ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

Public Health Assessment for

KERR-MCGEE, INCORPORATED
(a/k/a KERR-MCGEE CHEMICAL CORPORATION)
JACKSONVILLE, DUVAL COUNTY, FLORIDA
EPA FACILITY ID: FLD039049101
AUGUST 29, 2003

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
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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PUBLIC HEALTH ASSESSMENT

KERR-MCGEE, INCORPORATED
(a/k/a KERR-MCGEE CHEMICAL CORPORATION)

JACKSONVILLE, DUVAL COUNTY, FLORIDA

EPA FACILITY ID: FLD039049101

Prepared by:

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

FOREWORD

This document summarizes public health issues a former agricultural chemicals packaging and distribution facility in Jacksonville, Florida. It is based on a site evaluation prepared by the Florida Department of Health (DOH). A number of steps are necessary to do such an evaluation:

- Evaluating exposure: Florida DOH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is found on the site, and how people might be exposed to it. Usually, Florida DOH does not collect its own environmental sampling data. We rely on information provided by the Florida Department of Environmental Protection (DEP), the U.S. Environmental Protection Agency (EPA), and other government agencies, private businesses, and the general public.

- Evaluating health effects: If there is evidence that people are being exposed, or could be exposed, to hazardous substances, Florida DOH scientists will determine whether that exposure could be harmful to human health. Their report focuses on public health; that is, the health impact on the community as a whole, and is based on existing scientific information.

- Developing recommendations: In the evaluation report, Florida DOH outlines its conclusions regarding any potential health threat posed by a site, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of Florida DOH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies, including the EPA and Florida DEP. If, however, a immediate health threat exists or is imminent, Florida DOH will issue a public health advisory warning people of the danger, and will work to resolve the problem.

- Soliciting community input: The evaluation process is interactive. Florida DOH starts by soliciting and evaluating information from various government agencies, individuals or organizations responsible for cleaning up the site, and those living in communities near the site. Any conclusions about the site are shared with the groups and organizations providing the information. Once an evaluation report has been prepared, Florida DOH seeks feedback from the public. *If you have questions or comments about this report, we encourage you to contact us.*

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1.0 SUMMARY

The 31-acre Kerr-McGee site is in an industrial area on the St. Johns River in Jacksonville, Duval County, Florida, at 1611 Talleyrand Avenue. From 1893 until 1978, four successive companies formulated, blended, and packaged agricultural chemicals at this site. Kerr-McGee also made sulfuric acid and reconditioned steel drums at the site. Kerr-McGee ceased operations in 1978 and in 1989 demolished all structures on the site, leaving the concrete foundations of three buildings and dirt roads. The site is currently vegetated and access is restricted by a fence with hazardous waste site and "No Trespassing"warning signs that have an Environmental Protection Agency phone number to call for additional information.

Historical working conditions, the absence of personal protective equipment, and reports from former workers led Florida DOH to believe past working conditions may have posed a public health hazard for workers on and near the site. Because the nearest residences are about 500 feet northwest of the site, Florida DOH believes nearby residents may also have been exposed to site dust in the past. While public health agencies may be limited in what they can do because of the lack exposure information, Florida DOH has asked the National Institute for Occupational Safety and Health (NIOSH) who sometimes investigate workers' past exposures for a study of worker's health based on information recounted by former workers.

On-site surface soil, St. Johns River/Deer Creek sediments, and shallow groundwater both on and off the site are contaminated with agricultural chemicals and metals. The Florida Department of Health (Florida DOH), however, is not aware of any persons who are currently being exposed to contaminated soil, sediments, or shallow groundwater. Site access is restricted and Deer Creek is overgrown by vegetation. Residences in the area are supplied with municipal water and Florida DOH did not find any nearby private wells in the shallow aquifer. Therefore the site presents no current public health hazard.

The site might be a future public health hazard if people were to ingest, inhale, or have skin contact with contaminants in surface soil on the site, shallow groundwater under the site, or St. Johns River sediments near the site. Florida DOH discusses specific exposure pathways, exposure durations, and potential disease associations for the highest levels of 10 chemicals measured on and near the site. Florida DOH recommends dust generation be controlled and air quality monitored for metals and chlorinated pesticides during any future clean-up activities or remodeling, utilities installation, or construction or other work at the site that would disturb soils or remove vegetation. We recommend people avoid dust inhalation or hand-to-mouth contact with contaminated surface soil on the site. Florida DOH also recommends that groundwater from the shallow aquifer under (and near) the site not be used for drinking water or other uses that would allow people to breathe volatilized chemicals in an enclosed space. Florida DOH further recommends that people avoid hand-to-mouth contact with contaminated sediments in the St. Johns River near the site.

Florida DOH, Bureau of Community Environmental Health staff will evaluate additional groundwater and surface soil test results. Florida DOH will also inform and educate nearby residents about the public health threats associated with this site. Although Kerr-McGee still owns the site, the U.S. Environmental Protection Agency (EPA) will oversee assessment and cleanup of the site.

2.0 PURPOSE AND HEALTH ISSUES

In October 2000, the United States Environmental Protection Agency (EPA) asked the Florida Department of Health (DOH), Bureau of Community Environmental Health to assess the public health risked posed by the Kerr-McGee, Inc. hazardous waste site in Jacksonville, Florida. Florida DOH prepared this report in response to the EPA's request. This is the first site assessment by either the Florida DOH or the federal Agency for Toxic Substances and Disease Registry (ATSDR).

In this report, Florida DOH evaluates the past, current; and future potential for human exposures to chemicals at or near the Kerr-McGee site, discusses the possibility of these exposures causing illnesses, and identifies actions needed to protect public health.

Florida DOH conducted this public health assessment under a cooperative agreement with 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 a federal agency within the U.S. Department of Health and Human Services.

3.0 BACKGROUND

3.1 Site Description

This 31-acre site at 1611 Talleyrand Avenue is in a highly industrialized area along the St. Johns River in east Jacksonville, Florida (Figure1, Appendix B). The site is roughly rectangular in shape: 1,800 feet east to west and 900 feet north to south. The site is fenced along its northern boundary with Jaxport (the name of the port currently leased by Toyota) and along its western boundary on Talleyrand Avenue. Two gates in the fence along Talleyrand Avenue provide site access. The south end of the site is bordered by Deer Creek and undeveloped CSX Transportation, Inc. (CSXT) railroad property, an area of tidal wetlands and trees. The east side borders the St. Johns River.

Concrete foundations from the Florida Agricultural Supply Company (FASCO) building, a nearby herbicide building, and the machine shop storeroom are all that remain on the site. One waste impoundment and two dredge/fill ponds along the northern boundary of the site have been filled in with soil and are overgrown with vegetation (Figure 2, Appendix B). Grasses, palmettos, pines, and wetlands vegetation cover the site. There is little potential for dust because of this vegetation–except for vehicle traffic on the dirt roads and mowing activities during periods of dry weather.

The site elevation varies between 2 to16 feet above mean sea level, and the site is within the 500-year flood plain. The southern and eastern portions of the site are within the 100-year flood plain (IT 2000). The highest elevations are along the northern site boundary. Runoff from the northern part of the site and adjacent Jaxport site collects in a drainage ditch, and the City of Jacksonville pumps it to the Buckman Waste Water Treatment Plant. A swale (linear depression) runs nearly the length of the middle of the site (east to west). Storm water runoff from the central part of the site flows east and discharges into the St. Johns River (IT 2001).

The St. Johns River, Deer Creek, and the surficial aquifer are influenced by the ocean tides. Water levels in the monitoring wells change by as much as 1.75 feet between high and low tides.

3.2 Site History

Four agricultural chemical companies packaged, distributed, and/or formulated, fertilizer, herbicides, and pesticides at this site. The Wilson and Toomer Company owned the site from 1893 until the late 1950s. Plymouth Cordage owned the site from the late 1950s to 1965. The Emhart Company owned the site from 1965 to 1970. Kerr-McGee Chemical, LLC (Kerr-McGee) purchased the site in 1970. In addition to fertilizers, herbicides, and pesticides, Kerr-McGee made sulfuric acid in lead-lined chambers and reconditioned steel drums at the site. Lead and other metals were waste products of sulfuric acid production. Kerr-McGee stopped making sulfuric acid in 1972.

A surface impoundment (liquid-retention pond) north of the Florida Agricultural Supply Company (FASCO) building (Figure 2, Appendix B) received a variety of liquid wastes: pesticide and herbicide spills, product formulation residue (from cleaning of production tanks with soda ash and chlorine), process water, and wash-down water (liquid generated during nightly equipment cleaning).

Workers periodically pumped water from the surface impoundment to the two larger nearby ponds. Kerr-McGee also deposited sediments from the St. Johns River in these ponds. Sediments from the St. Johns River were dredged to keep the docks accessible to ships.

Former workers reported that they buried off-specification, malathion-impregnated fly flake on the northwestern part of the site in the 1950s. Other workers reportedly burned empty pesticide containers on the northwestern part of the site in the 1970s and disposed of superphosphate scrubber sludge south of the fertilizer plant (IT 2001).

In 1974, Florida DEP issued Kerr-McGee a National Pollutant Discharge Elimination System (NPDES) permit. Kerr-McGee discharged storm water from south of the fertilizer building to the St. Johns River via outfall #001. Kerr-McGee also discharged wastewater from the pesticide plant, the fertilizer plant, and non-contact cooling water from the sulfuric acid plant to the St. Johns River at outfall #002 (Figure 2, Appendix B).

Kerr-McGee ceased all operations in 1978. In 1983, the Florida Department of Environmental Protection (DEP) asked Kerr-McGee to assess soil and groundwater contamination. Contractors for Kerr-McGee conducted one groundwater investigation, one soil investigation, and six combined soil and groundwater investigations. On the basis of the data from these investigations, Kerr-McGee produced two baseline risk assessments and a remedial design.

In 1989, Kerr-McGee demolished all structures on the site, leaving only concrete foundations of three buildings. The company also filled in all three surface water holding areas with wood, concrete, and scrubber sludge. At that time Kerr-McGee also filled the drainage ditch south of the former fertilizer building, so storm water is no longer discharged at outfall #001. The City of Jacksonville plugged the end of another ditch (outfall #002) on the northern part of the site and began pumping storm water runoff to a nearby waste water treatment plant. Storm water runoff from the southern part of the site continues to flow south into Deer Creek, as it did in the past (E&E 1991).

In 1998, contractors for Florida DEP conducted an expanded site investigation. In late 1998, EPA assumed the lead for oversight of the site investigation and cleanup. In 2000, contractors for EPA conducted a remedial investigation to determine the extent of soil and groundwater contamination. In 2001, EPA began a second remedial investigation to more fully determine the extent of sediment and surface water contamination. Information from these measurements led them to seek additional on-site soil and off-site groundwater information. Appendix A summarizes these reports.

In April 2001, the Community Assessment Group representative petitioned the Florida DOH for a health study on the site. Florida DOH forwarded the petition to ATSDR's Division of Health Studies, National Institute of Safety and Health (NIOSH) of the National Institutes of Health, and the EPA Ombudsman to send to (Appendix E).

3.3 Demographics

In 1990, about 9,000 people lived within a 1-mile radius of the site. Approximately 33 percent were 19 years of age or less and approximately 49.8 percent were black/African American, 48.5 percent were white, and less than 2 percent were Latino/Hispanic, American Indian/Alaska Native, Asian/Pacific Islander, or other racial/ethnic groups. The average per capita income was $10,280; and about 23 percent (2,095 people) of the population were below the national poverty level **(Bureau of the Census, U.S. Department of Commerce, 1990).** The nearest residences are one block (500') west of the northwestern corner of the site; in the northeast quadrant of the intersection of 8th and Westcott.

3.4 Land Use

The area around the site is a highly industrialized deep-water port zoned "water dependent/water related industrial" (Figure 1, Appendix B). Other hazardous waste/industrial sites exist nearby. Between 1913 and 1950, the Armor Fertilizer Company made superphosphate on the property now called Jaxport, north of Kerr-McGee. Sun Coast Fuels and Industrial Water Services are both located northwest of the Kerr-McGee site. CSXT, a railroad company, owns the undeveloped tidal wetlands south of the site. Jones Chemical and Crowley Marine are located south of Deer Creek. Southwest of Kerr-McGee are another CSXT property and FMC Corporation (Agricultural Chemical Group). CSXT and FMC Corporation have contributed to polynuclear aromatic hydrocarbon and chlorinated pesticide contaminated sediments present in Deer Creek.

Schools near Kerr-McGee include:

- Axon School - 1 mile northwest of the site,
- Love School - 2/3 of a mile northwest of the site,
- Brown School - 2/3 of a mile west of the site,
- Gilbert Junior High School - 3/4 of a mile west of the site, and
- Oakland School - approximately 1 mile southwest of the site.

The University Hospital of Jacksonville is 1/4 mile north of the site on East 7th Street.

3.5 Natural Resource Use

Groundwater in the surficial aquifer under the site is generally less than 13 feet below the land surface. In this area, groundwater in the surficial aquifer is not used as a drinking-water source. City water is available for commercial, industrial, and residential use. There are a few inactive private wells within 1 mile of the site, but they are all hydraulically up-gradient of the Kerr-McGee site (IT 2001a). The nearest public water supply well is 0.5 mile west and hydraulically up-gradient of the site. Florida DOH did not find any private drinking water wells near the site.

In the past, four deep artesian (free-flowing) wells were reported to supply process water for site operations. These were very deep wells ranging from 768–1,055 feet below the land surface (Burlington, 1994). The oldest of these wells was installed in 1920. One well, in the northeastern part of the site, was reportedly plugged in 1971. The other three wells (near the FASCO building, inside the FASCO building, and near the St. Johns River) were plugged in 1992. Another artesian well was discovered during recent site sampling, a permit to abandon it was applied for in late 2002.

Deer Creek drains the southern part of the Kerr-McGee site, industrial areas south of Kerr McGee, and many upstream areas to the west. There is no apparent recreational use of Deer Creek near the site. Deer Creek flows into the St. Johns River south of the site. The Duval County Health Department reports that although people may eat fish and shellfish from other parts of the St. Johns River, the strong current and industrial traffic on this part of the river make pleasure or subsistence fishing from small boats unlikely. There is no shore access near the site.

3.6 Site Visits

In November 2000, Connie Garrett, Environmental Scientist and Specialist, Florida DOH, Bureau of Community Environmental Health attended a public meeting at which EPA detailed its plans for environmental testing.

On April 10, 2001, Connie Garrett and Beth Copeland, Health Education and Community Involvement Specialist also from Florida DOH **visited the site in conjunction with attending a second public meeting at the Eastside Community Center near the site.** Appendix B contains site photographs. Ms. Garrett and Ms. Copeland observed grasses, palmettos, pines and wetlands vegetation covering the site. Because of the vegetation, there appeared to be little potential for dust generation, except under dry-weather conditions when vehicles use the dirt roads on the site, or the site is mowed. They saw the concrete foundations of the three former buildings. They observed the western site boundary on Talleyrand Avenue is fenced and the two gates are posted with "No Trespassing" signs and hazardous waste signs which included a toll-free number for contacting the EPA.

The women also observed muddy water in Deer Creek which is overgrown with vegetation. The creek had sorbent booms on both sides of Talleyrand Avenue (Appendix B). These sorbent booms collect floating oil, grease, and gasoline. No particular odors were detected on the site. The few residences in the area were primarily middle- or lower middle-income homes.

On March 20, 2002, Ms. Garrett attended a third public meeting at the Eastside Community Center. At this meeting, EPA explained what had been found to date and what additional sampling needed to be carried out. Most of the people that attended this meeting stated they were concerned that there are many abandoned industrial sites in their neighborhood and that the Kerr-McGee site was not their only concern. Those present at the meeting said they viewed this site as just one of the long-term contributors to adverse environmental conditions in their neighborhoods, and they were concerned about restoring the quality of surface water and soil in the area. Ms. Garrett visited the site prior to this meeting with the EPA project manager, community health education specialist, and regional ombudsman. The site appeared little changed.

Ms. Copeland and Ms. Garrett visited the site again prior to Florida DOH's public meeting held to invite comments on the draft Public Health Assessment on February 14, 2003. Again the site appeared little changed except that site conditions were wetter than we had previously observed, with water standing in the vehicle ruts.

4.0 DISCUSSION

In this section Florida DOH reviews the available site information (groundwater, soil, sediment, and surface-water data). Florida DOH looked for information on possible chemicals that site operators could have released to soil or water in the past and for the current levels of those chemicals at the site. Next, a review was made of possible ways people might come into contact with chemicals from past releases at the site. Finally, Florida DOH determined whether or not these chemicals might cause adverse health effects if people are exposed to them.

Public health assessments attempt to moderate the uncertainties inherent in the health assessment process by using conservative but realistic assumptions when estimating or interpreting health risks. Also, the health-related values **(established by the ATSDR, EPA and DEP) Florida DOH uses** to evaluate the data include wide margins of safety. The assumptions, interpretations, and recommendations made in this public health assessment are intended to protect public health.

4.1 Environmental Contamination

This section provides a review of environmental data collected at and near the site since 1984. The sampling adequacy is evaluated and contaminants of concern at the site are identified. This section refers to tables that list the maximum concentration and detection frequency for each contaminant of concern in the groundwater, surface water, sediment, and soil. No air data were available. The contaminants of concern were selected by considering the following factors:

1. Concentrations of contaminants found on and off the site. Contaminants are only eliminated from further consideration if the **typical concentrations at unpolluted sites in the area** (background concentrations) and the on-site concentrations are both below standard comparison values established by **the ATSDR, EPA and DEP**. However, background concentration levels are useful in determining whether or not contaminants are site-related. This process provides the assessment of the public health risk presented by all contaminants detected at or near a site, regardless of whether they are site-related.

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

3. Community health concerns. These are concerns expressed by members of the nearby community about possible adverse health effects from exposure to site contaminants.

4. Comparisons of the maximum concentrations of contaminants identified at the site to ATSDR-published standard comparison values for contaminated environmental media for which a completed exposure pathway, or potential exposure pathway, is found to exist at the site. Standard comparison values are specific to the type of environmental media (water, soil, sediment) that is contaminated. These standard comparison values are used to select site contaminants for further evaluation. These values are not used to predict health effects or to establish clean-up levels. When site contaminants are found to have media concentrations that are above ATSDR's chemical-specific standard comparison values, the contaminant is selected for further evaluation. This does not necessarily mean that a contaminant represents a health risk. Site contaminants that fall below an ATSDR chemical-specific standard comparison value are unlikely to be associated with illness, and consequently are not evaluated further, unless the community has expressed a specific concern about the contaminant.

5. Comparisons of maximum site concentrations found in completed and potential exposure pathways to toxicological information published in ATSDR's chemical-specific Toxicological Profiles (available on the internet at http://www.atsdr.cdc.gov/toxpro2.html#-A-). These chemical-specific profiles summarize information about the toxicity of chemicals from the scientific literature.

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

1. Environmental Media Evaluation Guide (EMEG). An EMEG is derived from the ATSDR-established Minimal Risk Level (MRL), using standard exposure assumptions (e.g., ingestion of 2 liters of water per day and body weight of 70 kg. for adults). MRLs are estimated levels of daily human exposure to a chemical for a period of 1 year or longer which is likely to be without any appreciable risk of noncancerous illnesses.

