally, there are great uncertainties in extrapolating from high to low doses, and controversy in interpreting these results. Because the models used to estimate dose-response relationships in experimental studies are conservative, they may 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.