ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

ROYAL OAKS COMMUNITY
EDGEWATER, VOLUSIA COUNTY, FLORIDA
EPA FACILITY ID: FLN000407257
OCTOBER 6, 2004

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

PUBLIC HEALTH ASSESSMENT

ROYAL OAKS COMMUNITY

EDGEWATER, VOLUSIA COUNTY, FLORIDA

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Prepared by:

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

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Foreword

This document summarizes public health concerns at a former excavation pit that was filled with debris and converted to a residential community in Florida. The following steps are necessary to perform a public health assessment—

1. Evaluate exposure: First, Florida Department of Health (DOH) scientists review available information about environmental conditions at the site. Their 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 environmental sampling data. Florida DOH relies on information provided by the Florida Department of Environmental Protection (DEP), U.S. Environmental Protection Agency (EPA), and other government agencies, businesses, and the public.

2. Evaluate health effects: If evidence exists that people are exposed or could be exposed to hazardous substances, Florida DOH scientists will determine whether that exposure could be harmful to human health. The report focuses on the health impact on the community as a whole and is based on existing scientific information.

3. Develop 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. However, if an immediate health threat exists, Florida DOH will issue a public health advisory to warn people of the danger and will work to resolve the problem.

4. Solicit community input: The evaluation process is interactive. Florida DOH solicits and evaluates information from various government agencies, the organizations responsible for cleaning up the site, and the community surrounding the site. Any conclusions about the site are shared with the groups and organizations that provided 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 Royal Oaks community hazardous waste site is a residential community (manufactured housing) of about24-acres with 31 residents, including six children aged 10 to 15 years. The property is west of Mango Tree Drive, just south of West Park Avenue in Edgewater, Volusia County, Florida. From December 2000 until July 2002, metal drums and pails believed to have contained paint, solvents, and paint-related products were excavated, stockpiled, or disposed of, along with contaminated soil and water associated with the buried waste in the Royal Oaks community. As a result of these activities, exposures to contaminants in the air, soil, and water might have occurred in the past.

The U.S. Environmental Protection Agency (EPA) asked the Florida Department of Health (DOH) if chemicals from the Royal Oaks community excavation presented a public health threat. Florida DOH evaluated this threat during excavation and removal activities in 2000 and 2001. Residents were concerned about potential cancer in the Royal Oaks community and possible exposure to arsenic- and lead-contaminated dust and to contaminated drinking water. Levels of metals, especially arsenic and lead, were below health-based screening levels and were not likely to present a health hazard. None of the identified contaminants of concern in the Royal Oaks community are known human carcinogens.

Based on the available data, Florida DOH selected four chemicals as contaminants of concern: ethylbenzene, toluene, trimethylbenzene, and xylene. Levels of these volatile organic compounds (VOCs) were above health-based screening levels in the excavation during cleanup activities. Between December 2000 and July 2001, while excavation and removal actions were underway, community residents might have been exposed to airborne VOCs and to contaminated sediment in the form of dust. Exposure to dust could have been by inhalation and, secondarily, by accidental ingestion (i.e., touching dusty surfaces and then incidentally ingesting the dust).

People who inhaled airborne VOCs near the excavation pit are unlikely to experience any noncancerous health effects at the level measured by the EPA in October 2001 after excavation ceased. However, residents might have been exposed to higher concentrations of VOCs during excavation. Because no air monitoring took place during excavation, Florida DOH cannot determine the public health risk that was present at that time.

Little available data exists concerning human health effects (including cancer) after oral or dermal exposure to ethylbenzene, toluene, trimethylbenzene, and xylene. More health effects are known from long-term, low-level exposure to these chemicals from inhalation (breathing). However, because no air monitoring was performed during excavation, the public health risk from inhaling these chemicals during excavation and removal activities cannot be adequately determined. Therefore, this site has been identified as an Indeterminate Public Health Hazard for past exposures, and as a No Apparent Public Health Hazard for current and future exposures.

2.0 Purpose and Health Issues

The EPA asked the Florida DOH whether chemicals from the Royal Oaks community excavation presented a public health threat. The EPA based its request on residents' concerns and the possibility that contamination existed beneath some of the residences. The Florida DOH Bureau of Community Environmental Health prepared this report to respond to the EPA request. This public health assessment is the first evaluation of the site by either 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 exposures to chemicals at and near the Royal Oaks community site. The likelihood of these exposures to cause illnesses is then discussed, as is the need for additional actions to protect public health.

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

3.0 Background

3.1 Site History

The Royal Oaks community site is at 210 Mango Tree Drive in Edgewater, Volusia County, Florida (Figure 1). This 24-acre residential community consisted of 18 mobile homes, cleared lots, and undeveloped property (Figure 2). Approximately 31 persons lived in this community, including six children aged 10 years to 15 years old.

From 1962 to 1999, Hanson and McCallister, Inc. owned this site. The company had excavated large quantities of sand, creating a large borrow pit. The EPA reported that the pit was filled with land-clearing debris, tree stumps, and possibly construction debris.

In December 2000, utility workers installing underground lines discovered several 55-gallon metal drums and several 1-gallon paint cans buried under the southeastern portion of the site. The property owner's contractors uncovered more drums in extremely poor condition, containing sludge, solvents, and other paint-related chemicals (EPA 2001b). The Florida Department of Environmental Protection (DEP) tested the sludge from these drums and found that it contained lead and volatile organic compounds (VOCs).

In February 2001, the Florida DEP requested assistance from the EPA. In March 2001, the EPA conducted a geophysical survey to identify where additional drums might be buried. The EPA identified two locations. One location was on the southeast part of the site near where the drums were originally discovered. The other location was near the entrance to the site on Mango Tree Drive and consisted of nonhazardous buried debris.

In April and May 2001, the property owner's contractors excavated more soil on the southeast side of the site and underneath the driveway at a property on Towering Oaks Drive. They found additional 55-gallon drums and 1-gallon paint cans. Most of these drums were empty or rusted to the point of decomposition. Some of the drums appeared to be burned. The contractors also found

paint chips in the soil and intact, empty drums. They placed the drums and cans in an enclosed roll-off dumpster and fenced the area (Remediation Technologies Inc. 2001a).

In July 2001, the EPA assumed regulatory responsibility for site activities. The water-filled excavation pit bordered by Towering Oaks Way and Treaty Oak Way was several feet deep. Five manufactured homes were immediately adjacent to the excavated area. Some homes were less than 20 feet from the excavation. According to the EPA, other homes in the neighborhood could also have drums buried beneath them. The EPA reported residents were at risk of exposure to contaminants by inhalation, ingestion, and direct contact (EPA 2001b).