2. Cancer Risk Evaluation Guide (CREG). A CREG is the contaminant concentration estimated to result in no more than 1 excess cancer per 1 million persons exposed during a lifetime (i.e., 70 years). CREGs are calculated from the EPA-established cancer slope factors.

3. Reference Dose Media Evaluation Guides (RMEGs). An RMEG is the estimated daily human exposure level (for a period of 1 year or more) to a contaminant that is likely to be without an appreciable risk of noncancerous illnesses. RMEGs are derived, using standard exposure assumptions, from the EPA-established Reference Dose (RfD).

4. Lifetime Health Advisory (LTHA). A LTHA for drinking water is the EPA-estimated concentration of a drinking-water contaminant, at which illness is not expected to occur during a lifetime (i.e., 70 years) of exposure. LTHAs are set at levels that provide a safety margin to protect sensitive members (e.g., children, senior citizens) of the population.

Using the above criteria, the following contaminants of concern at the site were selected for further evaluation: aldrin, arsenic, benzene hexachlorides or hexachlorocyclohexanes (BHCs), chlordane, 1,1,1-trichloro-2,2-bis(para-chlorophenyl)ethane (DDT), 1,1-dichloro-2,2-bis(para-chlorophenyl)ethene (DDE), 1,1-dichloro-2,2-bis(para-chlorophenyl)ethane (DDD), 1,4-dichlorobenzene, dieldrin, heptachlor/ heptachlor epoxide, lead, and toxaphene.

The Florida DOH uses only ATSDR and other accepted standard comparison values to select contaminants of concern for further consideration. Identification of a contaminant of concern in this section of this report does not necessarily mean that exposure to the contaminant will cause illness. Identification of contaminants of concern helps narrow the focus of the public health assessment to those contaminants that pose a potential public health risk to area residents. When a contaminant of concern is selected in one environmental medium at a site, the contaminant is also reported in the other environmental media. The contaminants of concern at the Kerr-McGee site are evaluated in subsequent sections, along with a discussion of whether long-term, daily exposures would be likely to cause illness or to statistically increase the risk of cancer.

In the following sections, the contamination found to exist *on* the site is discussed, followed by a discussion of the contamination found to exist outside the site boundaries, i.e., *off* the site.

<u>4.1.1 On-site Contamination</u> - For this public health assessment, *on-site* is defined as the area within the Kerr-McGee property boundaries (Figure 1, Appendix B).

4.1.1.1 On-site Groundwater - Between 1992 and 2001, Florida DEP, Kerr-McGee, and EPA collected 86 groundwater samples from on-site monitoring wells. Not all samples were analyzed for all contaminants of concern.

Groundwater sample results from shallow wells (completed 15-20' below the land surface) and deep wells (completed 45-50' below the land surface) are considered together. A summary of the results appears in Table 1of Appendix B. On-site groundwater quality has been adequately characterized for this public health assessment because Florida DOH uses the highest chemical levels found to assess risks from an environmental media. To assure that the extent of groundwater contamination has been found, EPA's contractor will install two additional monitoring wells in the southeast corner of the site.

4.1.1.2 On-site Surface Soil - Between 1984 and 2001, Florida DEP, Kerr-McGee, and EPA collected 108 on-site surface-soil samples. Most of these samples were taken near the former buildings, railroad spurs, and impoundments/ponds. Not all samples were analyzed for all contaminants of concern. Although people are usually only exposed to contaminants from the top 3 inches of soil, Florida DOH considered composite soil samples from 0 to 24 inches below land surface as surface soils (Table 1, Appendix B).

Areas of on-site soil contamination appear to be well-defined, except in the northwestern portion of the site; that is along the property boundary and in the vicinity of the former storage warehouse. For this public health assessment, on-site surface-soil quality has not been adequately characterized. EPA does plan, however, to gather and analyze 27 additional on-site surface and sub-surface soil samples.

4.1.1.3 On-site Air - Florida DOH is unaware of any existing on-site air-monitoring data. Currently the site is vegetated, and no vehicles are using the dirt roads on the site. In the future, however, mowing or clearing the vegetation or driving on these dirt roads could expose workers and nearby residents to dust contaminated with arsenic, lead, and chlorinated pesticides - under prolonged, dry weather conditions.

4.1.2 Off-site Contamination - For this public health assessment, *off-site* is defined as the area outside the Kerr-McGee property boundaries (Figure 1, Appendix B).

4.1.2.1 Off-site Groundwater - Between 1987 and 2001, Florida DEP and EPA collected groundwater samples from five off-site monitoring wells. Not all samples were analyzed for all contaminants of concern.

Groundwater sample results from shallow wells (completed 15-20' below the land surface (bls) and deep wells (completed 45-50' bls) are considered together. Table 2, Appendix B summarizes the results. Gasoline-contaminated groundwater is present north of the site and chlorinated-solvent-contaminated groundwater is present northwest of the site. For this assessment, off-site groundwater quality has not been adequately characterized. The EPA plans to install seven additional shallow monitoring wells and 3 deep monitoring wells and then gather and analyze additional off-site groundwater samples from the new wells.

4.1.2.2 Off-site Surface Water - Nine surface-water samples have been taken from Deer Creek and the St. Johns River (Table 3, Appendix B). However, Deer Creek and the St. Johns River both drain storm water from other contamination sources. Flow direction in both Deer Creek and the St. Johns River changes with the ocean tides. Therefore, it is not possible to attribute all off-site surface-water contamination solely to the Kerr-McGee site. For this public health assessment, off-site surface-water quality has been adequately characterized.

4.1.2.3 Off-site Sediments - Forty-one off-site sediment samples have been taken from Deer Creek and the St. Johns River near the site (Table 3, Appendix B). Sediments are contaminated with chlorinated pesticides, polychlorinated biphenyls, and polynuclear aromatic hydrocarbons. Deer Creek and the St. Johns River, however, both drain storm water from other contamination sources. Flow direction in both Deer Creek and the St. Johns River changes with the tide. Therefore, it is not possible to attribute all off-site sediment contamination solely to the Kerr-McGee site. For this public health assessment, off-site sediments have been adequately characterized.

4.1.2.4 Off-Site Air - Florida DOH is unaware of any existing off-site air-monitoring data. Currently, the site is vegetated, and no vehicles are using the dirt roads on the site. In the future, however, mowing or clearing the vegetation or driving on the dirt roads could expose workers and nearby residents to dust contaminated with arsenic, lead, and chlorinated pesticides - under prolonged, dry weather conditions.

4.1.3 Quality Assurance and Quality Control - Florida DOH used existing environmental data to prepare this public health assessment. We assumed that these data are valid. The environmental samples were collected and analyzed by governmental consultants or consultants whom were overseen by governmental agencies. We also assumed that the consultants who collected and analyzed these samples followed adequate quality-assurance and quality-control measures in regard to chain-of-custody, laboratory procedures, and data reporting.

The completeness and reliability of the **referenced environmental data determine the validity** of the **analyses and conclusions drawn** for this **public health assessment.** Florida DOH assumed that estimated data and presumptive data were valid. Assuming presumptive data are valid errs on the side of public health safety by assuming that a contaminant is present, when it in fact it might not be present. If the **highest identified level of contaminant had a qualifier, that data qualifier is listed with the value in the appropriate table.**

Florida DOH did not consider groundwater analytical data collected before 1992. Before 1992, monitoring wells were constructed of galvanized pipe. When pesticides in groundwater combine with galvanized pipe, the resulting pesticide concentrations are artificially low when tested. The groundwater data collected after 1992 is acceptable and was considered for this public health assessment.

4.2 Physical Hazards

Florida DOH did not observe any physical hazards during its April 10, 2001, March 20, 2002, and February 14, 2003 site visits.

4.3 Exposure Pathways

Chemical contaminants in the environment can be harmful to public health, but only if people come into contact with the contaminants. It is essential to determine or estimate the frequency of contact people could have with hazardous substances in their environment in order to assess the public health significance of the contaminants.

To determine whether people can come into contact with contaminants at or from a site, the human exposure pathways are examined. An exposure pathway has five parts:

1) a contaminant source,
2) an environmental medium like groundwater or soil that can hold or move the contamination,
3) a point at which people come into contact with a contaminated medium a like a drinking water well or garden soil,
4) a completed exposure pathway like drinking contaminated water from a well or eating contaminated soil on homegrown vegetables, and
5) a population which might come into contact with the contaminants.

An exposure pathway is eliminated from consideration if one or more of these five parts is not present and is unlikely to ever be present. Exposure pathways that are not eliminated in this way are either completed pathways or potential pathways. Completed exposure pathways have all five parts present, and exposure to a contaminant has occurred in the past, is occurring in the present, or will occur in the future. Potential exposure pathways have one or more of the five parts missing now, but could be a completed pathway in the future, or could have been a completed pathway in the past.

Between 1893 and 1978, when the site was closed, workers at the site might have been exposed to metals, caustic acids, and herbicides and/or pesticides by inhalation, incidental ingestion, and/or skin absorption. Former workers recounting historical working conditions including the absence of personal protective equipment led Florida DOH to believe past working conditions may have posed a public health hazard for workers on and near the site. Because the nearest residence is about 500 feet northwest of the site, nearby residents may also have been exposed to site dust. Florida DOH has asked ATSDR to study worker's health based on information recounted by former workers. We have also relayed a worker health study request to the National Institute for Occupational Safety and Health (NIOSH) who sometimes investigate workers' past exposures.

4.3.1 Completed Exposure Pathways - With the exception of former workers, no other completed exposure pathways were identified by Florida DOH.

4.3.2 Potential Exposure Pathways - Florida DOH considered the following potential human exposure pathways (Table 4, Appendix B):

4.3.2.1 Airborne Dust - Florida DOH classifies airborne dust to be a potential exposure pathway because no air-monitoring data are available to confirm the presence of pesticides in off-site air. Between 1893 and 1978, when the site closed, workers at nearby businesses and nearby residents might have breathed dust from the site that was contaminated with arsenic, lead and/or agricultural chemicals. Florida DOH estimates that during this 85-year period, 100–1,000 nearby residents might have been exposed. The site is currently covered with vegetation, and no vehicles are using the dirt roads on the site; therefore, dust generation is unlikely. However, if soil at the site is disturbed in the future and dust generation is not controlled, nearby residents could be exposed to dust containing pesticides and/or agricultural chemicals under prolonged, dry weather conditions.

4.3.2.2 On-site Surface Soil - In the past, access to on-site surface soil was not restricted and either the public or former workers could have been exposed to contaminants in on-site soil. Currently this site is inactive and the site is fenced on the north and west sides; therefore, no people are present on the site who might accidentally ingest contaminated soil. Florida DOH classifies on-site surface soil as a potential exposure pathway; however, because if site land use were to change to residential in the future, people could be exposed to surface soil contaminated with metals and pesticides via incidental (accidental) ingestion.

4.3.2.3 Off-site Surface Water and Sediments - Florida DOH classifies off-site surface water and sediments as potential exposure pathways. Between 1893 and 1978,when the site closed, nearby residents may have come into contact with surface water and sediments from Deer Creek and the St. Johns River, which are near the site. Florida DOH estimates that during this 85-year period, 10–100 nearby residents might have been exposed by dermal (skin) absorption. Recent sediment analyses from the former dock area found aldrin at levels of possible health concern for children with who might ingest these sediments daily, for longer than one year. However, little opportunity exists now, or was likely in the past, for people to access areas with contaminated sediments, because the St. Johns River quickly becomes deep near the shore. Although Deer Creek sediments could be accessible under the bridge on the road to Crowley Marine and Jones Chemical, these sediments only contain DDD and DDT at levels of concern for statistical theoretical increases in cancer risk with daily, long-term ingestion. For these reasons, little opportunity exists for human exposure to contaminated sediments. However, if these contaminated sediments were dredged and placed in a public or residential area in the future, people might be exposed.

4.3. 2.4 Fish and Shellfish - Fish and shellfish from the St. Johns River or Deer Creek near the site could contain chemicals from this and other nearby industrial sites, from downtown Jacksonville storm water, and from point and non-point sources upstream–as the St. Johns River headwaters are 160 miles to the south. However, the occurrence of pleasure or subsistence fishing are not likely near the site because large shipping vessels and a fast current discourage small boats, and the shoreline is not readily accessible for bank fishing. The choking overgrowth of water plants in Deer Creek would make fishing difficult from the bridge. While fish and shellfish ingestion are potential exposure pathways, the Florida DOH is not recommending fish or shellfish sampling or analyses at this time. If information becomes available that indicates a need for such data, the Florida Exposure Investigator can coordinate fish or shellfish sampling and analysis, and evaluate the data.

4.3.2.5 On-site Shallow Groundwater - It is unlikely that groundwater from the shallow aquifer under this site was used in the past. Site operations used groundwater from the deeper Floridan aquifer. Although shallow groundwater under the site is contaminated, the groundwater flows east and south (away from nearby residential areas) and likely discharges into the St. Johns River and Deer Creek.

Currently, municipal water is available to area residents, and Florida DOH was unable to find any nearby private drinking-water wells. At this time, no one is known to be using contaminated shallow groundwater on or near the site for drinking, showering, or for any other indoor use. Because some parts of the site contain levels of groundwater contaminants that might cause acute illness from only the inhalation pathway, Florida DOH prefers to warn against its future use, rather than assume it will not be used due to poor potable quality. Florida DOH has observed shallow groundwater (including brackish or partly salty water) on and near other hazardous waste sites used for irrigation, aquaculture of soft-shelled clams, and toilet-flushing and hand-washing purposes in industrial facilities.

4.3.2.6 Off-site Shallow Groundwater - The shallow aquifer near the site is not currently used. Florida DOH did not find any shallow groundwater wells near the site. Municipal water is available, but for the reasons mentioned in the previous paragraph, Florida DOH wishes to keep contaminated off-site shallow groundwater as a potential future pathway.

4.4 Public Health Implications

The following sections discuss exposure levels and possible health effects that might occur if people were exposed daily to the highest measured levels of contaminants of concern found on and off the site. The chemicals are discussed by media, and chemicals that were measured at levels below their screening values are not discussed. For example, if a chemical was measured in groundwater above its screening value and in soil below its screening value, only the possible health effects of exposure to groundwater are discussed.

Limitations on assuming the highest measured levels of chemicals include the full range of chemicals and amounts an exposed person might encounter on the site include 1) a lack of statistical validation of the number of samples that were taken and the measured levels, 2) limited information on site waste placement, containment, or possible burial/spills, and 3) the possibility that chemicals were not identified or measured because they were not analyzed for. Dioxins are examples of chemicals that might be on the site because they were a common (and persistent) contaminant in older herbicides (2,4-D), but could not have been detected because they were not analyzed for.

4.4.1 Toxicological Evaluation - This subsection discusses exposure levels and possible health effects that might occur in people exposed to the highest measured levels of the contaminants of concern at the site. Also discussed are general ideas, such as the risk of illness, dose response and thresholds, and uncertainty in public health assessments.

To evaluate exposure, an estimated daily dose for children and for adults was made for each contaminant of concern identified at the site. Kamrin (1988) explains the concept of dose in the following 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 2,000 ounces to a 2,000-pound (1-ton) elephant. In each case, the amount per weight is the same:; i.e., 1 ounce for each pound of animal.
>
> This amount per weight is the *dose*. Dose is used in toxicology to compare the toxicity of different chemicals in different animals.

The units of milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day) are used to express doses in this public health assessment. A milligram is 1/1,000 of a gram (a gram weighs about what a raisin or paperclip weighs); a kilogram is approximately 2 pounds.

To calculate the daily dose of each contaminant, standard assumptions are used about body weight, ingestion and inhalation rates, duration of exposure (period of time), and other factors needed for dose calculation (ATSDR 1992, EPA 1997). In calculating the dose, it is assumed that people are exposed daily to the maximum concentration measured at the site for each contaminant in each environmental medium. ATSDR's toxicological profiles on contaminants separate exposures into three exposure routes - inhalation, ingestion, and dermal (skin) exposure. For each of these exposure routes, ATSDR also groups health effects by duration (time period) of exposure. *Acute exposures* are those with a duration of 14 days or less; *intermediate exposures* are those with a duration of 15 - 364 days; and *chronic exposures* are those that occur for 365 days or more (or an equivalent period of time for animal exposures). ATSDR Toxicological Profiles also provide information on the environmental transport and regulatory status of contaminants.

To estimate exposure from incidental ingestion of contaminated soil, Florida DOH used the following assumptions (EPA 1997):

1) children 1–4 years of age ingest an average of 200 mg of soil per day,
2) adults ingest an average of 100 mg of soil per day,
3) children 1–4 years of age weigh an average of 15 kg,
4) adults weigh an average of 70 kg,
5) children and adults ingest contaminated soil at the maximum concentration measured for each contaminant.

To estimate possible future exposure from drinking contaminated groundwater, Florida DOH used the following assumptions (EPA 1997):

1) children 1–4 years of age ingest an average of 1 liter of water per day,
2) adults ingest an average of 2 liters of water per day,
3) children 1–4 years of age weigh an average of 15 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.

Between the 1893 and 1978 when the site closed, nearby residents and on- or off-site workers might have breathed contaminated dust from this site. Based on chemicals measured in on- and off-site soil samples, this dust may have contained aldrin, arsenic, BHCs, chlordane, dieldrin, DDT/DDD/DDE, heptachlor/heptachlor epoxide, lead, and toxaphene. Determining the probability of illness from such exposures is not possible, however, because no air-monitoring or other exposure data exist. Tables 5, 6, and 7 of Appendix C summarize the maximum estimated exposure doses for known site contaminants, which have expected noncancerous health effects or statistically significant increased risks of cancer. In the following sections the potential health risks are interpreted.

4.4.1.1 Aldrin - If contaminated sediments from the St. Johns River were dredged, people could ingest these sediments via hand-to-moth activities or skin contact. The risk of noncancer illnesses posed for children who might accidentally eat the maximum aldrin concentrations measured in off-site sediments, daily, for more than a year, is not known. Similar aldrin doses, however, were associated with liver damage in a chronic rat study and kidney damage in a chronic dog study (ATSDR 1993a).

Also unknown is the risk of cancer to humans posed by accidentally ingesting the maximum aldrin concentration measured in on-site surface soil and St. Johns River sediments, daily, for more than a year. Aldrin was associated with liver and thyroid cancers in long-term studies of rats and mice (ATSDR, 1993a). On the basis of extrapolations from these animal studies, humans who accidentally ingest surface soil with the maximum aldrin concentration (daily, for longer than a year) could have a low-to-moderate statistical increase in cancer risk. Humans who accidentally ingest the maximum aldrin concentrations measured in off-site sediments on a daily basis for more that a year could have a statistically high increased cancer risk. At this time, with the exception of past workers, no persons are known to have had daily, long-term exposures to on-site soil or St. Johns River sediments.