In September 2001, a resident reported flooding and a broken sewer line in the neighborhood. The site owner buried the broken sewer pipe. Three weeks later, the EPA notified the Florida DOH, which in turn notified the Volusia County Health Department (CHD).

In October 2001, residents reported odors, burning eyes, nausea, vomiting, headache, dizziness, and skin problems before and after excavation activities to the Florida DOH . Residents also reported cancer and cancer deaths. Residents reported vapors entered their homes during the excavation. They were concerned that their children were exposed to arsenic- and lead-contaminated dust. Residents reported that during excavation, dust covered their homes and cars and that they had tracked this dust indoors. During the Florida DOH site visit, a boat repair facility and aromatic vapors were noticed to the north of the site.

In October 2001, the EPA tested ambient air at the site for volatile organic compounds (VOCs). Water, soil, and sediment from the excavation pit were also tested. The EPA found elevated levels of the following VOCs in some of the buried waste: ethylbenzene, toluene, xylene, and 1,2,4-trimethylbenzene.

Residents were relocated between October 2001 and May 2002 by the U.S. Army Corps of Engineers, after the EPA became involved with the cleanup. Prior to EPA's involvement, the property owner's contractor performed some excavation activities until residents reported symptoms they believed to be associated with vapors from the excavation.

In 2001 and 2002, Florida DOH evaluated chemical contaminants on site and environmental samples from off the site. A Health Consultation was released in the Fall of 2002, and Florida DOH held a public meeting to discuss the findings and record community concerns.

In September 2002, the EPA issued its final pollution report (Final POLREP #5). This report detailed the removal and proper disposal of all known contaminated soil and groundwater from the site, as well as backfilling of the excavation pit with clean soil and reseeding with grass.

On September 3, 2003, Florida DEP issued a **No Further Action Approval** letter to the property owner, releasing the property owner from any further obligation to conduct corrective actions (cleanup). This letter does not certify that the entire site is clean, but states that no contamination above state standards is known to exist on the site (Appendix E).

In December 2003, Florida DOH prepared the final Public Health Assessment for this site. A site chronology is included in Appendix A.

3.2 Site Description

The 24-acre Royal Oaks community had 18 single-family, manufactured houses. Approximately 31 residents, including at least six children aged 10 years to 15 years, were located on Mighty Oak Circle, Towering Oaks Way, and Treaty Oak Way in Edgewater, Volusia County, Florida (Figure 2). Some residents had young relatives and grandchildren who visited the property. The surrounding population was on commercial, manufacturing, and undeveloped land, and additional residences were located to the southwest along Carol Ann Drive.

3.2.1 Demographics. The area within 1 mile of the site encompasses parts of six Census Bureau block groups in Volusia County. In 2000, approximately 3,700 people lived within 1 mile of the site. About 25% were younger than 18 years of age, and 22% were older than 65 years. Of the total population, 1% were black, 96% were white, 2% were Hispanic, and 1% were American Indians, Asians, and other racial/ethnic groups (U.S. Bureau of the Census 2000).

3.2.2 Land Use. The site is in a mixed-use area of Edgewater, Florida. Several midsized commercial and manufacturing facilities are adjacent to the property to the north and east. Land to the west consists of a community park and single-family residences on Carol Ann Drive. Land to the south is mostly undeveloped. Railroad tracks and U.S. Highway 1 are east of the property.

3.2.3 Natural Resource Use. The Royal Oaks community drinking water is supplied by 19 wells operated by the Utilities Commission, City of New Smyrna Beach (UCNSB). Seven wells are located at the Glencoe Road Water Treatment Plant site. Six additional wells are located west of the Glencoe Plant along S.R. 44. The remaining six wells are located on S.R. 44, 12.5 miles inland. Well depths range from 183 feet to 364 feet, with an average depth of 240 feet.

3.3 Site Visit

Beth Copeland, Community Involvement Coordinator with the Florida DOH Bureau of Community Environmental Health, visited the site on October 4 and 5, 2001. Her findings are included in the Community Health Concerns section (5.0) of this report. On November 8, 2001, Shaun Crawford and Randy Merchant, also with the Bureau of Community Environmental Health, visited the site and the surrounding area and conducted a walking survey of the site and the surrounding area. Jeff Sulzbach of the Volusia County Health Department was present. The Florida DOH Bureau of Community Environmental Health, Health Assessment Team, also visited the site during a public meeting held in September 2002.

According to EPA estimates, 31 residents lived near the site in 18 manufactured homes. One resident was displaced by cleanup activities in 2001, and one other moved after excavation began. Six children lived at the Royal Oaks community site.

In January and September 2002, the excavation site was surrounded by a chain link fence with locked gates and some wind screening. Large mounds of excavated soil and sediment were stockpiled within the fenced area and partially covered with tarpaulins. At least two roll-off containers were within the fenced area. No excavation or remedial action occurred on the days of

the site visits. According to local health department representatives and the EPA, the former excavation pit has been filled with clean soil.

4.0 Discussion

In this section, Florida DOH reviews the available site information (air, water, and soil data), including information on the chemical concentrations present in the air, soil, and water. Florida DOH determines whether the chemicals could affect people's health.

The public health assessment process has inherent uncertainties because, as discussed in New Jersey Department of Environment Protection 1990:

- Science is never 100% certain;
- The risk assessment process is inexact;
- Information on the site and on actions (and interactions) of chemicals is never complete; and
- Opinions differ on the implications of known information.

Florida DOH addresses these uncertainties in public health assessments by using health-protective assumptions when estimating or interpreting health risks. Florida DOH also uses wide safety margins when setting health-related threshold values. The assumptions, interpretations, and recommendations made throughout this public health assessment are conservative in the direction of protecting public health.

4.1 Environmental Contamination

This section examines environmental data collected at and near the site, sampling adequacy, and contaminants of concern. The maximum concentration and detection frequency for the contaminants of concern in the various media are also listed. Contaminants of concern are selected by considering the following factors:

1. *Contaminant concentrations on and off the site.* Contaminants are eliminated from further consideration when both the background and onsite concentrations are below health-based comparison values. Background concentrations are useful in determining if contaminants are site-related. This approach is necessary for assessing the public health risk of all contaminants detected, whether site-related or not.