4.4.1.2 Arsenic -

Acute exposures (14 days or less) - If land use at the site changes in the future allowing children or adults to ingest the highest concentrations of arsenic measured in on-site groundwater daily, for 14 days or less, or if children ingested on-site surface soil with the highest measured arsenic concentrations daily, for 14 days or less, they might experience sore throat, runny nose, cough, abnormal electrocardiogram (abnormal heart rhythm), nausea, diarrhea, stomach cramps, mild anemia[1], tender calf muscles, impaired liver function, swollen eye lids, conjunctivitis[2], neuroretinitis[3], and decreased response to stimulation of the knees and legs (ATSDR 2000).

Intermediate exposure (15–365 days) -If land use at the site changes in the future allowing children or adults to ingest the highest concentrations of arsenic measured in on-site groundwater daily, for 15–365 days, or if children ingest on-site surface soil with the highest measured concentrations of arsenic daily, for 15-365 days, they may experience scaly skin rashes, changes in kidney function, impaired vision, weight loss, patchy increases and decreases in skin pigmentation, lack of feeling and tingling in the hands and feet, confusion, disorientation, and mental sluggishness (ATSDR 2000). Other symptoms for intermediate exposures might include the symptoms described above for acute exposures.

Chronic Exposures (longer than 365 days) - If land use at the site changes in the future allowing children or adults ingest the highest concentrations of arsenic measured in on-site groundwater or surface soil for more than 365 days, they might experience bronchitis, broncho-pneumonia, blackfoot disease, gangrene, increased risk of ischemic heart disease[4], increased heart and lung disease, stroke, high blood pressure, circulatory problems in the hands and feet (cyanosis), arterial thickening, constriction of blood vessels to the hands and feet (Raynaud's Disease), blood clots (thrombosis), blood vessel spasms (sudden constrictions of the blood vessels), low blood pressure, heart attack, gastrointestinal bleeding, vomiting blood, bloody stools, progressive liver disease[5], "fatty" liver, bleeding of the esophageal varices[6], swollen kidneys, diabetes, weak wrists, absence of ankle jerk, lack of vibratory sensation in the legs, fatigue, headache, dizziness, insomnia, nightmares, and numbness (ATSDR 2000). The possible symptoms for chronic exposures might also include the symptoms described above for acute and intermediate exposures. Shallow off-site groundwater contaminated with the highest levels of arsenic measured in monitoring wells might also cause these

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[1] Lower-than-normal number of red blood cells and reduced oxygen carrying capacity of the bloodstream.

[2] Redness and soreness (inflammation) of the clear covering (the conjunctiva) which coats the white of the eye and the eye lids.

[3] Inflammation of the retina and optic nerve of the eye.

[4] Decreased blood flow to the heart due to circulatory problems.

[5] Cell damage, regeneration, scarring, and disturbance of normal liver structures. Restricted blood flow can be associated with liver enlargement, high blood pressure in the liver, and ultimately liver failure.

[6] Longitudinal venous enlargement at the lower end of the esophagus which may develop due to high blood pressure in the liver. Esophagal varices also may burst and bleed.

chronic symptoms in adults who might use it for drinking and other purposes, daily, for longer than a year.

Florida DOH estimates that daily, long-term ingestion of on-site surface soil with the highest measured arsenic concentrations might result in a low to moderately increased risk of skin cancers[7] and liver cancer (hemangioendothelioma). Daily, long-term exposure to the highest arsenic concentration measured in on- and off-site groundwater might result in a high statistical increased risk of skin and liver cancer (ATSDR 2000).

4.4.1.3 Alpha-, Beta-, Delta- and Gamma-Benzene hexachloride (Hexachlorocyclohexane) also known as α-BHC, β-BHC, δ-BHC and γ-BHC - Technical grade BHC is a mixture of α-BHC, β-BHC, and δ-BHC. Lindane contains γ-BHC.

Acute exposure (14 days or less) - If land use at the site changes in the future allowing exposure to on-site groundwater with the highest measured concentrations of γ-BHC (Lindane) daily, for 14 days or less, the likelihood of illness is unknown. However, the dose of γ-BHC (Lindane) calculated to volatilize from shallow groundwater containing the highest concentrations of γ-BHC measured is the same as the inhalation dose that killed 16 percent of mice exposed 6 hours per day, for five days–in an acute study (ATSDR 1999a).

Intermediate exposure (15–365 days) - If land use at the site changes in the future allowing children or adults to be exposed (through ingestion or inhalation) for 15–365 days to the highest concentrations of technical grade BHC or γ-BHC (Lindane) measured in on- or off-site groundwater and on-site soil, the likelihood of illness is unknown. Slightly higher levels than the concentrations calculated for children's exposure to technical grade BHC measured in on-site groundwater were associated with convulsion, tremors, hind-leg paralysis, and salivation in an intermediate duration rat study (ATSDR 1999a). The amount calculated for children and adults who might be exposed to the highest concentrations of technical grade BHC measured in on-site groundwater (through ingestion or inhalation), is the same as the amount associated with liver cell breakdown in an intermediate duration rat study (ATSDR, 1999a). The exposure amounts calculated for the highest concentrations of γ-BHC (Lindane) measured in on- and off-site groundwater are higher than the concentrations that were associated with changes in mice immune systems in an intermediate duration study (ATSDR, 1999a).

The ability of technical grade BHC or γ-BHC (Lindane) to cause cancer in humans is unknown. BHCs have been associated with liver cancer (hepatocellular carcinoma and other tumors) in long-term studies of mice and rats (ATSDR, 1999a). On the basis of extrapolations from these animal studies, Florida DOH estimates that daily, long-term ingestion of on-site surface soil with the highest measured concentration of technical grade BHC might result in a low to moderately increased statistical risk of liver cancer. Daily, long-term ingestion and or inhalation of the highest concentrations of technical grade BHC found in both on- and off-site groundwater might result in a high-to-very high statistical increased risk of liver cancer.

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[7] Intra-epidermal carcinoma, basal cell carcinoma, and squamous cell carcinomas.

4.4.1.4 Chlordane -

If land use at the site changes in the future, people might be exposed to chlordane-contaminated, on-site surface soil through incidental ingestion. The accidental ingestion of small amounts of chlordane-contaminated on-site soil, or skin contact with chlordane-contaminated sediments from the St. Johns River or Deer Creek, is unlikely to result in noncancer illness. The increased cancer risk to humans from exposure to chlordane at these levels is unknown. Chlordane is, however, associated with liver tumors in mice (ATSDR 1994). Extrapolating from this mouse study, Florida DOH estimates that daily, long-term ingestion of on-site soil containing the highest chlordane concentrations measured might result in a low statistical increased risk of cancer in humans.

4.4.1.5 1,4-Dichlorobenzene -

If land use at the site changes in the future and wells were installed into the shallow aquifer, people could be exposed to contaminated groundwater via ingestion of well water, dermal contact, and inhalation of vapors. The levels of 1,4-dichlorobenzene measured are unlikely to result in any noncancer illness. Although the increased cancer risk to humans from exposure to 1,4-dichlorobenzene at these levels is also unknown, 1,4-dichlorobenzene has been associated with kidney cell adenomas in mice and liver cell carcinomas and adenomas in rats (ATSDR 1998). Extrapolating from these animal studies, Florida DOH estimates that daily, long-term ingestion of on-site shallow groundwater with the highest levels of 1,4-dichlorobenzene measured could result in a low statistical increase in cancer risk.

4.4.1.6 4,4'-Dichlorodiphenyl trichloroethane, 4,4'-Dichlorodiphenyl dichloroethane, 4,4'-Dichloro-diphenyl dichloroethene - 4,4'-Dichlorodiphenyl trichloroethane (DDT) breaks down into 4,4'-dichlorodiphenyl dichloroethane (DDD) and 4,4'-dichlorodiphenyl dichloroethene (DDE).

If land use at the site changes in the future, people could be exposed to DDT/DDE/DDD-contaminated on-site surface soil from incidental ingestion or from dermal (skin) contact with contaminated sediments in the St. Johns River or Deer Creek. Accidentally eating small amounts of DDT/DDE/DDD-contaminated soil from the site or having skin contact with DDT/DDE/DDD-contaminated sediments from the St. Johns River or Deer Creek is not likely to result in noncancer illness.

The increased cancer risk to humans from exposure to DDT/DDE/DDD at these levels is unknown. DDT, DDE, and DDD are, however, associated with many cancers in rat, hamster, and mouse studies[8] (ATSDR 1994). Extrapolating from animal studies, Florida DOH estimates daily, long-term exposure to the highest levels of DDT, DDE, and DDD in on-site surface soil could result in a low- to moderately-increased statistical risk of cancer. Increased cancer risk from daily, long-term exposure to the highest levels of DDT and its breakdown products in off-site soil or sediments would likely be non-apparent or insignificant.

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[8] The most prevalent type of cancer is hepatocellular carcinoma (liver cancer); other types include lung and liver lymphomas, lung adenocarcinomas, leukemia, adrenal neoplasms, and thyroid cell adenomas and carcinomas.

If land use at the site changes in the future and water wells are installed into the shallow aquifer, people could be exposed to contaminants in groundwater via ingestion, dermal contact, and vapor inhalation. The levels of DDT/DDE/DDD measured are not likely to result in noncancer illness. Again, extrapolating from animal studies, people having daily, long-term exposure to on-site groundwater with the highest measured levels of DDT/DDE/DDD could have a low-to-moderate increase in cancer risk.

4.4.1.7 Dieldrin -

If land use at the site changes in the future, people could be exposed to dieldrin-contaminated on-site surface soil from incidental ingestion, or contaminated shallow groundwater might be used for drinking water or other uses. Daily, long-term exposure to dieldrin through ingestion of in contaminated soil, inhalation of dust, skin contact with the surface soil, or by drinking shallow groundwater having the highest measured dieldrin levels, is unlikely to result in noncancer illness. While the increased cancer risk to humans from exposure to dieldrin at the highest measured levels at the site is unknown, dieldrin has been associated with liver and thyroid cancers in rats and mice (ATSDR 1993). Extrapolating from these animal studies, Florida DOH estimates long-term incidental ingestion of on-site surface soil with the highest levels of dieldrin measured might result in a moderate increase in cancer risk. Florida DOH estimates long-term exposure to the highest levels of dieldrin measured in on-site groundwater might result in a moderate statistical increase in cancer risk.

4.4.1.8 Heptachlor/Heptachlor Epoxide -

If land use at the site changes in the future, people might incidentally ingest heptachlor- or heptachlor epoxide in surface soil on the site or to come into contact with contaminated sediments in the St. Johns River. Accidentally eating small amounts of heptachlor- or heptachlor epoxide-contaminated soil from the site or having skin contact with heptachlor- or heptachlor epoxide-contaminated sediments from the St. Johns River or Deer Creek is unlikely to result in noncancer illness.

The increased cancer risk to humans from exposure to heptachlor and heptachlor epoxide at these levels in unknown. Heptachlor and heptachlor epoxide exposure are, however, associated with liver cancer (hepatocellular carcinoma) in mice (ATSDR, 1993). Extrapolating from **this animal study**, Florida DOH estimates daily, long-term incidental ingestion of on-site surface soil containing the highest levels of heptachlor/heptachlor epoxide may result in low to moderate increased cancer risk.

If land use at the site changes in the future and wells are installed into the shallow aquifer, people could be exposed to contaminated groundwater via ingestion of well water, dermal contact, and inhalation of vapors. The levels of heptachlor and heptachlor epoxide measured are unlikely to result in non-cancer illness. Again, extrapolating from animal studies, adults exposed daily to on-site groundwater with the highest measured levels of heptachlor and heptachlor epoxide for longer than one year could have a low increased cancer risk from inhalation and dermal routes of exposure.

4.4.1.9 Lead -

If land use at the site changes in the future, people might be exposed by ingestion to on- and off-site lead-contaminated surface soil, off-site sediments, or on-site lead-contaminated shallow groundwater. Florida DOH used a simple model to estimate blood lead levels and likely health effects (ATSDR 1999b). For lead, estimated blood levels more accurately predict health effects than traditional dose estimates. This model takes into account people's exposure to lead from sources other than the site. Florida DOH assumed future on-site residents could be exposed to lead-contaminated surface soil 19 hours per day.

If children were exposed on a continuous basis to the highest concentrations of lead in the on-site surface soil (6,300 parts per million), their blood lead levels may increase to between 32 and 104 micrograms per deciliter (µg/dl) (Table 9, Appendix C). If wells are installed into the shallow aquifer, children exposed continuously to the highest concentrations of lead in the on-site shallow groundwater (486 parts per billion), could have their blood lead levels increase to between 13 and 97 µg/dl (Table 13, Appendix C).The following table details possible health effects in children associated with elevated blood lead levels from many studies (ATSDR 1999b).

Likely Health Effects in Children from Blood Lead Levels of 32 – 104 Micrograms per Deciliter (µg/dl).
No known threshold - Decreased aminolevulinic acid dehydratase (ALAD) enzyme activity. ALAD is necessary for hemoglobin synthesis. A large decrease in ALAD activity can lead to anemia.
1.4 -17.4 µg/dl - Alterations in visual evoked potentials[9].
6.5 µg/dl (mean at 24 months of age) - Lower cognitive function test scores in children 5 to 10 years of age.
6 - 20 µg/dl - Heart abnormalities (degenerative changes in myocardium and electrocardiogram abnormalities).
6 - 200 µg/dl - Decreased neurobehavioral function; slightly decreased performance on IQ tests and other measures of neuro-psychological function.
7 - 80 µg/dl - Decreased Pyrimidine 5' nucleotidase[10].
≥ 9 µg/dl - Impaired motor developmental in 6 year olds.

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[9] The visual evoked potential measures the electrical response of the brain's primary visual cortex to a visual stimulus.

[10] Pyrimidines, along with purines, "are the building blocks of DNA and RNA, the basic elements of cell programming machinery. In addition, they fulfill a variety of functions in the metabolism of the cell of which the most important are regulation or cell metabolism and function, energy conservation and transport, formation of coenzymes and of active intermediates of phospholipids and carbohydrate metabolism. Therefore in case a deficit exists, any system can be affected" (Van Gennip 1999).

Likely Health Effects in Children from Blood Lead Levels of 32 – 104 Micrograms per Deciliter (µg/dl).
10 - 15 µg/dl - Impaired mental and physical development.
11.9 µg/dl (geometric mean) - Dizziness when standing (postural disequilibrium).
12 -17 µg/dl - Reduced birth weight and/or reduced gestational age. Increased incidence of still birth and neonatal death.
12 - 120 µg/dl - Decreased vitamin D metabolism.
≥15 µg/dl - Increased zinc protoporphyrin (ZPP) which can lead to anemia.
≥ 20 µg/dl - Moderate deficit in Wechsler Performance IQ (intelligence test) in 6.5 year olds.
≥20 µg/dl - Hematocrit of less than 35% and anemia.
20 - 30 µg/dl - Lack of feeling in the fingers/toes and slower nerve responses.
25 - 35 µg/dl - Increased iron protoporphyrin (FEP) which can lead to anemia.
30 - 60 µg/dl - Growth retardation.
37.3 µg/dl (average) - Increased blood pressure.
≥40 µg/dl - Decreased hemoglobin (oxygen carrying molecule in red blood cells) and anemia.
60 - 100 µg/dl - Colic.
60 - 450 µg/dl - Irritability, lethargy, behavioral problems.
>80 µg/dl - Increased amino acids in urine.
80 - 800 µg/dl - Swelling and inflamation of the brain (encephalophathy).

If land use at the site changes in the future and adults are exposed continuously to the highest concentrations of lead in the on-site surface soil (6,300 parts per million), their blood lead levels could increase to between 30 and 103 µg/dl (Table 10, Appendix C). If wells are installed into the shallow aquifer, adults exposed continuously to the highest concentrations of lead in the on-site shallow groundwater (486 parts per billion), could have their blood lead levels increase to between 12 and 26 µg/dl (Table 11, Appendix C).

Blood lead levels in adults up to 103 µg/dl are associated with anemia, increased blood pressure, dizziness, and reproductive problems. The following table details possible health effects in adults associated with elevated blood lead levels from many studies (ATSDR 1999b).

Likely Health Effects in Adults From Blood Lead Levels Between 30 and 103 Micrograms per Deciliter (µg/dl)
3 - 56 µg/dl - Decreased aminolevulinic acid dehydratase (ALAD) enzyme activity. ALAD is necessary for hemoglobin synthesis. A large decrease in ALAD activity can lead to anemia.

Likely Health Effects in Adults From Blood Lead Levels Between 30 and 103 Micrograms per Deciliter (μg/dl)
5.5 (average) μg/dl - Decreased performance on neurobehavioral tests.
7 - 38 μg/dl - Increased blood pressure most prominent in middle-aged white men.
7 - 80 μg/dl - Decreased Pyrimidine 5' nucleotidase[11].
≥10 μg/dl - Increased incidence of miscarriages and still births.
18 - 26 μg/dl - Renal impairment with gout or hypertension.
>25 - 35 μg/dl - Increased iron protoporphyrin (FEP) which can lead to anemia.
30 - >70 μg/dl - Decreased peripheral nerve conduction velocity.
>35 μg/dl - Increased urinary or blood delta-aminolevulinic acid (ALA), protoporphyrin IX, and co-protoporphyrin.
36 (mean) μg/dl - Dizziness when standing (impaired postural balance).
37.2 μg/dl - Decreased fertility.

Florida DOH also estimated blood lead levels for daily ingestion of off-site sediments. These levels were much lower than those calculated from on-site ingestion of surface soil. The range for children having daily, long-term exposure to the highest measured levels of lead in sediments could be 8 to 23 μg/dl and the range for adults having daily, long-term exposure could be 7 to 22 μg/dl. Florida DOH does not know of anyone who may having daily, long-term ingestion exposure to off-site sediments at this time.

4.4.1.10 Toxaphene -

If land use at the site changes in the future, people might be exposed to toxaphene-contaminated on-site surface soil via incidental ingestion. However, based on animal studies, long-term, daily ingestion of toxaphene at the highest levels measured in soil is unlikely to result in non-cancer illness. The increased cancer risk to humans from exposure to toxaphene at these levels in unknown. Toxaphene is, however, associated with liver and thyroid cancers (hepatocellular carcinoma and follicular cell carcinomas) in rat and mouse studies (ATSDR 1996). Extrapolating from these animal studies, Florida DOH estimates daily, long-term incidental ingestion of on-site surface soil with the highest levels of toxaphene could result in a moderate statistical increased cancer risk.

If land use at the site changes in the future and wells are installed into the shallow aquifer, people could be exposed to toxaphene-contaminated groundwater via ingestion. The levels of toxaphene measured are also unlikely to result in non-cancer illness. Again extrapolating from animal studies, daily, long-term exposures to the highest levels of toxaphene measured in on-site groundwater could

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[11] Same as footnote 10.

result in a moderate increased cancer risk; daily, long-term exposures to the highest levels of toxaphene measured in off-site groundwater could result in a low increased cancer risk.

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

4.5 Children and Other Unusually Susceptible Populations

4.5.1 Children's Health Consideration - ATSDR and Florida DOH recognize that in communities faced with the contamination of their environment, the unique vulnerabilities of infants and children demand special attention. Children are at a greater risk than are adults for certain kinds of exposure to hazardous substances emitted from waste sites. Because they play outdoors and because they often carry food into contaminated areas, children are more likely to be exposed to contaminants in the environment. Children are shorter than adults, which means they breathe dust, soil, and heavy vapors closer to the ground. They are also smaller, resulting in higher doses of chemical exposure per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Probably most important, however, is that children depend on adults for risk identification and risk management, housing, and access to medical care. Thus, adults should be aware of public health risks in their community, so they can guide their children accordingly.

In recognition of these concerns, ATSDR has developed chemical screening values for children's exposures which were used in preparing this report. Although children are known to have special susceptibilities to exposures to chlordane and lead, because of the high levels of arsenic and other chemicals measured, children should avoid going on the site as even limited exposures could cause illness.

4.5.2 - Other Unusually Susceptible Populations - 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 persons' ability to detoxify or excrete harmful chemicals or may increase the effects of damage to organs or systems in the body.

5.0 COMMUNITY HEALTH CONCERNS

Florida DOH met with former site workers, workers from nearby facilities, and community members on four different occasions. Florida DOH staff attended a Town Hall meeting held by Councilwoman Lockett-Felder on October 12, 2000. At that meeting our staff explained that we would assess public health concerns for the site and spoke with a former site worker who was concerned about the potential for adverse health effects from work exposures at the site. He recounted that he and other workers had not been provided protective equipment or protective clothing for use in handling agricultural chemicals on the site. He explained that while he worked there workers did not have set jobs, but worked on all parts of the site so that all were exposed to herbicides, pesticides and fertilizers and processing chemicals like sulfuric acid. His greatest concern was for other men who had worked at the site for a long time.

Florida DOH and Duval County Health Department staff attended two meetings held at the Jacksonville Eastside Community Center. On April 10, 2001 we participated in one of the twice-monthly meetings held by the International Longshoremen's Union. In addition to unloading chemicals from ships onto the site, some of the men attending the International Longshoremen's Union alumni meeting had also worked at the site. As part of the meeting evaluation, we asked participants about their site-related health concerns. Men who had worked on the site or had unloaded chemicals wrote that they were concerned about exposures to fertilizers, herbicides, pesticides, and sulfuric acid gas (Appendix E). We summarize their responses in the following section.

- All 16 responders reported respiratory problems; four as "breathing concerns", four as "short of breath", two as "respiratory"concerns, one as "spitting blood", three as "difficulty breathing", one as "lungs", and one as "difficulty breathing while sleeping".
- Fourteen responders reported work exposure health concerns; seven said they didn't know what chemicals they were exposed to at work or the health effects of those exposures, two reported dusty working conditions, (one as concern for inhalation of chemicals and one as concern for inhalation of chemicals in dust or air), two were concerned they had exposed their families, one wanted to know which chemicals could be absorbed through the skin, one wanted to know which chemicals could "contaminate his organs and tissues", one wanted to know if there was anything that they could do now for themselves, and one wanted to know if there was anything they could do now for their family.
- Three reported eye problems.
- Two reported they were "nervous".
- Two reported asbestos exposure.
- One (not necessarily the same) respondent reported each of the following symptoms: chest pains, weakness, confusion, swelling of the body, pain around the waist, high blood pressure, liver concerns, kidney concerns, diabetes and complications that led to the left foot and ankle being removed, difficulty swallowing, headaches, back pain, weak legs, and neck pain.
- One asked if they could get compensation and how long it might take to get it.
- Four wanted to know what we found out and when the information will be released, and one asked if this information will include all the ships they worked on?

Another person asked who oversees the site. While Kerr-McGee owns the site, the US Environmental Protection Agency will oversee the site assessment and cleanup. Based on a request from these meeting participants and their Community Assessment Group representative, Florida DOH submitted a petition for a health study to the ATSDR Division of Health Studies in July 2001, and to NIOSH in October 2001 (cover letters and health concerns sheets - Appendix E).

Florida DOH staff attended a meeting EPA held at the Eastside Community Center on March 20, 2002. At this meeting, EPA personnel explained what site testing had found and what additional sampling was needed. A community leader voiced interest in other operating and abandoned industrial sites in the area. She was concerned about restoring the quality of surface water and soil in downtown area neighborhoods and viewed this site as just one of the long-term contributors to adverse environmental conditions. After this meeting, Florida DOH staff discussed the former-workers' request for a health study with the EPA ombudsman Caroline Robinson who also attended the meeting. At her request, Florida DOH sent the ombudsman a copy of this petition on March 24, 2002, to forward to NIOSH.

DOH sent out approximately 400 meeting announcements in early February 2003 to residents within ½ mile of the site and to other interested parties. These announcements included site-findings fact sheets, information on how to obtain the entire Kerr-McGee Public Health Assessment, and requests for site-related public health concerns. In the following paragraphs, Florida DOH answers the residents who responded in writing to evaluation forms included in the meeting announcements.

"What are the short term and long term effects if a person is exposed to the dust?" This person only received a fact sheet. Florida DOH assumes the person meant on-site dust containing contaminants. Florida DOH will makes sure this person gets a copy of the health assessment; we answer this question in section 4.4.1. and we talk about off-site dust exposure in the next paragraph. The same person asked **"If the land is cleaned and buildings are built on this land, what is the possibility of contamination coming to the surface again?"** A cleanup strategy has not been decided on at this time. The intent of cleanup is a long-term, safe, solution. The EPA will have public meetings for discussion of just such issues when they feel they know the amount and extent of soil and groundwater contamination on the site. Their cleanup plans generally have five or six options.

"I walk down Talleyrand on both sides of the street and can read the sign on the fence that says Kerr-McGee. Could I come in contact with any of the chemicals listed in the fact sheet?" No elevated levels of chemicals have been measured in off-site soil near the site and most of the contaminated soil measured on the site is around the old building foundations and the railroad. While someone walking past the site might inhale a very small amount of dust with chemicals from on the site, it is unlikely breathing such a small amount of dust could affect their health. In this Public Health Assessment, Florida DOH recommends any cleanup action that raises dust should be monitored and any dusty conditions during cleanup should be suppressed.

Florida DOH's greatest concerns for exposures that could occur before the site is cleaned up are for the person(s) who mow the site, especially during dry weather. We wrote a letter to the EPA's contact for the site at Kerr-McGee recommending respiratory protection for the person(s) who will be mowing the site (Appendix E). We recommend a sealed, tight-fitting mask with carbon filters, (not just a paper dust mask). We also recommended mowing personnel be advised not to eat or smoke on the site, because hand to mouth actions might increase the amount of soil accidently ingested.

"I have a shallow well I use only for watering the lawn and flowers, and my little fish pond." Florida DOH assumes this person is wondering if water from this well is safe for the lawn, flowers and fish. The simple answer right now, is that we do not know. We do know that if the well has chemicals they are probably not from the Kerr-McGee site. Chemicals in groundwater on the site that came from past site operations will move toward the St. Johns

River and possibly Deer Creek but not toward nearby homes. However, groundwater testing that was done for the Kerr-McGee site suggests that there are other sources of groundwater contamination in the area. Solvents are moving into groundwater beneath the site from the northwest and gasoline components are moving into groundwater beneath the site from the north, but right now the sources for these chemicals hav not been found. Since the person asking this question did not indicate that their irrigation water was being used indoors (an inside area might trap chemicals prone to "bubbling out" of water) or that it was being used on food crops or for drinking, this irrigation water is not likely to be an exposure pathway **for people** *even if* future investigations show that shallow groundwater contamination (not related to the site) exists beneath the responders home.

Florida DOH staff held two meeting-sessions inviting public comments on the Kerr-McGee Public Health Assessment at the Brown Eastside Branch Library on February 14, 2003. Recollections of former workers and a former worker from a nearby business helped us answer a question posed by a fact-sheet responder and the Community Assessment Group technical advisor.

"Are there any ways of determining the exposures in the past? From your fact sheet you stated how important that could be to know what kind of health effects to expect". The Community Assessment Group technical advisor proposed that Florida DOH or another agency could estimate workers' past exposures in conjunction with plant records, worker's recollections of the chemicals they were exposed to and the workers' health records. Finding out what chemicals and what levels of these chemicals people were exposed to on and near this site may be difficult because of the following factors.

1) The chemicals measured on the site today are persistent in the environment. In addition to these chemicals, former site or nearby workers may have been exposed to other persistent chemicals that were not analyzed for in the EPA assessment. For example, early production of the herbicide 2,4-D (2,4-dichlorophenoxy acetic acid) was sometimes contaminated with dioxin. Dioxin is not pesticide, and it is very difficult and expensive to analyze for. In addition, any estimation of past exposures would have to include non-persistent agricultural chemicals and processing chemicals (like sulfuric acid). A complete determination would need to verify which chemicals were made or used by Wilson Toomer, Plymouth Cordage, and Emhart, *in addition to Kerr-McGee*, as they might have acted on same of the same tissues, organs, or systems as the persistent chemicals still found on the site. In all that would include 85 years of records. The Community Assessment Group technical advisor (Appendix E) asked that a study be carried out to determine if diseases related to chemical exposures are higher in former workers than the general population. For such a study it would be helpful to know what chemicals the workers were exposed to, to know which diseases to count as exposure-related. It may be also difficult to determine whether workers, especially former longshoremen, were exposed to non-site related chemicals or agents such as asbestos or silica which can also harm the lungs.

2) Basic assumptions made currently for modeling workers' exposures will not be valid on this site. According to former workers, before Kerr-McGee owned the site, they were not provided a lunchroom, bathrooms, a locker-room to change out of work clothes, or a place to shower. According to the former workers, none of the owners provided protective gear or safety training. Models Florida DOH looked at (Kreiger 2001) assumed protective gear and

very little skin exposure for worker's exposures. Former workers at the February 2003 meeting reported holding their breath or using socks and rags to cover their mouths. These former workers reported that if they objected to these working conditions, the managers pointed to the railroad (that is, they were asked to leave).

3) Assumptions we make today about how people could be exposed may not be valid. A retired worker from a nearby site told meeting participants that some site chemicals were unloaded from ships with bucket hoppers. He said the dust blew down the river in a cloud one or two miles long if it was windy. He related that dust collected on the water fountains and inside the warehouses where he worked. He reported that some of the dust burned his skin and that he was hospitalized for skin burns that persisted for three months. He said that exposure to chemical dust from this site has permanently discolored the skin on his hands and face and that he now has severe allergic reactions which cause the skin on his entire body to swell. Without first-hand information like this, Florida DOH would never know about such exposures because the workers and warehouses he spoke of are not there today. Other former site workers showed us what they reported to be chemical burns on their arms and said they had others.

4) We can not assume that all exposed former workers are or will be diagnosed and treated for those exposures. Differences in health benefits could cause unequal access to medical care; the International Longshoremen's Union workers reported having " good insurance", they reported some former site workers got a benefits buyout, and the worker from the nearby site reported he is on Medicaid.

As a first step, Florida DOH researched the health effects known from occupational studies for the chemicals measured at elevated levels on the site. The following information adds to chemical health effects listed in section 4.4.1 for chronic exposures.

Occupational studies of exposures to arsenic have shown that skin can be a route of exposure and systemic toxicity in persons having extensive acute skin contact with solutions of inorganic arsenic (Klassen 2001, p. 818). Occupational exposures to airborne arsenic may be associated with lung cancer, usually a poorly differentiated form of epidermoid bronchogenic carcinoma. The time period between initiation of exposure and occurrence of arsenic-associated lung cancer has been found to be on the order of 35 to 45 years (Klassen 2001, p. 820). Arsenic-related skin cancers can be basal or squamous cell carcinomas that differ from ultra-violet light-associated cancers because they generally occur on areas of the body not exposed to the sun and they occur in multiple lesions. Chronic ingestion of arsenic in drinking water has recently been associated through dose-response with bladder cancer (Klassen 200, p. 820).

Organochlorine pesticides tend to be stable chemicals that don't readily vaporize (a physical breakdown process) or metabolize (a biological breakdown process). While these properties made them effective pesticides, they have been banned in North America and Europe because these same properties cause them to persist in the environment, to bioaccumulate, to biomagnify in food chains, and to occur at biologically active levels at the top of food chains. In exposed workers these chemicals can be stored in fatty tissues because they tend to be fat soluble. One risk of such storage is that a person losing weight intentionally or due to illness will release these compounds into their bodies.

DDT and DDD first affect peoples' central nervous systems. Acute exposures cause numbness of the tongue, lips, and face. Other nervous system effects are fearfulness, sensitivity to light, touch, and sound, irritability, dizziness, vertigo, tremor, and convulsions. In animals fed non-acute doses, long term changes were observed in the liver and reproductive organs; DDT and DDD have estrogenic effects (that is they may shrink male organs or enlarge female organs–causing difficulty in maintaining pregnancy) (Klassen 2001, p.772). Snodgrass (in Kreiger 2001, p. 597) describes chronic poisoning from halogenated hydrocarbon pesticides (chlordane, DDT, dieldrin, Lindane, toxaphene) as resulting in measurable neurophysiological abnormalities. He notes chronic toxic encephalophathy once established, improves only slightly or not at all with time. Older individuals reportedly are more severely affected and less likely to recover. In one study, psychometric retesting four years after ceasing exposure showed significant deterioration in verbal memory with improvement in visual memory. Computed tomography sometimes showed loss of brain substance, while sometimes it did not.

While DDT and DDD are not readily absorbed through the skin, aldrin, dieldrin, heptachlor, toxaphene and chlordane are, and therefore pose appreciable hazards to occupationally exposed individuals. Chronic exposure to low or moderate concentrations of aldrin, dieldrin, heptachlor, toxaphene and chlordane elicits a spectrum of signs and symptoms, involving both the sensory and motor components of the central nervous system. Even at relatively low doses, these chemicals tend to induce convulsions before less serious signs of illness occur. Although the sequence of signs of illness generally includes headaches, nausea, dizziness, over-excitedness, muscle jerks and twitches, some patients have convulsions without warning symptoms. In addition to these symptoms, chronic exposure to low or moderate concentrations of these agents elicit a spectrum of other symptoms including insomnia, anxiety, irritability, heart rhythm changes, chest pains, joint pain, skin rashes, impaired coordination of the muscles, slurred speech, visual difficultly in focusing and fixating on objects, nervousness, depression, loss of recent memory, muscle weakness, hand tremors, and low sperm count (Klassen 2001, p. 772).

Similarly, Snodgrass (in Kreiger 2001, p. 597) describes the signs and symptoms of chronic poisoning from chlordane, heptachlor, aldrin, and dieldrin (organochlorine-cyclodiene pesticides) as either continuous and having progressive symptoms, or as asymptomatic with adverse health effects seen only with additional exposure. The development of symptoms, or the development of an asymptomatic body burden are due to the slow accumulation seen in chronic exposure. He reports that workers applying dieldrin developed symptoms with exposure of between 3 and 8 months. Mild illness consisted of persistent headache that was unresponsive to drugs, dizziness, general malaise, insomnia, nausea, increased sweating, nystagmus[12], double-vison, ringing in the ears, slight involuntary movements, and blurred

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[12] Nystagmus is an involuntary eye condition characterized by rapid, jerky eye movements which usually results in some degree of visual loss.

vision. Severe illness included progression to sudden involuntary muscle contractions or one or more limbs, sometimes accompanied by a brief loss of consciousness. Snodgrass describes elevated serum epinephrine and serum glucose, indicating the adrenal glands were stimulated in asymptomatically exposed workers.

Exposure to Lindane produces signs of poisoning that resemble those caused by DDT (tremors, lack of muscle control, convulsions, sweating, increased heart rate and breathing, and inability to stand). In severe cases of acute poisoning, violent convulsions occur and degenerative changes in the liver and renal tubules have been noted. Technical grade BHC used in insecticidal preparations contains a mixture of isomers: the alpha and gamma isomers are convulsant poisons, the beta and delta isomers are central nervous system depressants. The mechanisms of action remain unknown (Klassen 2001, p. 772).

Once acquired, the boitransformation and degradation of chlorinated pesticides proceeds at an exceptionally slow pace. The boitransformation of many chlorinated pesticides reduces their toxicity and yet only marginally affects the estrogenicity of these compounds. In contrast, the biotrans-formation of aldrin, chlordane and heptachlor increases their neurotoxicity. Chlorinated pesticide metabolic compounds are stored in fat and are only slowly released. Chlordane leaves the system in a matter of weeks, while aldrin, dieldrin, DDT, and others may remain for months to years. The life-threatening situation in organochlorine insecticide poisoning is associated with tremors, motor seizures, and interference with respiratory functions (Klassen 2001, p. 774).

"One of the most difficult aspects in evaluating a patient who presents with or claims to have chronic pesticide poisoning is obtaining a meaningful medical history. Individuals with legitimate toxicologic events may be unable to reconstruct a completely useful history despite skillful questioning" (Snodgrass in Kreiger, 2001; pp. 597, 598). Clinical toxicology patient history forms and instructions for using them are available from ATSDR at http://www.atsdr.cdc.gov/HEC/CSEM/exphistory/using_form.html. Snodgrass reports such forms are particularly useful in a environmental–occupational toxicology clinic setting.

Snodgrass separates the workup of neurotoxicity in individual patients into the assessment of the peripheral nervous system, the central nervous system and the autonomic nervous system. Testing involves assessment of the muscles, coordination, reflexes, heat and cold, pinprick, vibrations, complex shape recognition, bladder, bowel, and sexual functions, pupil response, tearing, sweating, salivation, blood pressure, concentration, memory, cognitive function, behavior, mood, and affect. Knowledge of the specific toxin is helpful in planning and analyzing nervous system evaluation (in Kreiger 2001, p. 600). Snodgrass relates the most frequently reported behavioral effects of chemicals is a disturbance in psychomotor functioning. Usually, this is characterized by a delay or slowness in response time, clumsy or awkward eye-hand coordination or dexterity, or a combination of these. Such effects may be assessed by trained psychologists with a battery of neuropsychological tests, for example the Halstead–Reitan battery, the Luria-Nebraska battery and the Pittsburgh Occupational Exposure Test battery.

6.0 CONCLUSIONS

Historical working conditions, the absence of personal protective equipment, and reports from former workers led Florida DOH to believe **past working conditions may have posed a public health hazard** for workers on and near the site. Because the nearest residences are about 500 feet northwest of the site, Florida DOH believes nearby residents may also have been exposed to site dust in the past. While public health agencies may be limited in what they can do because of the lack exposure information, Florida DOH has asked the National Institute for Occupational Safety and Health (NIOSH) who sometimes investigate workers' past exposures for a study of worker's health based on information recounted by former workers.

On-site surface soil, St. Johns River/Deer Creek sediments, and shallow groundwater both on and off the site are contaminated with agricultural chemicals and metals. The Florida Department of Health (Florida DOH), however, is not aware of any persons who are currently being exposed to contaminated soil, sediments, or shallow groundwater. Site access is restricted and Deer Creek is overgrown by vegetation. Residences in the area are supplied with municipal water and Florida DOH did not find any nearby private wells in the shallow aquifer. Therefore the site presents **no current public health hazard**.