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

3. *Community health concerns.*

4. *Comparison of maximum concentrations with published ATSDR standard comparison values to provide complete and potential exposure pathways.* The ATSDR's published standard comparison values are media-specific concentrations used to select contaminants for further evaluation. They are not used to predict health effects or to set cleanup levels. When ATSDR standard comparison values are absent, other regulatory guidelines can be used.

5. *Comparison of maximum concentrations with toxicological information published in ATSDR toxicological profile documents to provide complete and potential*

exposure pathways. These chemical-specific profiles summarize toxicological information found in scientific literature.

The following standard comparison values (ATSDR 2001 and Florida DEP 1999) were used to select contaminants of concern, in order of priority:

1. *Environmental Media Evaluation Guides (EMEGs).* The ATSDR derives EMEGs from their Minimal Risk Levels (MRLs) by using standard exposure assumptions, such as ingestion of 2 liters of water per day and body weight of 70 kg spell out first time used for adults. MRLs are estimates of daily human exposure, generally for 1 year or longer, to a chemical likely to be without an appreciable risk of noncancerous illnesses.

2. *Reference Dose Media Evaluation Guides (RMEGs).* The ATSDR derives RMEGs from the EPA's Reference Dose (RfD), using standard exposure assumptions. RfDs are estimates of daily human exposure to a chemical not likely to have an appreciable risk of noncancerous illness. Exposure estimates are generally for 1 year or longer.

3. *Cleanup Target Levels (CTLs).* CTLs are the Florida DEP's minimum allowable concentrations of contaminants in soil (SCTLs) and groundwater (GCTLs). Florida DEP CTLs are enforceable and are required to be equal to or lower than federal standards. Florida DEP CTLs were used because the ATSDR does not have a standard for lead, mercury, butylbenzene, isopropyltoluene, and trimethylbenzenes in soil or water.

Using the components and criteria listed above, four chemicals were selected as contaminants of concern: ethylbenzene, toluene, trimethylbenzene, and xylene. Only the ATSDR values and other standard comparison values, such as DEP CTLs, were used to select contaminants of concern for further consideration. Identification of a contaminant of concern in this section does not necessarily mean that exposure will cause illness. Rather, identification serves to narrow the focus of the public health assessment to those contaminants most important to public health. The contaminants of concern are evaluated in subsequent sections and determined whether exposure is likely to cause illness.

This public health assessment first discusses the contamination that exists on the site and then the contamination that occurs off the site. "Onsite" is the area within the Royal Oaks community property boundary, including the fenced excavation pit, and "offsite" is the area outside the Royal Oaks community property boundary, as shown in Figure 2, Appendix B.

4.1.1 Onsite Contamination

4.1.1.1 Onsite Groundwater (Pit Water). No onsite groundwater wells existed at the time of this public health assessment. For the purpose of this report, the water samples collected by EPA and Remtech from the excavation pit are referred to as groundwater samples. Pit water is the closest representative media for shallow groundwater beneath the site.

Pit-water sample results are summarized in Table 1, Appendix C. For this public health

assessment, the onsite groundwater (pit) samples are sufficient to characterize the onsite groundwater.

4.1.1.2 Onsite Soil/Sediment. EPA and Remtech tested surface soil, excavation stockpile soil, and sediment from the bottom of the excavation pit.

The results for onsite soil analyses are summarized in Table 2, Appendix C. Although measured contaminant levels in the excavation pit sediments are above comparison values (Table 3, Appendix C), residents are not exposed to onsite sediment contamination at the bottom of the excavation pit because public access is restricted. Public access to the pit was also restricted during cleanup activities. Although neither Florida DEP or EPA certify that all contaminated soil has been removed from the site, both agencies have declared that no further action or removal is necessary at this time. According to agency documents, all contaminated soil identified as associated with drum removal and disposal has been properly removed and disposed. For this public health assessment, soil samples have been adequately characterized.

4.1.1.3 Onsite Drinking Water. In November and December 2001, the Volusia County Health Department (CHD) tested onsite tap-water samples from six residences. The residential drinking water is supplied by the city of Edgewater and is presumably safe. Nevertheless, the Volusia CHD tested drinking-water samples because of a history of broken and rerouted water lines in the subdivision (due to contaminant excavation) and the demonstrated ability of volatile organic compounds (VOCs) to infiltrate pressurized water lines.

Analyses of samples from the public drinking water supply did not show the presence of site-related contaminants. Thus, Florida DOH concludes that for this public health assessment, onsite drinking water has been adequately tested. The lead level in water collected from outside hose spigots at two homes on the site was slightly above the drinking- water standards. The source of the lead was most likely the brass fittings inside the spigot. The testing of drinking water from inside these homes detected no lead.

4.1.1.4 Ambient Air. In October 2001, EPA tested ambient air around the onsite excavation pit using a portable air-monitoring instrument.

The results for ambient-air analyses are summarized in Table 4, Appendix C. Because the portable air-monitoring instrument is not accurate for all chemicals and because air-sampling data are absent for the period when active excavation occurred, past ambient air quality was not adequately characterized for this public health assessment.

4.1.2 Offsite Contamination

4.1.2.1 Offsite Groundwater. Most of the area surrounding the site is supplied with municipal water. In November 2001, the Volusia CHD sampled six private wells on Carol Ann Drive to the west and southwest of the site. The Florida DOH Laboratory analyzed these samples for volatile organic compounds (VOCs) and metals.

Analyses of samples from these wells did not show the presence of site-related contaminants. A lack of onsite and offsite shallow groundwater samples at the time of this public health

assessment prevented adequate characterization of offsite groundwater. However, for this public health assessment, offsite groundwater contamination has been adequately characterized. After additional groundwater sampling, EPA and Florida DEP released the site from additional testing.

4.1.3 Quality Assurance and Quality Control. Existing environmental data have been used to prepare this public health assessment. These data are assumed valid because government consultants or consultants overseen by government agencies collected and analyzed the environmental samples. It is further assumed that consultants who collected and analyzed these samples followed adequate quality-assurance and quality-control measures concerning chain-of-custody, laboratory procedures, and data reporting.

The completeness and reliability of the referenced information determine the validity of the analyses and conclusions drawn for this public health assessment. In each of the preceding onsite and offsite contamination subsections, the adequacy of the data was evaluated to estimate exposures. The estimated data and presumptive data were assumed valid because of the qualifications of the sampling agency and the analytical laboratory. This assumption is protective of public health by assuming that a contaminant exists when in fact it might not exist.