The site might be a **future public health hazard** if people were to ingest, inhale, or have skin contact with contaminants in surface soil on the site, shallow groundwater under the site, or St. Johns River sediments near the site. Florida DOH discusses specific exposure pathways, exposure durations, and potential disease associations for the highest levels of 10 chemicals measured on and near the site in section 4.0. Currently Florida DOH knows of no human exposure pathway between site-related contamination and people's ingestion of fish or shellfish. The stretch of the St. Johns River adjacent to the site has swiftly-moving and deep water, large industrial water craft, and little bank access; all of which would discourage bank or dinghy fishing.

7.0 RECOMMENDATIONS

While public health agencies may be limited in what they can do because of the lack exposure information, Florida DOH has asked the National Institute for Occupational Safety and Health (NIOSH) who sometimes investigate workers' past exposures for a study of former worker's health.

People's access to site contaminants should continue to be restricted until the site is cleaned up. Kerr-McGee should maintain the fence and warning signs, site workers should control dust generation, monitor air quality for metals and chlorinated pesticides, and wear respiratory protection during any future mowing, sampling, cleanup, remodeling, utilities installation, or construction activities that would disturb soils or remove vegetation at the Kerr-McGee site. People should not drink contaminated groundwater from the shallow aquifer under or near the Kerr-McGee site, or use it in any enclosed space where the could inhale chemicals that escape from it. People should avoid exposure to contaminated sediments (especially if they are dredged).

If in the future a pathway becomes known that would link site contamination and people's fish or shell-fish ingestion, Florida DOH can recommend testing of fish or shellfish. However, even if tested fish showed elevated metals or pesticides, it would likely be difficult to isolate this site as the sole contamination source.

8.0 PUBLIC HEALTH ACTION PLAN

This section describes what the federal Agency for Toxic Substances and Disease Registry (ATSDR) and the Florida Department of Health (DOH) plan to do at this site. The purpose of a Public Health Action Plan is to reduce any existing health hazards and to prevent any from occurring in the future. ATSDR and Florida DOH will do the following:

1. In the event that NIOSH becomes involved with former site workers, Florida DOH will work with them to determine if historical worker exposure can be addressed through health studies or other means. Florida DOH will provide health education to former workers and their health care providers, and will continue to will inform and educate nearby residents about the public health threats associated with the Kerr-McGee site.

2. Florida DOH, Bureau of Community Environmental Health will continue to work with the federal Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection to protect public health. The EPA will oversee site remediation and/or ensure deed restrictions warn future property owners of remaining contaminated soil, sediments, and groundwater.

3. Florida DOH, Bureau of Community Environmental Health will evaluate additional groundwater and surface soil test results for public health.

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APPENDIX A.

KERR-MCGEE SITE SUMMARY

Owners and Operations

Wilson and Toomer, 1893 to late 1950s: Manufactured fertilizer, added pesticides and herbicide operations in the 1950s.

Plymouth Cortage, late 1950s to1965: Manufactured fertilizer, herbicides, and pesticides .

Emhart Corporation, 1965 to1970: Manufactured fertilizer, herbicides, and pesticides.

Kerr-McGee owners, 1970 to present:
manufactured fertilizer, herbicides, and pesticides,
made sulfuric acid and superphosphate fertilizer, and
reconditioned 55-Gallon Drums.

In December 1983, the Florida Department of Environmental Protection (DEP) requested Kerr-McGee to assess site contamination.

Kerr-McGee Site Investigations
(Final Report Dates, Not Sample Collection Dates)

August 1984	Kerr-McGee LLC Phase II: History and Phase I Site Evaluation - Contractors investigated soil and groundwater contamination, reviewed historic data, installed 3 geologic test borings and tested groundwater samples from 14 galvanized-casing monitoring wells. Contractors also tested 10 soil locations at depths 0-0.5' and 3.5 - 5'. Some of these shallow samples have the highest chemical levels, perhaps because they give surface data and don't mix in deeper, cleaner soil.
March 1985	Kerr-McGee LLC Phase III Results and Conclusions for the Groundwater Assessment Plan. Contractors investigated soil and groundwater contamination, took 6 additional soil samples, added two galvanized-casing monitoring wells and took four sediment samples. Ray Harbison authored the Risk Assessment.
January 1988	Kerr-McGee LLC Soil and Groundwater Investigation. Contractors took 38 soil samples in eastern and northern parts of site and analyzed for pesticides. Highest concentration of chlorinated pesticides were found between pesticide and herbicide buildings. This area was used for bulk rail car loading and unloading; product may have been spilled during these activities. Contractors resampled groundwater from the existing galvanized-casing monitoring wells.

January 1991	Mathes & Associates Soil Sampling. Contractors took 15 soil samples from around the fertilizer building and 10 soil samples from around the herbicide and pesticide buildings. This report included a FASCO site (pesticide building) Risk Assessment.
October 1993	Burlington Field Investigation Report. Contractors determined the galvanized-casing monitoring wells reduced the amounts of pesticides measured in groundwater; installed and sampled groundwater from 13 new PVC-cased monitoring wells. Contractors sampled soil from two dredge and fill ponds, surface impoundment and northwest corner of the site. Contractors took soil samples from just below the land surface to just above the water table, found concentrations of ∝ BHC as high as 2,770 ppm, 8 feet below the surface at the location of MW-17P.
April 1994	Burlington Remedial Investigation Report. Contractors took 21 borings around MW17P that revealed paper, wood and concrete debris from site demolition work. Contractors took soil samples at varying depths (looking for vertical extent of soil contamination), 4 surface soil samples were suitable for Florida DOH's exposure-based screening, contractors also took and 7 groundwater samples (from monitoring wells).
December 1996	Philip Revised Remedial Investigation Report. Contractors excavated test trenches in the vicinity of MW17P (northern part of site) to delineate the extent of debris in this portion of the site. Contractors sampled deep soil near MW-17 and took 15 groundwater samples (from existing monitoring wells and 2 new monitoring wells).
April 1998	Philip Remedial Design Investigation Report and Remedial Design. Contractors had eight soil sample locations; they took samples at surface and 1.5' depth, they also took 19 groundwater samples (from existing monitoring wells and 4 new monitoring wells). They found the highest pesticide concentrations in the shallow soil north of the herbicide building.
May 1999	E & E Expanded Site Investigation Report. Contractors took 15 soil samples, 6 groundwater samples (from monitoring wells), 2 on-site sediment samples, eight off-site sediment samples, and 2 off-site groundwater samples (from monitoring wells). They found contamination in an off-site monitoring well and also found that monitoring well water levels fluctuate with the tides.
July 2001	IT Corporation Remedial Investigation/Feasibility Study for Operable Unit-1. Contractor wanted to fill soil and groundwater data gaps.
December 2001	IT Corporation Remedial Investigation/Feasibility Study for Operable Unit-2. Contractor wanted to fill sediment data gaps, off-site.

Nearby Site Investigations
(Final Report Dates, Not Sample Collection Dates)

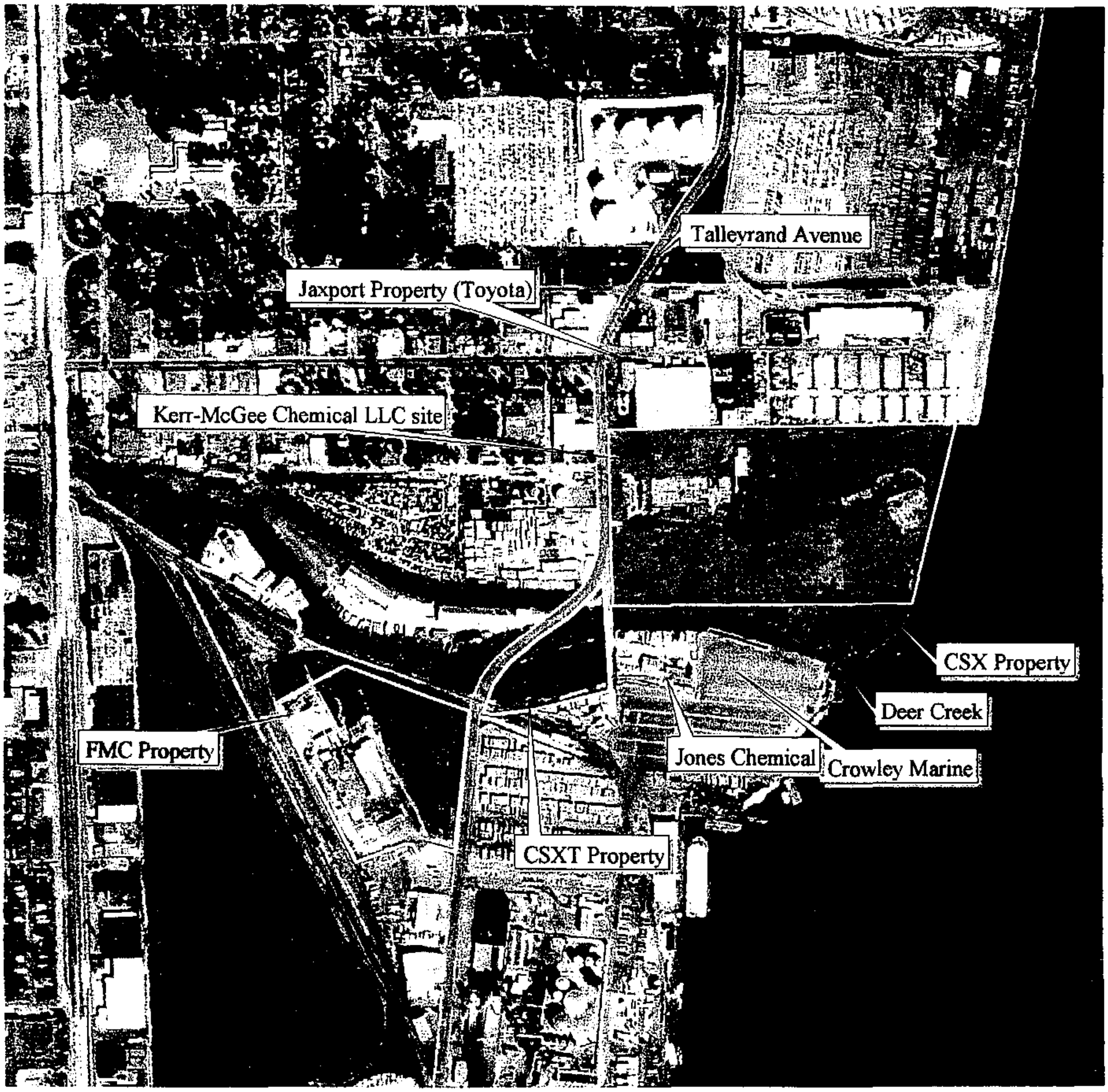
1985	CSXT site, Hydrologic Assessment of the Kopper Industries/Seaboard Site, Geraghty and Miller analyzed for PAHs, PCBs and pesticides in 24 surface soil samples and nine sediment cores. They found creosote in all the creek sediments with the deepest creosote found 500' east of the Talleyrand dead-end–16" below the level of the surface. They also took three surface water samples from Deer Creek that contained low levels of naphthalene.
November 1987	FMC site, Engineering Science took four surface water and five sediment samples, they found chlorinated pesticides (DDT, toxaphene) and trichlorobenzene in the surface water and pesticides in the sediments.
September 1988	FMC site, ESE took 10 surface water samples from Talleyrand Ditch and Deer Creek and two sediment samples in Talleyrand Ditch and Deer Creek, they analyzed these samples for (and found) pesticides, PCBs and metals.
1988	St. Johns River Water Management District and the U.S. Army Corps of Engineers Jacksonville looked at sediment quality in the St. Johns River at a location 7.5 miles upstream of the Kerr-McGee site. They found PAHs phthalates, pesticides, PCBs and metals in this "background" sediment.
December 1993	CSXT site, Contamination Assessment Report, Geraghty and Miller analyzed for PAHs, and pesticides in three surface water samples (all below detection level except BHC pesticides) and five sediment samples (elevated levels of pesticides and PAHs).
1999	ARCADIS sampled 16 sediment cores to visually characterize sediments for creosote content. Four cores from two locations were analyzed for semi-volatile compounds, metals, acid-volatile sulfides, elevated PAHs were found in most of the sediments. ARCADIS analyzed two surface-water samples from Deer Creek.

APPENDIX B.

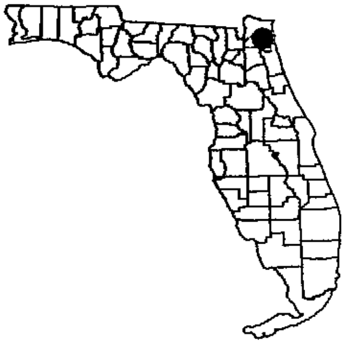
FIGURES

Figure 1: Kerr-McGee Chemical and Surrounding Properties

1995 Aerial Photography



Site Location



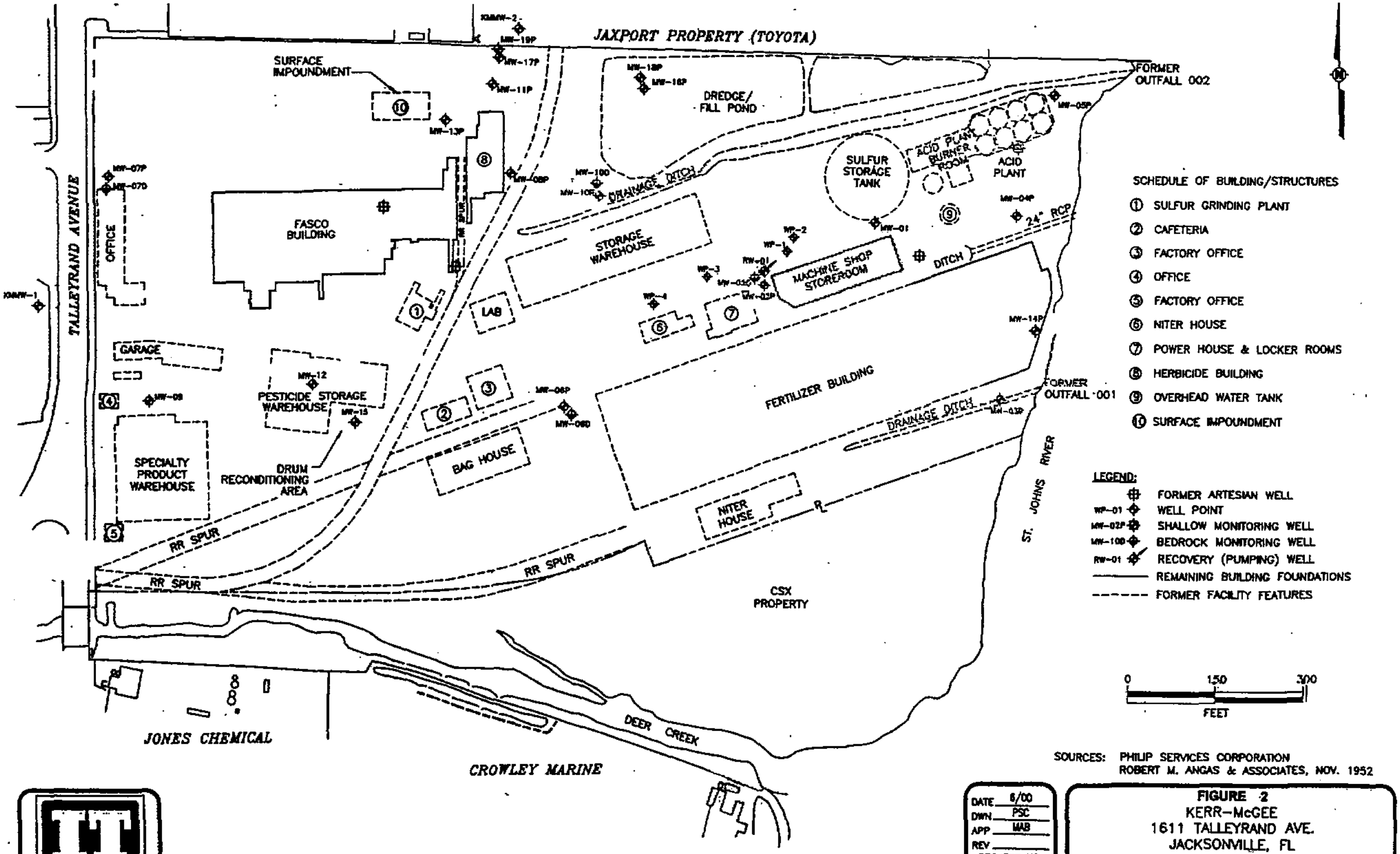
N
W E
S

0 0.08 0.16 0.24 Miles

1:9480

Florida Department of Health

Bureau of Environmental Epidemiology



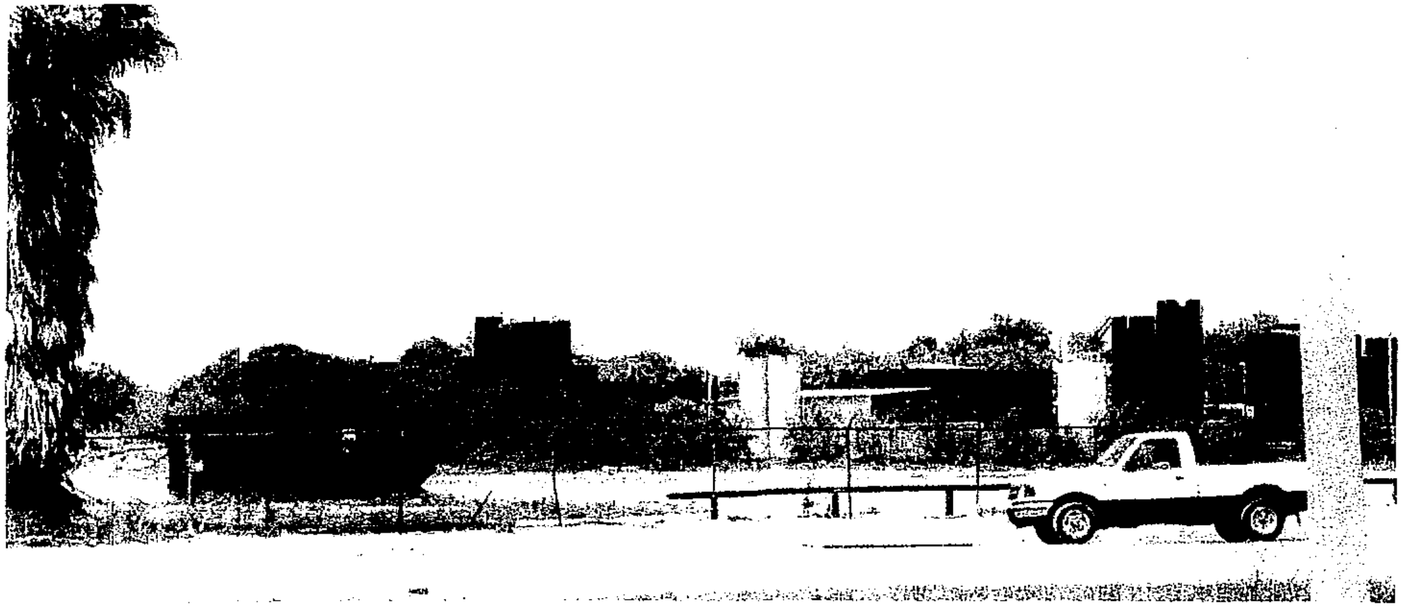
SOURCES: PHILIP SERVICES CORPORATION
ROBERT M. ANGAS & ASSOCIATES, NOV. 1952

IT CORPORATION

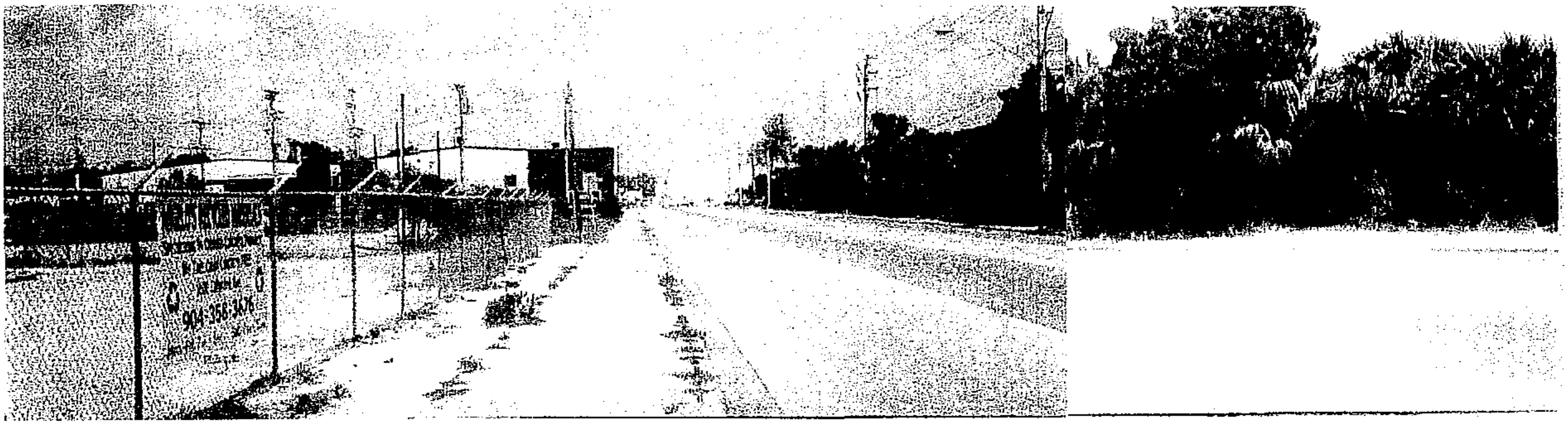
DATE	6/00
DWN	PSC
APP	MAB
REV	
PROJECT NO.	806578