4.2 Physical Hazards

During the November 2001 site visit, DOH staff noted that the water-filled excavation pit could be a drowning hazard if the pit was accessible. The excavation pit and related materials were enclosed by a chain-link fence with locked gates. Since that time, the excavation pit was filled and the fence removed.

4.3 Pathways Analyses

Chemical contaminants in the environment can harm people's health, but only if people have contact with those contaminants at a high enough concentration (dose) to cause a health effect. Knowing or estimating the frequency with which people could have contact with hazardous substances is essential to assessing the public health importance of these contaminants.

To decide if people can contact contaminants at or near a site, DOH looks at the human exposure pathways. An exposure pathway has five parts. These parts are:

1. a source of contaminants;
2. an environmental medium that can hold or move the contamination, such as, air, water, or soil;
3. a point at which people can come in contact with a contaminated medium, such as, in drinking water or in garden soil;
4. an exposure route, such as, drinking contaminated water from a well or eating contaminated soil on homegrown vegetables; and
5. a population who could come in contact with the contaminants.

An exposure pathway is eliminated if at least one of the five parts is missing and will not occur in the future. Exposure pathways are not eliminated if they are either completed or potential. For completed pathways, all five pathway parts exist and exposure to a contaminant has occurred, is occurring, or will occur. For potential pathways, at least one of the five parts is missing, but could exist. Also for potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

4.3.1 Completed Exposure Pathways. No known past, present, or future completed exposure pathways exist for the Royal Oaks community.

4.3.2 Potential Exposure Pathways. The following human exposure pathways are considered to be potential (Table 5, Appendix C):

4.3.2.1 Airborne Contaminants. Between December 2000 and July 2001, residents could have inhaled VOCs in the air during excavation and removal activities.

4.3.2.2 Airborne Dust. Between December 2000 and July 2001, while excavation and removal actions were taken, community residents might have been exposed to sediment in the form of dust. Exposure might have been by inhalation and, secondarily, ingestion (touching dusty surfaces and incidentally ingesting the dust).

4.3.2.3 Groundwater (Pit Water). Although no groundwater data existed for the site, water-sample collection and analyses from the excavation pit supported the assumption that groundwater contamination existed. Exposure to contaminated groundwater by ingestion and dermal contact could have been a potential future exposure pathway if drinking water wells were installed in areas of groundwater contamination or if contaminated groundwater reached public or private water supply wells. However, the EPA and Florida DEP have determined that no further groundwater monitoring is necessary, due to cleanup activities and the lack of identified contamination. No evidence exists of past exposures to groundwater contamination at the Royal Oaks community site.

4.4 Public Health Implications

People who inhaled airborne ethylbenzene or toluene near the excavation pit are unlikely to experience any noncancerous health effects at the level measured by the EPA in October 2001 after excavation ceased. However, residents might have been exposed to higher concentrations of VOCs during excavation. Because no air monitoring took place during excavation, Florida DOH cannot determine the public health risk.

Few data are available concerning human health effects, including cancer, after oral or dermal exposure to ethylbenzene, toluene, trimethylbenzene, and xylene. More information is known about the likely health effects from long-term, low-level exposure to these chemicals from inhalation (breathing). However, because no air monitoring took place during excavation, the public health risk from inhaling these chemicals during excavation and removal activities cannot be adequately determined.

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

Evaluation of exposure requires estimation of the daily dose of each contaminant of concern found at the site. Kamrin (1988) explains a dose in this manner:

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

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

Milligrams of contaminant per kilogram of body weight per day (mg/kg/day) were used to express the daily dose. A milligram is about the weight of a raisin or a paper clip, and a kilogram is about 2 pounds.

Standard assumptions about body weight, ingestion and inhalation rates, exposure time length, and other factors needed for dose calculation were used to calculate the daily dose of each contaminant (ATSDR 1992). The calculation of the dose assumed that people are exposed to the maximum concentration measured for each contaminant in each medium (Appendix C; Table 7). Florida DOH uses the maximum concentration of each contaminant until sufficient data are available to calculate a mean, median, mode, or other measure of central tendency.

To estimate exposure from incidental ingestion of contaminated soil, Florida DOH made the following assumptions: (1) children between the ages of 1 year and 6 years ingest an average of 200 milligrams (mg) of soil per day, (2) adults ingest an average of 100 milligrams of soil per day, (3) children weigh an average of 15 kilograms (kg), (4) adults weigh an average of 70 kg, and (5) children and adults ingest soil at the maximum concentration measured for each contaminant.

To estimate possible future exposure from drinking contaminated groundwater, Florida DOH made the following assumptions: (1) children between the ages of 1 year and 6 years ingest an average of 1 liter of water per day, (2) adults ingest an average of 2 liters of water per day, (3) children weigh an average of 15 kilograms (kg), (4) adults weigh an average of 70 kg, and (5) children and adults ingest contaminated groundwater at the maximum concentration measured for each contaminant.

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

4.4.1.1 Ethylbenzene. People who inhaled ethylbenzene vapors near the excavation pit are unlikely to experience any noncancerous health effects at the level measured by the EPA in October 2001 after excavation ceased. Residents might have been exposed to higher ethylbenzene concentrations during excavation. Because no air monitoring took place during excavation, the public health risk during excavation and removal activities cannot be determined.

Insufficient evidence exists to suggest whether ethylbenzene is a carcinogen in humans (ATSDR 1999).

4.4.1.2 Toluene. People who inhaled toluene vapors near the excavation pit are unlikely to experience any noncancerous health effects at the level measured by the EPA in October 2001 after excavation ceased. Residents might have been exposed to higher toluene concentrations during excavation. Because no air monitoring took place during excavation, the public health risk during excavation and removal activities cannot be determined.

Toluene was not detected in water samples. For children exposed by ingestion or dermal contact to drum sediment containing toluene, no increased risk would exist for noncancerous health effects. The exposure level was below the Lowest Observed Adverse Effect Level (LOAEL) for acute and intermediate exposures for animals.

There is insufficient evidence to suggest whether exposure to toluene vapors can cause cancer in animals. No studies were located regarding carcinogenic effects in humans after oral or dermal exposures to toluene (ATSDR 2000).

4.4.1.3 Trimethylbenzene (TMB). For the purpose of this public health assessment, only 1,2,4-trimethylbenzene (1,2,4-TMB) is evaluated for potential health effects because 1,2,4-TMB occurs at this site in greater concentrations than 1,3,5-TMB. Also, 1,2,4-TMB is more toxic than 1,3,5-TMB, and most of the health research is based on 1,2,4-TMB.

Insufficient toxicological research exists to permit determination of whether the levels of 1,2,4-trimethylbenzene found at this site are likely to cause illness. Similarly, insufficient evidence exists to suggest whether exposure to trimethylbenzene by inhalation, ingestion, or dermal contact can cause cancer in humans.

4.4.1.4 Xylene. It is unknown if people inhaled xylene vapors near the excavation pit before excavation ceased. The EPA in October 2001 found no xylene vapors in air samples collected after excavation ceased. Because no air monitoring took place during excavation, the public health risk cannot be determined.

According to ATSDR, no studies were located regarding carcinogenic effects in humans after inhalation and oral exposures to mixed xylenes. Only limited evidence suggests that xylene could be a promoter for skin cancer and could also act as an initiator or carcinogen by dermal exposure (ATSDR 1995).

4.4.2 Risk of Illness, Dose Response/Threshold and Uncertainty. Appendix D discusses limitations on estimating the risk of illness, the theory of dose response, and the concept of

thresholds. Also, Appendix D discusses the sources of uncertainty inherent in public health assessments.

4.5 Children and Other Unusually Susceptible Populations

4.5.1 Children. Before birth, children are forming body organs that need to last a lifetime. Because some contaminants cross the placental barrier, the mother's exposure to chemicals can cause the fetus to be exposed. During fetal growth, exposure could lead to injury or illness, causing malformation of organs (teratogenesis), disruption of function, or premature death.

After birth, the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Children could be at greater risk than adults from exposure to hazardous substances emitted from waste sites. Children are more likely to be exposed because they play outdoors, and because they can bring food into contaminated areas. Children are shorter than adults and can breathe dust, soil, and heavy vapors close to the ground. Pound for pound of body weight, children drink more water, eat more food, and breathe more air than do adults. Therefore, children can have much greater "doses" than adults of contaminants that are present in soil, water, and air (ATSDR 1998). Some contaminants at the Royal Oaks site that could have affected children include:

Ethylbenzene	Gaseous ethylbenzene is heavier than air, and children generally spend more time on the floor or ground than do adults. Whether children would be different from adults in their weight-adjusted intake of ethylbenzene is currently unknown;
Toluene	Gaseous toluene is heavier than air, and because young children are closer to the ground or floor because of their height, they can breathe more toluene than adults during accidental exposures. Older children and adolescents could be exposed to toluene if they breathe household products containing toluene to obtain a so-called "high;"
Xylene	Xylene exposure symptoms for children are expected to be similar to those for adults. Ingestion of aspirin is likely to speed up the adverse effects of xylene in both the expectant mother and the fetus;
TMB	Too little is known about TMB (trimethylbenzene) to determine whether children are any more susceptible to exposure than are adults.

For children who lived on the site, exposure to these chemicals could have occurred by exposure to airborne contaminants and dust during excavation activities. However, since air monitoring was not conducted during excavation and removal activities, it is not known if any of these contaminants were present at levels that could have caused adverse health effects. Air monitoring after the excavation and removal activities were completed did not indicate these contaminants were present at levels where adverse health effects could have been likely.

The children living at Royal Oaks have been tested for lead in their blood, and no elevated blood lead levels were found. The results of this blood lead testing are given in a separate health consultation produced by the Florida DOH (2003).

4.5.2 **Other Unusually Susceptible Populations.** A susceptible population has different or enhanced responses to a toxic chemical than most people exposed to the same levels of that chemical in the environment. Reasons include genetic makeup, age, health, nutritional status, and exposure to other toxic substances (i.e., cigarette smoke or alcohol). These factors can limit the ability to detoxify or excrete harmful chemicals or could increase the effects of damage to organs or systems in the body. The following is not an exhaustive list, and it only reflects currently available data:

Ethylbenzene Ethylbenzene exposure of individuals with impaired pulmonary function has been shown to worsen symptoms. Individuals with liver or kidney disease might be more susceptible to ethylbenzene toxicity, as would persons taking medications or other drugs that are known hepatoxins. Persons with dermatitis or other skin diseases could be at greater risk because ethylbenzene is a defatting agent that could aggravate these symptoms.

Toluene Toluene metabolism can be affected by environmental and genetic factors. Chronic consumers of alcohol or people taking medications that interfere with toluene metabolism could be more susceptible. Ethnic variations in enzyme efficiency are known to exist. Individuals with pre-existing defects in heart rhythm, asthma, or other respiratory difficulty might be at an increased risk from toluene exposure.

Xylene Xylene exposure of individuals with subclinical and clinical epilepsy, renal, hepatic, or cardiac disease could be more susceptible to the effects of xylene. People with respiratory diseases, such as asthma, could potentially be at risk after inhalation exposure. The bioavailability of dermally absorbed xylene adsorbed to clay soils is greater than the bioavailability of dermally absorbed pure xylene. For females, toxicokinetic studies have shown that the bioavailability of xylene absorbed to soil is greater than when xylene is ingested alone.

TMB Little dose/response information exists regarding TMB (trimethylbenzene). For the purpose of this public health assessment, it is assumed that persons with compromised respiratory, renal, hepatic, and cardiac systems will be more susceptible to TMB exposure than those in the general population.

Because air monitoring was not conducted during excavation and removal activities, it is not known if any of these contaminants were present at levels where adverse health effects may have been likely. Air monitoring after the excavation and removal activities were complete did not indicate these contaminants were present at levels where adverse health effects could have been likely.

5.0 Community Health Concerns

On October 4 and 5, 2001, Beth Copeland of the Florida DOH visited the Royal Oaks community property and spoke with residents at an EPA-sponsored community meeting. She recorded questions and concerns from community residents. The EPA also reported some community health concerns to the Florida DOH.

Concern: **Are lead and arsenic, especially in dust at our homes, a problem for us and our children?**

Response: Although there are no air samples for arsenic- or lead-contaminated dust, the very low concentrations of arsenic and lead in the soil are unlikely to result in unhealthy dust levels.

Concern: **Are the foods (tomatoes and citrus fruit) we grow safe to eat?**

Response: The level of contaminants found at this site is not likely to concentrate to unhealthy levels in homegrown fruit or vegetables. Washing fruits and vegetables is recommended but not necessary.