FIGURE 2
KERR-McGEE
1611 TALLEYRAND AVE.
JACKSONVILLE, FL
SITE MAP

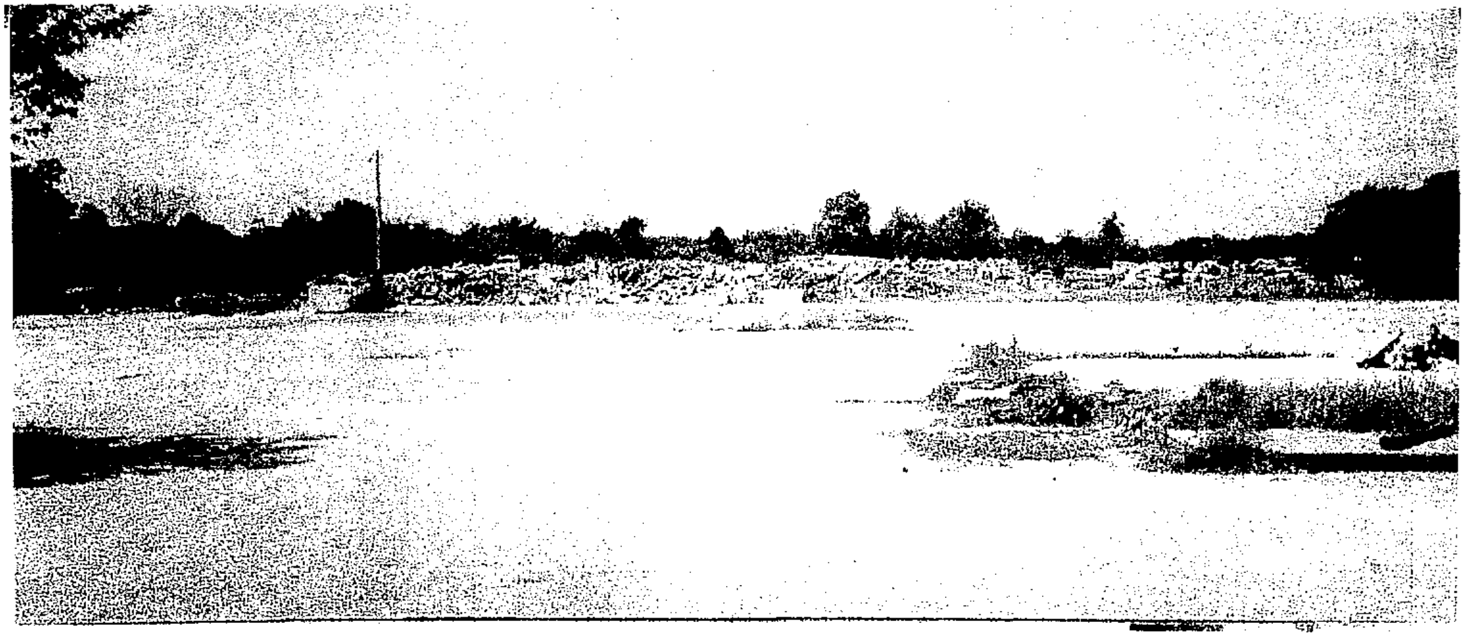
Photograph 1: View of Kerr McGee site looking east from Talleyrand Avenue.



Photograph 2: View west of Talleyrand Avenue from same location as photograph above.



Photograph 3: View looking north on Talleyrand Avenue, northern part of site is the vegetated area on the right site of the road.



Photograph 4: View of site on the left side of photograph 3, above.

Photograph 5: Closeup of monitoring wells through the fence on the southeast part of the site. Bridge is visible in the background.

Photograph 6: Closeup of gate on the southern portion of the site.


4 10 '01

Photograph 7: Road on the southern part of the site.


Photograph 8: Jones Chemical south of the site.

Photograph 9: Deer Creek upstream of bridge on Talleyrand Avenue.

Photograph 10: Deer Creek downstream of bridge on Talleyrand Avenue.

APPENDIX C.

TABLES

Explanation of Abbreviations for Tables 1, 2, and 3
* Comparison values are used to select chemicals for further scrutiny, not for determining the possibility of illness.
ATSDR - Agency for Toxic Substance and Disease Registry
CREG - Cancer Risk Evaluation Guide for one in one million excess cancer (ATSDR)
EMEG - Environmental Media Evaluation Guide(ATSDR)
FDEP - Florida Department of Environmental Protection
Florida Guidance Concentration - These are suggested standards based on a Carcinogenic health effect or Systemic toxicant health effect
INT - Intermediate Exposure is 15 to 364 days in duration.
J - Approximate Value; quantitative Quality Control out of range
LTHA - Lifetime Health Advisory (ATSDR)
MCL - Maximum Concentration Level, an enforceable drinking water standard in Florida
µg/L - micrograms per liter - unit measure for liquids
mg/kg - milligrams per kilogram - unit measure for solids
NA - Not Analyzed
ND - Not Detected Above Screening Value
PWS - Primary Drinking Water Standard - Enforceable Florida Standards
RES/IND - residential use / industrial use (land use designations)
RMEG - Reference Dose Media Evaluation Guide (ATSDR)
SCTL - Soil Cleanup Target Levels (FDEP)

Table 1. Maximum Contaminant Concentrations in On-Site Surface Soil (0-2 Feet Deep) and Groundwater (All Depths)

	Soil							Groundwater						
Contaminant	Screening Value Child/Adult (mg/kg)	Source of Screening Value	CREG (mg/kg)	#/total above scr.	Max. Soil Concen. (mg/kg)	Year Sampled	Location	Screening Value Child/Adult (µg/L)	Source of Screening Value	CREG (µg/L)	#/total above scr.	Max. Ground-water Concen. (µg/L)	Year Sampled	Location
aldrin	2/20	EMEG=RMEG	0.04	8/105	**76.8**	1991	SHA-7	0.3/1	EMEG=RMEG	0.002	-----	**ND**	-----	-----
arsenic	20/200	EMEG=RMEG	0.5	4/10	**5,100**	2000	SB-2	3/10	EMEG=RMEG	0.02	28/66	**1900**	1998	RW01
alpha-BHC	400/600	EMEG	0.1	2/106	**920**	2000	SB-8	0.5	FL GUIDANCE CARCINOGEN	-----	40/86	**1100**	1993	MW11P
beta-BHC	30/400	INT. EMEG	0.4	7/106	**320**	2000	SB-8	0.2	FL GUIDANCE CARCINOGEN	-----	41/86	**160**	1999	MW19D
delta-BHC	22/420	SCTLS RES/IND.	-----	5/106	**89**	2000	SB-7	0.05	FL GUIDANCE SYSTEMIC TOXICANT	-----	53/86	**1780**	1994	MW11P
gamma-BHC	0.5/7	INT. EMEG	-----	20/106	**424**	1988	SS122	0.2	FL GUIDANCE CARCINOGEN	-----	30/86	**910**	1999	MW19P
chlordane	30/400	EMEG=RMEG	2	9/105	**365**	11/84	4a	6/20 MCL=2	EMEG	0.1	3/26	**.31**	2000	MW6T
DDD	4.6/18	SCTLS RES/IND.	3	29/106	**1181**	5/84	3a	.1	FL GUIDANCE CARCINOGEN	.1	14/86	**125**	1994	MW17P
DDE	3.3/13	SCTLS RES/IND.	2	28/106	**230**	2000	SB-8	-----	-----	.1	4/86	**13.2**	1994	MW17P
DDT	3.3/13	SCTLS RES/IND.	2	20/108	**1,437**	1984/2000	4a & SB-8	5/20	RMEG	.1	7/86	**82.2**	1994	MW17P
dieldrin	3/40	EMEG=RMEG	0.04	19/106	**96 J**	2000	SB-8	0.5/2	EMEG=RMEG	0.002	24/60	**7.6 J**	2000	MW4T
heptachlor	30/400	RMEG	0.2	1/32	**63**	2000	SB-5	5/20 MCL=0.4	RMEG	0.008	1/39	**0.774**	1993	MW11P
heptachlor epoxide	.7/9	RMEG	0.08	3/45	**27.5**	1988	SS117	0.1/.5 MCL=0.2	RMEG	0.004	1/26	**0.046 J**	2000	MW12TD
lead	400/920	SCTLS RES/IND.	-----	2/17	**6,300**	2000	SB-20	MCL=15	FL PRIMARY STANDARD	-----	5/30	**486**	1999	MW11P
toxaphene	50/700	INT. EMEG	.6	10/70	**3000**	1984	4a	10/40 MCL=3	INT. EMEG	0.03	3/32	**53**	1999	MW19P
1,4 -dichlorobenzene	20,000/ 300,000	INT. EMEG	-----	NA	-----	-----	-----	75	LTHA	-----	8/32	**330J**	1999	MW19P

Table 2. Maximum Contaminant Concentrations in Off-Site Surface Soil (0-2 Feet Deep) and Groundwater (All Depths)

	Soil							Groundwater						
Contaminant	Soil Screening Value Child/Adult (mg/kg)	Source of Screening Value	CREG (mg/kg)	#/total above screening value	Max. soil concen. (mg/kg)	Year Sampled	Location	Groundwater Screening Value Child/Adult (μg/L)	Source of Screening Value	CREG (μg/L)	#/total above screening value	Max. Ground-water Con. (μg/L)	Year	Location
aldrin	2/20	EMEG=RMEG	0.04	3/24	2400 J	1999	KMSD-6	0.3/1	EMEG=RMEG	0.002	0/5	ND	-----	-----
arsenic	20/200	EMEG=RMEG	0.5	1/24	21	2000	SD-10	3/10	EMEG=RMEG	0.02	0/5	ND	-----	-----
alpha-BHC	400/600	EMEG	0.1	0/24	ND	-----	-----	0.5	FL GUIDANCE CARCINOGEN	-----	2/5	1000	1999	KMMW02
beta-BHC	30/400	INT. EMEG	0.4	0/24	ND	-----	-----	0.2	FL GUIDANCE CARCINOGEN	-----	1/5	150	1999	KMMW02
delta-BHC	22/420	SCTLS RES/IND.	-----	0/24	ND	-----	-----	0.05	FL GUIDANCE SYSTEMIC TOXICANT	-----	2/5	520	1999	KMMW02
gamma-BHC	0.5/7	INT. EMEG	-----	0/24	ND	-----	-----	0.2	FL GUIDANCE CARCINOGEN	-----	2/5	550	1999	KMMW02
chlordane	30/400	EMEG=RMEG	2	0/24	ND	-----	-----	6/20 MCL=2	EMEG	0.1	0/3	ND	-----	-----
DDD	4.6/18	SCTLS RES/IND.	3	1/26	41	1999	KMSD-9	0.1	FL GUIDANCE CARCINOGEN	0.1	0/5	ND	-----	-----
DDE	3.3/13	SCTLS RES/IND.	2	1/26	2.7	1999	KMSD-9	-----	-----	0.1	0/5	ND	-----	-----
DDT	3.3/13	SCTLS RES/IND.	2	1/26	55	1999	KMSD-5	5/20	RMEG	0.1	0/5	ND	-----	-----
dieldrin	3/40	EMEG=RMEG	0.04	0/24	ND	-----	-----	0.5/2	EMEG=RMEG	0.002	1/3	0.04 J	2000	MW20T
heptachlor	30/400	RMEG	0.2	0/16	ND	-----	-----	5/20 MCL=0.4	RMEG	0.008	0/3	ND	-----	-----
heptachlor epoxide	.7/9	RMEG	0.08	0/16	ND	-----	-----	0.1/.5 MCL=0.2	RMEG	0.004	1/3	0.32	2000	MW20T
lead	400/920	SCTLS RES/IND.	-----	2/24	1240	1999	KMSD-5	MCL=15	FL PRIMARY STANDARD	-----	0/3	ND	-----	-----
toxaphene	50/700	INT. EMEG	.6	0/16	ND	-----	-----	10/40 MCL=3	INT. EMEG	0.03	1/5	30	1999	KMMW02
1,4 -dichlorobenzene	20,000/300,000	INT. EMEG	-----	-----	ND	-----	-----	75	LTHA	-----	1/5	190	1999	KMMW02

Table 3. Maximum Contaminant Concentrations in Deer Creek and Drainage Ditch Sediments and Surface Water Samples taken for the nearby FMC and CSXT Sites. All samples FDOH included here are off-site for FMC, CSXT and Kerr-McGee.

	Deer Creek and Drainage Ditch Sediments							Surface Water Samples						
Contaminants	Soil Screening Values Child/Adult (mg/kg)	Source of Screening Value	CREG (mg/kg)	# above screening value /total #	Max. Sediment Concen. (mg/kg)	Year	Location	Groundwater Screening Value Child/Adult (μg/L)	Source of Screening Value	CREG (μg/L)	# above screening value /total #	Max. Ground-water Concen. (μg/L)	Year	Location
aldrin	2/20	EMEG=RMEG	0.04	0/4	ND	-----	-----	0.3/1	EMEG=RMEG	0.002	0/6	NA	-----	-----
arsenic	20/200	EMEG=RMEG	0.5	0/17	ND	-----	-----	3/10	EMEG=RMEG	0.02	1/6	1010	1988	Deer Creek, FMC # 6
alpha-BHC	400/600	EMEG	0.1	0/15	ND	-----	-----	0.5	FL GUIDANCE CARCINOGEN	-----	7/9	2	1988	Deer Creek, FMC # 3
beta-BHC	30/400	INT. EMEG	0.4	0/15	ND	-----	-----	0.2	FL GUIDANCE CARCINOGEN	-----	3/9	0.66	1993	CSXT SW-3
delta-BHC	22/420	SCTLS RES/IND.	-----	0/15	ND	-----	-----	0.05	FL GUIDANCE SYSTEMIC TOXICANT	-----	7/9	2.62	1993	CSXT SW-1
gamma-BHC	0.5/7	INT. EMEG	-----	0/15	ND	-----	-----	0.2	FL GUIDANCE CARCINOGEN	-----	5/6	11	1988	Deer Creek, FMC #s 3&8
chlordane	30/400	EMEG=RMEG	2	0/3	ND	-----	-----	6/20 MCL=2	EMEG	0.1	-----	NA	-----	-----
DDD	4.6/18	SCTLS RES/IND.	3	1/16	5.7	1987	FMC SED-5	0.1	FL GUIDANCE CARCINOGEN	0.1	-----	NA	-----	-----
DDE	3.3/13	SCTLS RES/IND.	2	0/16	ND	-----	-----	-----	-----	0.1	-----	NA	-----	-----
DDT	3.3/13	SCTLS RES/IND.	2	1/16	37	1987	FMC SED-5	5/20	RMEG	0.1	-----	NA	-----	-----
dieldrin	3/40	EMEG=RMEG	0.04	0/7	ND	-----	-----	0.5/2	EMEG=RMEG	0.002	0/7	ND	-----	-----
heptachlor	30/400	RMEG	0.2	0/7	ND	-----	-----	5/20 MCL=0.4	RMEG	0.008	-----	NA	-----	-----
heptachlor epoxide	.7/9	RMEG	0.08	0/4	ND	-----	-----	0.1/.5 MCL=0.2	RMEG	0.004	-----	NA	-----	-----
lead	400/920	SCTLS RES/IND.	-----	0/1	ND	-----	-----	MCL=15	FL PRIMARY STANDARD	-----	-----	NA	-----	-----
toxaphene	50/700	INT. EMEG	.6	-----	NA	-----	-----	10/40 MCL=3	INT. EMEG	0.03	-----	NA	-----	-----
1,4 -dichlorobenzene	20,000/300,000	INT. EMEG	-----	0/1	ND	-----	-----	75	LTHA	-----	-----	NA	-----	-----

Table 4. Potential Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRON-MENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
On-Site Surface Soil	Waste Disposal	On-site Surface Soil	On-Site	Accidental Soil Ingestion, Dermal Contact	Future On-Site Residents	Future
Airborne Dust	Contaminated On-site Surface Soil	Air	Nearby Neighborhood	Inhalation	100 to 1,000 Nearby Residents	1893-1978
Off-Site Surface Water and Sediments	Site Storm Water Runoff	Surface Water and Sediments	Deer Creek and St. Johns River near the site.	Dermal	10 to 100 Nearby Residents	1893-1978
Fish and Shellfish	Site Storm Water Runoff	Fish and Shellfish	St. Johns River	Ingestion	People who eat fish caught in the St. Johns River near Kerr-McGee	1950s to the present and future
On-Site Shallow Groundwater	Waste Disposal	Groundwater	Future On-Site Wells	Ingestion, Dermal Contact, Inhalation of Vapors	Future On-Site Residents	Future

Model Parameters and Assumptions for Tables 5, 6, and 7
(Groundwater/Dermal does not provide for small children because model doesn't have provision for baths instead of showers. The calculated inhalation values are lower for children as well because small children usually don't take showers.)