Concern: **Water lines in the park have been broken and replaced in the past. Can contaminants get into these lines?**

Response: The Volusia CHD tested drinking water in the Royal Oaks community. Heavy metals and volatile organic compounds (VOCs) were well below the maximum contaminant level (MCL) and are safe for human consumption. Two samples collected from hose bibs (spigots) outside the residences indicated a level of lead slightly higher than the MCL. Elevated levels of lead in outside hose spigots are probably the result of lead leaching out of brass fittings in the faucet assembly. Thus, residents should not drink from outside hose spigots.

Concern: **Many residents have experienced unusual nausea, vomiting, headaches, dizziness, and skin rashes, especially when digging was going on, and bad smells and dust were in the air. Could the excavation of the waste be causing or contributing to these symptoms?**

Response: These symptoms could be caused by exposure to volatile organic compounds (VOCs). It is possible that residents were exposed to VOCs. Because no air monitoring was done at the time of active excavation, DOH cannot determine if VOCs caused these symptoms. The Florida DOH recommends monitoring for VOCs during any future digging.

Concern: Some residents are concerned about the number of cancers and cancer deaths in the Royal Oaks community.

Response: When all types of cancer are considered collectively, cancer is not a rare disease. In the United States, one of three people will develop some type of cancer during their lifetime. One of four people will die of some type of cancer. Not enough evidence exists to determine whether the chemicals of concern at this site cause cancer. However, the Florida DOH will review additional environmental data when the information becomes available.

Concern: Some residents are concerned that their children were exposed to arsenic- and lead-contaminated dust.

Response: Although there are no air samples for arsenic- or lead-contaminated dust, the very low concentrations of arsenic and lead in the soil are unlikely to result in unhealthy dust levels. Florida DOH conducted an exposure investigation of children and found no elevated levels of blood lead in Royal Oaks community children (2003).

On September 12, 2001, the Florida DOH held a public meeting at the Edgewater Community Center to explain the findings and to record additional questions and concerns from community residents. The following issues were raised and addressed.

Concern: Are any contaminants migrating off the site?

Response: To date, soil and groundwater testing have not shown offsite migration.

Concern: Why has it taken 2 years to do well monitoring?

Response: Up to the point that well monitoring was done, there was no reason to suspect that wells might be impacted by the contamination (i.e., no complaints of smell, taste, color, etc.). The wells that were monitored were located offsite. Drinking water near the excavation was supplied by the city and was tested and shown to be safe to drink from inside taps. Testing of the wells offsite also showed the drinking water to be safe to drink.

Concern: Why weren't people tested during excavation?

Response: Prior to Florida DOH's involvement in the project, no indication existed that residents might be exposed to contaminants in the excavation. Only after determining the existence of an exposure pathway did it become apparent that residents might be exposed to dust and vapors. The types of contaminant vapors found in the excavation do not stay in the body long, and they were at levels low enough that they would be unlikely to be found in blood or urine tests. Children were tested for lead in blood, and the measurements were lower than CDC's guidance level for blood lead (Florida DOH Exposure Investigation 2003).

Concern: **Did the children's blood lead levels show higher lead levels than children 3 to 4 miles away from the site?**

Response: The blood lead levels of the children at this site were all below CDC's guidance level of 10 micrograms per liter, and therefore are not likely to cause illness (Florida DOH Exposure Investigation 2003).

Concern: **What about the people who were there during excavation?**

Response: Prior to Florida DOH's involvement at the site, people may have been exposed to vapors and dust from the excavation. When Florida DOH was asked to help with the site, excavation had already ceased and there was no measurable activity or contamination that could have caused exposures to local residents.

Concern: **Mr. McAllister and RemTek took air samples during early excavation. What were the results?**

Response: Mr. McAllister took air samples, but these unofficial results could not be verified. Air sampling conducted by the EPA after excavation stopped showed levels of vapors in the air at safe levels.

Concern: **When will our lives get back to normal?**

Response: The Florida DOH has completed its investigation and has determined that the site is a **no apparent public health hazard** for current and future exposures. EPA has completed its excavation and contamination investigation. The Florida DEP has issued a **no further action approval** letter to the property owner, releasing the site from further investigation and cleanup at this time.

Concern:	**Can we get city water now through annexation? (From residents on Carol Ann Drive)**
Response:	This is an issue the residents should take up with their county and city representatives.
Concern:	**How often are the wells going to be tested?**
Response:	The Volusia County Health Department offered to test the drinking water wells on Carol Ann Drive every 4 to 6 months. However, the groundwater around the site has not been impacted. Therefore, no additional groundwater tests by government agencies are planned at this time.
Concern:	**How long is it going to take for everyone to complete work at Royal Oaks?**
Response:	The Florida DOH has completed its investigation and has determined that the site is a **no apparent public health hazard** for current and future exposures. The EPA has completed its contamination investigation. The Florida DEP has issued a No Further Action Approval letter to the property owner, releasing the site from further investigation and cleanup at this time.
Concern:	**Could children at the site be at risk of developing brain tumors as a result of exposure to contamination from the excavation?**
Response:	To date, the levels and types of contaminants identified on the Royal Oaks property have not been linked to brain tumors.

6.0 Conclusions

The Florida DOH categorizes the Royal Oaks community site as a **No Apparent Public Health** Hazard for current and future exposures, and an Indeterminate Public Health hazard for past exposures.

Currently, there is no apparent public health hazard for nearby residents. There is no current excavation activity or apparent site-related contamination. There are no known current completed exposure pathways that could cause adverse health effects in residents.

Assessing the probability of illness from past inhalation exposure to contaminated dust or airborne contaminants during excavation and removal activities is not possible because of the lack of air monitoring data during excavation.

7.0 Recommendations

No public health recommendations are necessary at this site.

8.0 Public Health Action Plan

This section describes what ATSDR and the Florida 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 hazards from occurring in the future. ATSDR and Florida DOH will do the following:

1. The Florida DOH, Bureau of Community Environmental Health will inform and educate nearby residents about the public health assessment of this site.
2. Florida DOH, Bureau of Community of Environmental Health will urge residents not to drink from outside hose spigots.

The conclusions and recommendations in this report are based on the information reviewed.

At a September 12, 2002 public meeting, Florida DOH provided nearby residents draft copies of this public health assessment and a summary fact sheet. Florida DOH also placed copies of this draft public health assessment report at the Edgewater City Hall, the public library, and on the Florida DOH web site. About 20 people submitted comments by the October 31, 2002 deadline.

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APPENDIX A. SITE CHRONOLOGY

CHRONOLOGY

Royal Oaks community

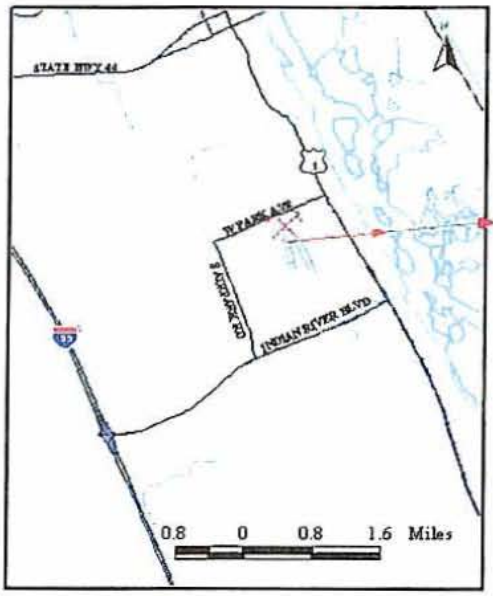
1962–1999	Property owned by an excavating company, Hanson & McAllister, Inc.
1975–1984	Site consists of an excavated sand borrow pit filled with construction debris.
December 2000	Utility workers installing underground lines discover several 55-gallon metal drums and 1-gallon paint cans buried on the southeastern portion of the property. The Florida Department of Environmental Protection (DEP) is contacted after a private contractor working for the property owner unearths more than 20 metal drums. The Florida DEP collects samples of sludge from the drums and has them analyzed for metals and volatile organic compounds (VOCs). Analysis shows that the sampled material contains VOCs and lead and is a characteristic hazardous waste.
February 2001	Florida DEP contacts the EPA and requests assistance with the investigation.
March 2001	EPA conducts a geophysical survey to identify the locations of underground anomalies, where additional drums could be buried. Two locations are identified: one in the area of the existing drum site, another near the entrance to the subdivision on Mango Tree Drive.
April–July 2001	The property owner's private contractor conducts additional drum removal actions from the area of excavation. During this time, more than 100 additional drums in poor condition are removed from the excavation. Also, a resident living near the excavation is relocated by the EPA, and the resident's house is removed from the property.
July 2001	All excavation and removal actions are suspended. The residents complain about potential health problems they believe to be associated with the drum excavation. Some of the residents' homes are less than 20 feet from the excavation. During the drum removal actions, residents say that dust covered their homes and cars and was tracked indoors. Residents complain of odors, nausea, vomiting, headache, dizziness, skin problems, and cancer. Residents are also concerned about deformities and discoloration

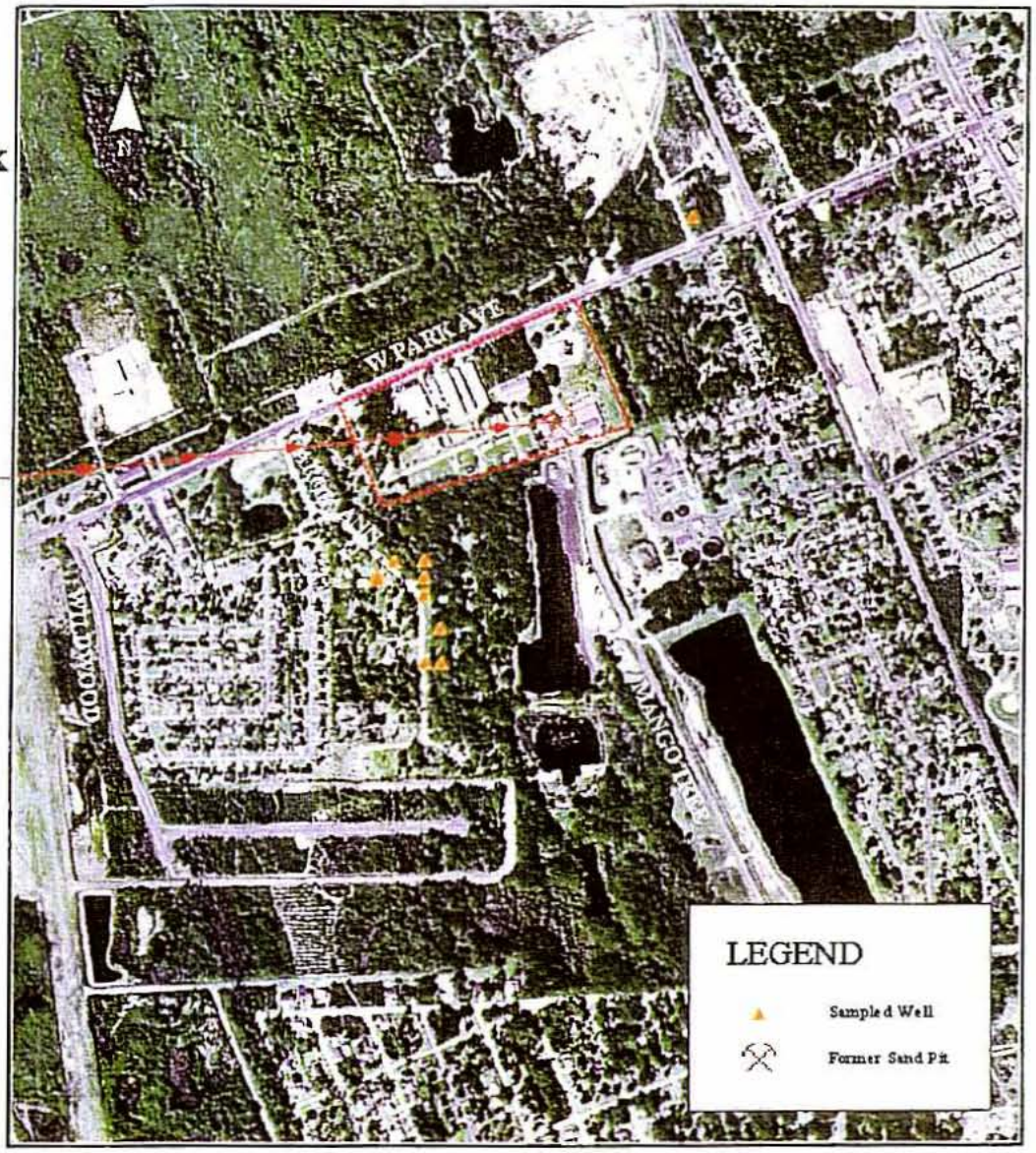
	on fruit and trees in their yards, as well as the quality of water they are drinking, even though they are on a municipal water system.
August 2001	The EPA determines that residents of the community are at risk of exposure to potential contaminants by inhalation, ingestion, and dermal contact with air, groundwater, and surface/subsurface soil related to the drum excavation site.
September 2001	A resident reports flooding in the neighborhood and discovers a broken sewer line. The owner is contacted and buries the broken pipe. The Volusia County Health Department is not notified until 3 weeks later.
October 2001	EPA collects air, surface soil, and pit water (groundwater) samples.
November 2001	Volusia CHD samples tap water and groundwater. Metals and VOCs in drinking water samples are below action limits. Florida DOH visits the site to assess current conditions.
December 2001	The Florida DOH coordinates blood lead testing of six children aged 10 years to 15 years living in the Royal Oaks Community. All six children have blood lead less than the 10 mg/dL CDC guidance level.
February 2002	EPA begins to relocate residents.
2001–2002	Florida DOH evaluates chemical contaminants on site and environmental samples from off the site. A health consultation is released in the Fall of 2002, and Florida DOH holds a public meeting to discuss the findings and record community concerns.
September 2002	The EPA issues its final pollution report (Final POLREP #5). This report details the removal and proper disposal of all known contaminated soil and groundwater from the site, as well as backfilling of the excavation pit with clean soil and re-seeding with grass.
September 2003	Florida DEP issues a **no further action approval** letter to the property owner, releasing the property owner from any further obligation to conduct corrective actions (cleanup). This letter does not certify that the entire site is clean but says no contamination above state standards is known to exist on the site.