Exposure Medium: Groundwater
Exposure Point: **On-site tap water**
Scenario Time-frame: Future
Land Use Conditions: Residential

Receptor Population: Residents
These doses were calculated using Risk Assistant software by Hampshire Research Institute, Version 2.0. The part of this software Florida DOH uses allows us to set custom exposures that we can use for every site with accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA, 1991).
The following 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
Adult skin surface area- 23,000cm2
Child skin surface area- 7,200cm^2
* The air concentration is given in milligrams per cubic meter because the values for inhalation studies in most of the Toxicologic Profiles are given in these units. The air concentration is not a dose, therefore it is the same for adults and children.

μg/L = microgram per liter of water
mg/kg/day = milligrams per kilogram body weight per day
mg/^{M3} = milligrams per cubic meter

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

Exposure Medium: Soil
Exposure Point: **On-site soil and dust**
Scenario Time-frame: Future
Land Use Conditions: Residential

Receptor Population: Residents
These doses were calculated using Risk Assistant software and accepted values for soil consumption, dust inhalation exposure and dermal exposure parameters (EPA, 1991).
The following doses were calculated using the following values:
Adult body weight- 70 kg
Child body weight- 15 kg
Adult soil consumption- 100 mg/day
Child soil consumption- 200 mg/day
Adult shower time- 0.2 hours
Adult skin surface area- 23,000cm^2
Child skin surface area- 7,200cm^2
* The air concentration is given in milligrams per cubic meter because the values for inhalation studies in most of the Toxicologic Profiles are given in these units. The air concentration is not a dose, therefore it is the same for adults and children.
mg/kg = milligram per kilogram of soil
mg/kg/day = milligrams per kilogram body weight per day
mg/^{m3} = milligrams per cubic meter

Table 5. Maximum Dose (mg/kg/day) From Future Residential Use of On-Site Groundwater and Contact With On-Site Soil.

	Groundwater								Soil					
Contaminant of Concern	(max. GW conc. µg/L)	Oral MCL (mg/kg/day)	Groundwater- Ingestion (mg/kg/day)		Groundwater- Dermal (mg/kg/day)		Inhalation MCL (mg/^{m3})	Groundwater- Inhalation (mg/^{m3})	(max. Soil conc. mg/kg)	Oral MCL (mg/kg/day)	Soil- Ingestion (mg/kg/day)		Inhalation MCL (mg/^{m3})	Dust- Inhalation (mg/^{m3})
			Child	Adult	Child	Adult		Child&Adult			Child	Adult		Child&Adult
aldrin	–	Ac 0.002 Chr 0.00003	0	0	0	0	–	0	76.8	Ac 0.002 Chr 0.00003	0.001	0.0001	–	0.000004
arsenic	1900	Ac 0.005 Chr 0.0003	0.1	0.05	0	0.0001	–	MD	5,100	Ac 0.005 Chr 0.0003	0.07	0.007	–	0.0003
alpha-BHC	1100	Chr 0.008	0.07	0.03	0	0.01	–	1.0/12.1	920	Chr 0.008	0.01	0.001	–	0.00005
beta-BHC	160	Ac 0.2 Int 0.0006	0.01	0.005	0	0.003	–	0.15/1.8	320	Ac 0.2 Int 0.0006	0.004	0.0005	–	0.00002
delta-BHC	1780	–	0.1∑0.2	0.05∑0.09	0	0.009∑0.02	–	1.8∑3.0/19.6∑33	89		0.001∑0.02	0.0001∑0.002	–	0.000005∑0.00006
gamma-BHC	910	Ac 0.01 Int 0.00001	0.06	0.03	0	0.01	–	0.9/10	424	Ac 0.01 Int 0.00001	0.006	0.0006	–	0.00002
chlordane	.31	Ac 0.001 Int 0.0006	0.00002	0.000009	0	0.00003	Int 0.0002 Chr 0.00002	0.0003/0.003	365	Ac 0.001 Int 0.0006	0.005	0.0005	Int 0.0002 Chr 0.00002	0.00002
DDD	125	–	0.008	0.004	0	0.04	–	0.1/1.4	1181		0.02	0.002	–	0.00007
DDE	13.2	–	0.0009	0.0004	0	0.004	–	0.01/0.1	230		0.003	0.0003	–	0.00001
DDT	82.2	Ac 0.0005 Int 0.0005	0.005 ∑0.01	0.002 ∑0.006	0	0.05 ∑0.09	–	0.08 ∑0.2/ 0.9 ∑2.4	1,437	Ac 0.0005 Int 0.0005	0.02 ∑0.04	0.002 ∑0.004	–	0.00008 0.002 p.m.
dieldrin	7.6 J	Int 0.0001 Chr 0.00005	0.0005	0.0002	0	0.0002	–	OMB	96J	Int 0.0001 Chr 0.00005	0.001	0.0001	–	0.000005
heptachlor	0.774	–	0.00005	0.00002	0	0.00001	–	0.0007/0.009	63	–	0.0003	0.00009	–	0.000003
heptachlor epoxide	0.046 J	–	0.000003	0.000001	0	0.000005	–	0.0005/0.00005	27.5	–	0.0004	0.00004	–	0.000002
lead	486	–	0.03	0.01	0	0.00003	–	MD	6,300	–	0.08	0.009	–	0.0003
toxaphene	53	Ac 0.005 Int 0.001	0.004	0.002	0	0.002	–	0.05/0.6	3000	Ac 0.005 Int 0.001	0.04	0.004	–	0.0002
1,4 -dichlorobenzene	330J	Int 0.4	0.02	0.009	0	0.007	Ac 0.8 p.m. Int 0.2 p.m.	0.3/3.6		Int 0.4	0	0	Ac 0.8 p.m. Int 0.2 p.m.	0

Table 6. Maximum Dose (mg/kg/day) From Future Residential Use of Off-Site Groundwater and Residential Contact With Off-Site Soil.

	Groundwater								Soil					
Contaminant of Concern	(max. GW conc. µg/l)	Oral MCL (mg/kg/day)	Groundwater- Ingestion (mg/kg/day)		Groundwater- Dermal (mg/kg/day)		Inhalation MCL (mg/^{m3})	Groundwater- Inhalation (mg/^{m3})	(max. Soil conc. mg/kg)	Oral MCL (mg/kg/day)	Soil- Ingestion (mg/kg/day)		Inhalation MCL (mg/^{m3})	Dust- Inhalation (mg/^{m3})
			Child	Adult	Child	Adult		Child&Adult			Child	Adult		Child&Adult
aldrin	ND	Ac 0.002 Chr 0.00003					–		2400 J	Ac 0.002 Chr 0.00003	0.03	0.003	–	0.0001
arsenic	ND	Ac 0.005 Chr 0.0003					–		21	Ac 0.005 Chr 0.0003	0.0003	0.00003	–	
alpha-BHC	1000	Chr 0.008	0.07	0.03	0	0.013	–	1.0/11.0	ND	Chr 0.008			–	
beta-BHC	150	Ac 0.2 Int 0.0006	0.01	0.004	0	0.003	–	0.1/1.6	ND	Ac 0.2 Int 0.0006			–	
delta-BHC	520	–	0.03 Σ0.1	0.01 Σ0.04	0	0.003 Σ0.02	–	0.5 Σ1.6/ 5.7 Σ18.3	ND	–			–	
gamma-BHC	550	Ac 0.01 Int 0.00001	0.04	0.02	0	0.007	–	0.5/6.0	ND	Ac 0.01 Int 0.00001			–	
chlordane	ND	Ac 0.001 Int 0.0006					Int 0.0002 Chr 0.00002		ND	Ac 0.001 Int 0.0006			Int 0.0002 Chr 0.00002	
DDD	ND	–					–		41	–	0.0005	0.00006	–	0.000002
DDE	ND	–					–		2.7	–	0.00004	0.000004	–	0.0000002
DDT	ND	Ac 0.0005 Int 0.0005					–		55	Ac 0.0005 Int 0.0005	0.0007 Σ0.001	0.00008 Σ0.0001	–	0.000003 Σ0.000005
dieldrin	0.04 J	Int 0.0001 Chr 0.00005	0.000003	0.000001	0	0.000001	–	OMB	ND	Int 0.0001 Chr 0.00005			–	
heptachlor	ND	–					–		ND	–			–	
heptachlor epoxide	0.32	–	0.00002	0.000009	0	0.00003	–	0.0003/0.004	ND	–			–	
lead	ND	–					–		1240	–	0.02	0.002	–	0.00007
toxaphene	30	Ac 0.005 Int 0.001	0.002	0.0009	0	0.001	–	0.03/0.3	ND	Ac 0.005 Int 0.001			–	
1,4 -dichlorobenzene	190	Int 0.4	0.01	0.005	0	0.004	Ac 0.8 p.m. Int 0.2 p.m.	0.2/2.0	ND	Int 0.4			Ac 0.8 p.m. Int 0.2 p.m.	

Table 7. Maximum Dose (mg/kg/day) From Use of Off-Site Surface Water and Contact With Off-Site Sediment.

	Groundwater								Soil					
Contaminant	Max. Water conc. (µg/L)	Oral MCL (mg/kg/day)	Water- Ingestion (mg/kg/day)		Water- Dermal (mg/kg/day)		Inhalation MCL (mg/m^3)	Vapor- Inhalation (mg/m^3)	Max. Sediment conc. (mg/kg)	Oral MCL (mg/kg/day)	Soil- Ingestion (mg/kg/day)		Inhalation MCL (mg/m^3)	Dust- Inhalation (mg/m^3)
			Child	Adult	Child	Adult		Child&Adult			Child	Adult		Child&Adult
aldrin	ND	Ac 0.002 Chr 0.00003					–		ND	Ac 0.002 Chr 0.00003			–	
arsenic	1010	Ac 0.005 Chr 0.0003	0.07	0.03	0	0.00007	–	MD	ND	Ac 0.005 Chr 0.0003			–	
alpha-BHC	2	Chr 0.008	0.0001	0.00006	0	0.00003	–	0.002/0.02	ND	Chr 0.008			–	
beta-BHC	0.66	Ac 0.2 Int 0.0006	0.004	0.002	0	0.001	–	0.07/0.7	ND	Ac 0.2 Int 0.0006			–	
delta-BHC	2.62	–	0.0002 ∑0.004	0.00003 ∑0.002	0	0.00001 ∑0.001	–	0.003/.03	ND	–			–	
gamma-BHC	11	Ac 0.01 Int 0.00001	0.0007	0.0003	0	0.0001	–	0.01/0.12	ND	Ac 0.01 Int 0.00001			–	
chlordane	ND	Ac 0.001 Int 0.0006					Int 0.0002 Chr 0.00002		ND	Ac 0.001 Int 0.0006			Int 0.0002 Chr 0.00002	
DDD	ND	–					–		5.7	–	0.00008	0.000008	–	0.0000003
DDE	ND	–					–		ND	–			–	
DDT	ND	Ac 0.0005 Int 0.0005					–		37	Ac 0.0005 Int 0.0005	0.0007 ∑0.1	0.00005 ∑0.00006	–	0.000002 ∑0.000002
dieldrin	ND	Int 0.0001 Chr 0.00005					–		ND	Int 0.0001 Chr 0.00005			–	
heptachlor	ND	–					–		ND	–			–	
heptachlor epoxide	ND	–					–		ND	–			–	
lead	ND	–					–		ND	–			–	
benzene	ND	–					Ac 0.05 p.m. Int 0.004 p.m.		ND	–			Ac 0.05 p.m. Int 0.004 p.m.	
1,4 -dichlorobenzene	ND	Int 0.4					Ac 0.8 p.m. Int 0.2 p.m.		ND	Int 0.4			Ac 0.8 p.m. Int 0.2 p.m.	

Table 8. Estimated Exposure Lengths for Non-Cancerous Health Effects and Increased Risk for Cancer Assuming Long-Term Exposures to Maximum Contaminant Concentrations (Cancer risks are listed only for media with 1 in 10,000 or equivalent increase)

Chemical	On-site Groundwater				On-site Soil/Sediments				Off-site Groundwater				Off-site Soil/Sediments			
	children's health effects	adult's health effects	children's incr cancer	adult's incr cancer	children's health effects	adult's health effects	children's incr cancer	adult's incr cancer	children's health effects	adult's health effects	children's incr cancer	adult's incr cancer	children's health effects	adult's health effects	children's incr cancer	adult's incr cancer
Aldrin							7:10,000 ed 1:1M in dr	8:10,000 ed 2:1M in dr					Chronic		2:100 ed 3:1M in dr	2:100 ed 7:100,000 in dr
Arsenic	Acute Intermed. Chronic	Acute Intermed. Chronic	8:1,000 ed in dr	3:100 ed in 8:100,000 dr	Acute Intermed. Chronic	Chronic	4:100 ed 5:1M in dr	5:1,000 ed 1:10,000 in dr		Chronic	4:1,000 ed in dr	2:100 ed in 4:100,000 dr				
Chlordane							3:10,000 ed in dr	3:10,000 ed in dr								
1,4-Dichlorobenzene				9:100,000 ed 9:100,000 in 1:100,000 dr												
DDD, DDE, DDT			2:10,000 ed in dr	7:10,000 ed 1:1,000 in 1:1,000 dr			6:10,000 ed in dr	5:10,000 ed in dr								
Dieldrin			3:10,000 ed in dr	1:1,000 ed OMB in 1:1,000 dr			1:1,000 ed in dr	9:10,000 ed in dr								
Heptachlor/ Heptachlor Epoxide				4:100,000 ed 2:10,000 in 1:10,000 dr			3:10,000 ed in dr	4:10,000 ed in dr								
Technical grade BHC	Intermed. Chronic	Intermed. Chronic	2:100 ed 2:1,000 in 0 in 1dr	8:100 ed 3:10 in 4:100 dr			3:1,000 ed in dr	4:10,000 ed 1:100,000 in dr			2:100 ed 1:1,000 in dr	7:100 ed 2:10 in 3:100 dr				
Gamma BHC/Lindane	Intermed. Chronic	Acute Intermed. Chronic							Intermed. Chronic	Intermed Chronic						
Lead	modeled	modeled	modeled	modeled	modeled	modeled	modeled	modeled								
Toxaphene			2:10,000 ed 1:100,000 in dr	7:1,000 ed 3:1,000 in 9:10,000 dr			2:1,000 ed in dr	2:1,000 ed in dr				4:10,000 ed 1:1,000 in 5:10,000 dr				

Exposure length
Acute - daily exposure for 1-14 days
Intermediate - daily exposure for 14-365 days
Chronic - daily exposure for longer than 1 year

Exposure Route
ed - ingestion exposure - chemical is eaten or drunk
in - inhalation exposure - chemical is inhaled
dr - dermal exposure - chemical is absorbed through the skin

Increased cancer risk for daily chronic exposure; 2:100 would be an expected increase of 2 in 100.

Table 9. Estimated Blood Lead Concentrations In Children Ingesting On-Site Surface Soil (micrograms per deciliter - up/dl)

Media	Conc. *		Time	Slope§		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.8	2.46	3.04	0.1968	0.4864
Air (in)	0.3*	0.6*	0.8	2.46	3.04	0.5904	1.4592
Food	5*	5*	0.8	0.24	0.24	0.96	0.96
Water	4*	4*	0.8	0.16	0.16	0.512	0.512
Soil	6300	6300	0.8	0.002	0.016	10.08	80.64
Dust	6300	6300	0.8	0.004	0.004	20.16	20.16
Total‡						**32.4992**	**104.218**

*Default Value from ATSDR 1999a, Appendix D.

§These slopes were for children from ATSDR 1999a, Appendix D.

ATSDR's Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

Table 10. Estimated Blood Lead Concentrations In Adults Ingesting On-Site Surface Soil (micrograms per deciliter - up/dl)

Media	Conc. *		Time	Slope†		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.8	1.59	3.56	0.1272	0.5696
Air (in)	0.3*	0.6*	0.8	1.53	3.56	0.3672	1.7088
Food	5*	5*	0.8	0.016	0.0195	0.064	0.078
Water	4*	4*	0.8	0.03	0.06	0.096	0.192
Soil	6300	6300	0.8	0.002	0.016	10.08	80.64
Dust	6300	6300	0.8	0.004	0.004	20.16	20.16
Total‡						**30.8944**	**103.3484**

*Default Value from ATSDR 1999a, Appendix D.

†Slopes for adults from ATSDR 1999a, Appendix D.

ATSDR's Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

Table 11. Estimated Blood Lead Concentrations In Children Ingesting Off-Site Sediments (micrograms per deciliter - up/dl)

Media	Conc. *		Time	Slope§		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.8	2.46	3.04	0.1968	0.4864
Air (in)	0.3*	0.6*	0.8	2.46	3.04	0.5904	1.4592
Food	5*	5*	0.8	0.24	0.24	0.96	0.96
Water	4*	4*	0.8	0.16	0.16	0.512	0.512
Soil	1240	1240	0.8	0.002	0.016	1.984	15.872
Dust	1240	1240	0.8	0.004	0.004	3.968	3.968
Total‡						**8.2112**	**23.2576**

*Default Value from ATSDR 1999a, Appendix D.

§These slopes were for children from ATSDR 1999a, Appendix D.

ATSDR's Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

Table 12. Estimated Blood Lead Concentrations In Adults Ingesting Off-Site Sediments (micrograms per deciliter - up/dl)

Media	Conc. *		Time	Slope†		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.8	1.59	3.56	0.1272	0.5696
Air (in)	0.3*	0.6*	0.8	1.53	3.56	0.3672	1.7088
Food	5*	5*	0.8	0.016	0.0195	0.064	0.078
Water	4*	4*	0.8	0.03	0.06	0.096	0.192
Soil	1240	1240	0.8	0.002	0.016	1.984	15.872
Dust	1240	1240	0.8	0.004	0.004	3.968	3.968
Total‡						**6.6064**	**22.3884**

*Default Value from ATSDR 1999a, Appendix D.

†Slopes for adults from ATSDR 1999a, Appendix D.

ATSDR's Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

Table 13. Estimated Blood Lead Concentrations In Children Ingesting On-Site Groundwater (micrograms per deciliter - up/dl)

Media	Conc. *		Time	Slope§		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.8	2.46	3.04	0.1968	0.4864
Air (in)	0.3*	0.6*	0.8	2.46	3.04	0.5904	1.4592
Food	5*	5*	0.8	0.24	0.24	0.96	0.96
Water	486	486	0.8	0.03	0.24	11.664	93.312
Soil	10*	70*	0.8	0.002	0.016	0.016	0.896
Dust	10*	70*	0.8	0.004	0.004	0.032	0.224
Total‡						**13.4592**	**97.3376**

*Default Value from ATSDR 1999a, Appendix D.

§These slopes were for children from ATSDR 1999a, Appendix D.

ATSDR's Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

Table 14. Estimated Blood Lead Concentrations In Adults Ingesting On-Site Groundwater (micrograms per deciliter - up/dl)

Media	Conc. *		Time	Slope†		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.8	1.59	3.56	0.1272	0.5696
Air (in)	0.3*	0.6*	0.8	1.53	3.56	0.3672	1.7088
Food	5*	5*	0.8	0.016	0.0195	0.064	0.078
Water	486	486	0.8	0.03	0.06	11.664	23.328
Soil	10*	70*	0.8	0.002	0.016	0.016	0.896
Dust	10*	70*	0.8	0.004	0.004	0.032	0.224
Total‡						**12.2704**	**26.8044**

*Default Value from ATSDR 1999a, Appendix D.

†All these slopes values were for adults from ATSDR 1999a, Appendix D.

ATSDR's Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

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 the site needs a follow-up health study and to identify possible associations.

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

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

Dose Response/Thresholds

The focus of toxicological studies in humans or animals is identification of the relationship between exposure to different doses of a specific contaminant and the chance of having a health effect from each exposure level. This dose-response relationship provides a mathematical formula or graph that we use to estimate a person's risk of illness. The actual shape of the dose-response curve requires scientific knowledge of how a hazardous substance affects different cells in the human body. There is one important difference between the dose-response curves used to estimate the risk of 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 Kerr-McGee site.

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

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

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

APPENDIX E

LONGSHOREMEN'S HEALTH STUDY PETITION

16 Page fax on April 30, 2001

To: Beth Copeland and Connie Garrett, Florida Dept. of Health
cc: Dr. Liz Bozeman, Dr. Aaron Hilliard, Michael Bryant, Dr. Henry Thomas, Mindy Gardner

From: Mike Hartman, Community Technical Advisor, Jacksonville University

Petition and Summary of Former Worker Health Concerns

A. Petition for Epidemiological Study

Attached are copies of 14 completed survey forms filled out by former workers at a plant that manufactured fertilizers, pesticides and herbicides at 1611 Talleyrand Ave. in Jacksonville Florida from 1893 to 1978. I expect to receive another 7-10 forms from individuals that have completed but not yet turned in these forms. Please realize how difficult it is for these former workers, who are not well educated, to understand and appreciate risks from exposure to toxic chemicals and know how to answers questions in writing dealing with this subject matter.

As can be seen from these forms, former workers at this plant are very concerned about their health. These concerns comes from seeing the death and illnesses of former workers and their realization now what they did not realize when they worked there, that they were exposed to some highly toxic chemicals which may have adverse health risk consequences. They remember good pay for work with chemicals but working conditions with little or no safety training or use of protective clothing. Some of the chemicals produced at the plant included Dieldrin, DDT, DDD, and DDE.

The former workers are not militant in their concerns. They do not allege any bad faith or fraudulent cover-up of exposure conditions by the former corporations that use to own and operate the plant. They feel proud that the plant produced chemicals that helped our agriculture industry control insects and weeds while increasing the yield of agricultural products in the period the plant operated. They appear to simply want to know whether their health, the health of their wives and children and the health of the nearby community has been adversely affected by the exposure situations inadvertently created over a period of many years at the subject plant. If society benefited from the many products these workers helped create, then equity would seem to warrant that society have their concerns investigated.

By studying the health of the workers and their families and understanding exposure conditions at the plant during the period from about 1950 to 1978, valuable epidemiological information about how toxic substances in the environment affect human health can be learned.

Unfortunately there is no government agency that is mandated to do a epidemiological investigation of past toxic exposure conditions and their morbidity and mortality effects to workers and the community. We learned from your presentation on April 10th that ATSDR has the expertise and with sufficient evidence may be able to find funds to do an investigation with the help of the Florida Dept. of Health. If an epidemiological study were to be performed, it is assumed the study design would either be a case control or retrospective cohort study. Experts in ATSDR and your agency will know which study design is appropriate for this population and exposure situation.

Local experts from the Duval County Health Dept. and this writer stand ready to be of help in any planned study. It is assumed a study plan and project budget needs to be prepared. For planning purposes I would estimate a former worker population of about 80 individuals and a community population that lived near the site during the period of peak exposures (1950-1978) of around 30. If deceased workers and individuals who formerly lived nearby are added in a mortality study, this could increase the population under study by 60-80 additional individuals. More information about work practices and reports of accidental releases and routine discharges from the facility may be available from Kerr-McGee Corp. and the Jacksonville Environmental Services Division who issued NPDES discharge permits for the facility.

On behalf of the former workers and their families and some of the residents in the community, please consider this a petition to conduct an epidemiological study of the groups indicated in this fax.

B. Summary of Survey Findings

The simple nature of the survey form, the confusion and complexity of the toxic exposures to this group and the subjectivity in understanding some of the responses to survey questions makes for difficult survey analysis. Nevertheless, the 14 completed forms show that:

1. 85% felt the FDH presentation was very good in its clarity and answers to questions.
2. 57% felt the presentations helped very well what to expect and the remaining 42% fell the presentation was mostly helpful in knowing what to expect.
3. 72% indicated breathing or respiratory problems were their chief concern. There was a small (7-14%) number that indicated diverse concerns about eye problems, skin irritation, headaches, back pain, nervousness, difficulty swallowing, weak legs, chest pains and high blood pressure.

FLORIDA DEPARTMENT OF HEALTH

Florida Department of Health
Bureau of Environmental Epidemiology

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Concerns, Questions and Comments

About the Kerr-McGee Hazardous Waste Site in Jacksonville FL

Your comments about the Florida Department of Health's part of today's presentation:

1. The presenters were clear and answered questions. [✓ Very Good] Mostly Some Not at all
2. I now know a lot more about what to expect. [✓ Very Well] Mostly Some Not at all
3. I now understand that many agencies, with different Jobs will be working on this site. [✓ Very Well] Mostly Some Not at all

My health concerns are Breathing

My other concerns: People are still working and ground is still Contaminated

Other things I would like to know about this site or the agencies working on it:

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site:

Your Phone [redacted] *E-mail*
Name [redacted]
Address

FLORIDA DEPARTMENT OF HEALTH

Florida Department of Health
Bureau of Environmental Epidemiology

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Concerns, Questions, and Comments

[illegible] Hazardous Waste Site in Jacksonville, Fla.

Your comments about the Florida Department of Health's part of today's presentation:

1. The presenters were clear and answered questions. [✓ Very Good] Mostly Some Not at all
2. I now know a lot more about what to expect. [✓ Very Well] Mostly Some Not at all
3. I now understand that many agencies, with different Jobs will be working on this site. [✓ Very Well] Mostly Some Not at all

My health concerns are

Working there at that Plant I don't Know What I may have come in Contact with. That may be Now affecting me or my family Members.

My other concerns:

Other things I would like to know about this site or the agencies working on it:

What are Some of the things that can now be done for the families?

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site:

Your Ph[redacted] *E-mail*
Name [redacted]
Address

FLORIDA DEPARTMENT OF HEALTH

Florida Department of Health
Bureau of Environmental Epidemiology

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Concerns, Questions, and Comments

About the Kerr-McGee Hazardous Waste Site in Jacksonville, FL

Your comments about the Florida Department of Health's part of today's presentation:

1. The presenters were clear and answered questions.	[✓ Very Good]	Mostly	Some	Not at all
2. I now know a lot more about what to expect.	Very Well	[✓ Mostly]	Some	Not at all
3. I now understand that many agencies, with different Jobs will be working on this site.	[✓ Very Well]	Mostly	Some	Not at all

My health concerns are NERVOUS; SPITTING blood; chest PAINS; SHORTNESS OF BREATH; WEAKNESS; CONFUSE; SWELLING (BODY FLUID).

My other concerns:

How do I get compensated for conditions;
How long will it take;
What are my option

Other things I would like to know about this site or the agencies working on it:
When will the information be release to us, (written info), concerning the hazardous waste, and does this include the ships we worked.

If you would like for your personal [redacted] **tion, please write his name and address (at least the city) here:**

If you would like to be on our mailing

Your Phone [redacted] *E-mail*
Name
Address [redacted]

FLORIDA DEPARTMENT OF HEALTH

Florida Department of Health
Bureau of Environmental Epidemiology

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

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3. I now understand that many agencies, with different Jobs will be working on this site.	[✓ Very Well]	Mostly	Some	Not at all

My health concerns are Shortness of breath and pain around the waist.

My other concerns:
That I have been exposed to asbestos And the fact that
it was really dusty. And it is hard to breathe at nite
while sleeping

Other things I would like to know about this site or the agencies working on it:
When will it be completed.

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site:

Your Pho[redacted] *E-mail*
Name
Address

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3. I now understand that many agencies, with different Jobs will be working on this site. [✓ Very Well] Mostly Some Not at all

My health concerns are Breathing

My other concerns:

Other things I would like to know about this site or the agencies working on it:

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here:

If you would like to be on our mailing list for materials on this site:

Your Phone [redacted] *E-mail*
Name [redacted]
Address [redacted]
[redacted]

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3. I now understand that many agencies, with different Jobs will be working on this site. [✓ Very Well] Mostly Some Not at all

My health concerns are My Breathing
I have shorting of the Breath

My other concerns:

how will it ~~if~~ effect my heath
And other

Other things I would like to know about this site or the agencies working on it:

is it still danger And Danger to others

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site:

Your Phone [redacted] mail
Name
Address

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2. I now know a lot more about what to expect. Very Well [✓ Mostly] Some Not at all
3. I now understand that many agencies, with different Jobs will be working on this site. Very Well [✓ Mostly] Some Not at all

My health concerns are High Blood Kinney & Liver Lunga Dibeted & Nervest, and Eye sites.

My other concerns: I wark When It wae Wilson Toymer about 10 years ago. I had my Left Foot and ankle removed about Eight years ago.

Other things I would like to know about this site or the agencies working on it:

yes I Would like to know.

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site: [redacted]

Your Pho[redacted] *E-mail*
Name [redacted]
Address [redacted]

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2. I now know a lot more about what to expect.	Very Well	[✓ Mostly]	Some	Not at all
3. I now understand that many agencies, with different Jobs will be working on this site.	Very Well	[✓ Mostly]	Some	Not at all

My health concerns are: Respretory Difficult Breathing
Eye problems

My other concerns: [illegible] Heath is a concern And to make sure this area is Cleaned up

Other things I would like to know about this site or the agencies working on it:
How to overcome what issues that arises from this Heath issue

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site:

Your Phone [redacted] E-mail
Name [redacted]
Address [redacted]

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2. I now know a lot more about what to expect.	Very Well	[✓ Mostly]	Some	Not at all
3. I now understand that many agencies, with different Jobs will be working on this site.	[✓ Very Well]	Mostly	Some	Not at all

My health concerns are IF TheSe MaTerialS have AFFected my body In any way because I worked There a many days and nights

My other concerns: How Toxic The Site IS

Other things I would like to know about this site or the agencies working on it:
Every Thing

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here [redacted]

If you would like to be on [redacted]

Your Phone [redacted] E-mail
Name [redacted]
Address [redacted]

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HEALTH

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3. I now understand that many agencies, with different Jobs will be working on this site. Very Well Mostly [✓ Some] Not at all

My health concerns are My MAin Health Concern IS The Enhalement of ContaminateD DUST OR AIR — Also Skin Contact With ContaminAnt That Go Through the Skin

My other

TISSUES OF my Body Might Be ContaminateD

Other things I would like to know about this site or the agencies working on it:

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site:

Your Phon[redacted] E-mail
Name
Address

HEAL I

Concerns, Questions and Comments

About the Kerr-McGee Hazardous Waste Site in Jacksonville, FL

1. The presenters were clear and answered questions. [✓ Very Good] Mostly Some Not at all
2. I now know a lot more about what to expect. [✓ Very Well] Mostly Some Not at all
3. I now understand that many agencies, with different Jobs will be working on this site. [✓ Very Well] Mostly Some Not at all

My health concerns are Breathing + Swalling it hard For Me to swolow

My other concerns: How will it Affect my Health concerning said site

Other things I would like to know about this site or the agencies working on it:

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here:

If you would like to be on our mailing list for materials on this site:

Your Phone [redacted] *E-mail*
Name
Address

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3. I now understand that many agencies, with different Jobs will be working on this site. [✓ Very Well] Mostly Some Not at all

My health concerns are Headache, back pain, legs weak and neck pain. And that I may have worked with [illegible]

My other concerns:
Everything that [illegible], I would like to know the [illegible]

Other things I would like to know about this site or the agencies working on it:
Every thing that concerns. And what all I may have come in contact with.

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site:

Your Phone [redacted] *E-mail*
Name
Address [redacted]

Florida Department of Health
Bureau of Environmental Epidemiology

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AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

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3. I now understand that many agencies, with different Jobs will be working on this site. [✓ Very Well] Mostly Some Not at all

My health concerns are I ~~[illegible]~~ LAWRENCE FIELDS Have some Breathing problems. The cause of my breathing problems may come From being Expose To that site. During the 1966-ETC.

My other concerns:
Are There are others working in that site Now.
I would like to know if that site is Hazardous.

Other things I would like to know about this site or the agencies working on it:
How is the overseer over the site.

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here:

If you would like to be on our mailing list for materials on this site:

Your Phone [redacted] *E-mail*
Name [redacted]
Address [redacted]

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3. I now understand that many agencies, with different Jobs will be working on this site. [✓ Very Well] Mostly Some Not at all

My health concerns are Respretory
Difficult Breathing
Eye problems

My other concerns: Health is a concern
and to make sure this
area is cleaned up.

Other things I would like to know about this site or the agencies working on it:

How to over come what issues
that arise from this Health issue

If you would like for your personal doctor to get our information, please write his name and address (at least the city) here: [redacted]

If you would like to be on our mailing list for materials on this site: [redacted]

Your Phone [redacted] *E-mail*
Name [redacted]
Address

APPENDIX F

ATSDR GLOSSARY OF ENVIRONMENTAL HEALTH TERMS

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption - The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute - Occurring over a short time [compare with **chronic**].

Acute exposure - Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure**].

Additive effect- A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with **antagonistic effect** and **synergistic effect**].

Adverse health effect - A change in body function or cell structure that might lead to disease or health problems.

Aerobic.-.Requiring oxygen [compare with **anaerobic**].

Ambient.-.Surrounding (for example, *ambient* air).

Anaerobic.-.Requiring the absence of oxygen [compare with **aerobic**].

Analyte - A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study - A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect - A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with **additive effect** and **synergistic effect**].

Background level - An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation - Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study - A study that uses (a) **biomedical testing** or (b) the measurement of a substance [an **analyte**], its **metabolite**, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see **exposure investigation**].

Biologic monitoring - Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake - The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing - Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota - Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden - The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP - See **Community Assistance Panel.**

Cancer - Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk - A theoretical risk of for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen - A substance that causes cancer.

Case study - A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study - A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number - A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system - The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**]

Chronic - Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure - Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Cluster investigation - A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP) - A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV) - Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) - CERCLA, also known as **Superfund**, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration - The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant - A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect - A disease or injury that happens as a result of exposures that might have occurred in the past.

Dermal - Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact - Contact with (touching) the skin [see **route of exposure**].

Descriptive epidemiology - The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit - The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention - Measures used to prevent a disease or reduce its severity.

Disease registry - A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD - United States Department of Defense.

DOE - United States Department of Energy.

Dose (for chemicals that are not radioactive) - The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals) - The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship - The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media - Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism - Environmental media include water, air, soil, and **biota** (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

EPA - United States Environmental Protection Agency.

Epidemiologic surveillance - The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Epidemiology - The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure - Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure assessment - The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction - A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation - The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway - The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching), and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Exposure registry - A system of ongoing follow up of people who have had documented environmental exposures.

Feasibility study - A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS) - A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds - Training sessions for physicians and other health care providers about health topics.

Groundwater - Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with **surface water**].

Half-life ($t_{½}$) - The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard - A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat) - The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste - Potentially harmful substances that have been released or discarded into the environment.

Health consultation - A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Health education - Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation - The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to estimate the possible association between the occurrence and exposure to hazardous substances.

Health promotion - The process of enabling people to increase control over, and to improve, their health.

Health statistics review - The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard - The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence - The number of new cases of disease in a defined population over a specific time period [contrast with **prevalence**].

Ingestion - The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation - The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure - Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

In vitro - In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with **in vivo**].

In vivo - Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with **in vitro**].

Lowest-observed-adverse-effect level (LOAEL) - The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring - A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism - The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite - Any product of **metabolism**.

mg/kg - Milligram per kilogram.

mg/cm^2 - Milligram per square centimeter (of a surface).

mg/m^3 - Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration - Moving from one location to another.

Minimal risk level (MRL) - An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

Morbidity - State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality - Death. Usually the cause (a specific disease, condition, or injury) is stated.

Mutagen - A substance that causes **mutations** (genetic damage).

Mutation - A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL) - EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard - A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL) - The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard - A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see **National Priorities List for Uncontrolled Hazardous Waste Sites**]

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how the body changes it, and how it leaves the body.

Pica - A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume - A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure - The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population - A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP) - A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb - Parts per billion.

ppm - Parts per million.

Prevalence - The number of existing disease cases in a defined population during a specific time period [contrast with **incidence**].

Prevalence survey - The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention - Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public comment period - An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session - An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action - A list of steps to protect public health.

Public health advisory - A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA) - An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Public health hazard - A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or **radionuclides** that could result in harmful health effects.

Public health hazard categories - Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are **no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard**, and **urgent public health hazard.**

Public health statement - The first chapter of an ATSDR **toxicological profile**. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public meeting - A public forum with community members for communication about a site.

Radioisotope - An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide - Any radioactive isotope (form) of any element.

RCRA [See **Resource Conservation and Recovery Act (1976, 1984)**]

Receptor population - People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD) - An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry - A systematic collection of information on persons exposed to a specific substance or having specific diseases [see **exposure registry** and **disease registry**].

Remedial Investigation - The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA) - This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA - RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD - See **reference dose.**

Risk - The probability that something will cause injury or harm.

Risk reduction - Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication - The exchange of information to increase understanding of health risks.

Route of exposure - The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Safety factor [see uncertainty factor]

SARA [see **Superfund Amendments and Reauthorization Act**]

Sample - A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size - The number of units chosen from a population or environment.

Solvent - A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination - The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Special populations - People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder - A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics - A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance - A chemical.

Substance-specific applied research - A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's **toxicological profiles**. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund Amendments and Reauthorization Act (SARA) - In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water - Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].

Surveillance [see **epidemiologic surveillance**]

Survey - A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see **prevalence survey**].

Synergistic effect - A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see **additive effect** and **antagonistic effect**].

Teratogen - A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent - Chemical or physical (for example, radiation, heat, cold, microwaves) agents which, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile - An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology - The study of the harmful effects of substances on humans or animals.

Tumor - An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor - Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Urgent public health hazard - A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs) - Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:

Environmental Protection Agency	http://www.epa.gov/OCEPAterms/
National Center for Environmental Health (CDC)	http://www.cdc.gov/nceh/dls/report/glossary.htm
National Library of Medicine	http://www.nlm.nih.gov/medlineplus/dictionaries.html

CERTIFICATION

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

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

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