APPENDIX B. FIGURES

FLORIDA DEPARTMENT OF HEALTH

Royal Oaks Trailor Park
Volusia County





Map Prepared By
Drinking Water Toxics Section
Bureau of Water Programs
Florida Department of Health
October 18, 2001

Figure 1

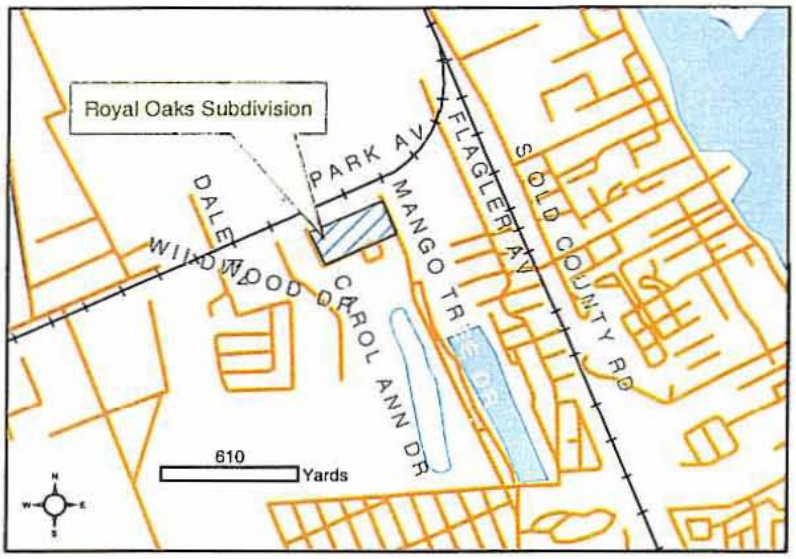

Royal Oaks Subdivision
PARK AV
FLAGLER AV
S OLD COUNTY RD
DALEWOOD DR
CAROL ANN DR
610
Yards

Figure 2

APPENDIX C. TABLES

Table 1. Highest Detected Chemical Concentrations in Onsite Groundwater

Chemicals of Concern	Highest Groundwater Concentration	Comparison Values
Toluene	nd	0.2[B]
Ethylbenzene	30,250	1.0[*]
Total Xylenes	16,000	2.0[†]
1,2,4-TMB	23,500	0.01[‡]
1,3,5-TMB	7,500	0.01[‡]

Samples collected 21DEC00, 24OCT01
All units in ppm = parts per million (mg/kg)
TMB = Trimethylbenzene
nd = Not Detected
* - ATSDR Hierarchy II (Intermediate) RMEG for Child
† - ATSDR Hierarchy II (Intermediate) EMEG for Child
‡ - FDEP Groundwater Criteria (Minimum Criteria Organoleptic)

Table 2. Highest Detected Chemical Concentrations in Onsite Soil

Chemicals of Concern	Highest Soil Concentration	Comparison Values
Toluene	nd	1,000[†]
Ethylbenzene	11	5,000*
Total Xylenes	9.75	10,000[†]
1,2,4 - TMB	na	13[§]
1,3,5 - TMB	na	11[§]

Samples collected 21DEC00, 24OCT01
All units in ppm = parts per million (mg/kg)
TMB = Trimethylbenzene
nd = Not Detected
na = not analyzed
* - ATSDR Hierarchy II (intermediate) RMEG for Child
† - ATSDR Hierarchy II (Intermediate) EMEG for Child
§ - FDEP Direct Exposure (Residential)

Table 3. Highest Detected Chemical Concentrations in Onsite Sediment

Chemicals of Concern	**Highest Sediment Concentrations**	**Comparison Values**
Toluene	5,400	1,000†
Ethylbenzene	3,085	5,000*
Total Xylenes	4,950	10,000†
1,2,4-TMB	1,050	13
1,3,5-TMB	300	11§

Samples collected 21DEC00, 24OCT01
All units in ppm = parts per million (mg/kg)
TMB = Trimethylbenzene
* - ATSDR Hierarchy II (Intermediate) RMEG for Child
† - ATSDR Hierarchy II (Intermediate) EMEG for Child
§ - FDEP Direct Exposure (Residential)

Table 4. Highest Detected Chemical Concentrations in Onsite Air

Chemicals of Concern	**Highest Ambient Air Concentrations**	**Comparison Values**
Toluene	1.4	1.0**
Ethylbenzene	2.4	1.0††
Total Xylenes	nd	0.7**
1,2,4-TMB	na	na
1,3,5-TMB	na	na

Samples collected 24OCT01
All units in ppm = parts per million (mg/kg)
TMB = Trimethylbenzene
na = Not Analyzed
nd = Not Detected
NA = Not Applicable
** - ATSDR Hierarchy II (Intermediate) EMEG / MRL
†† - Additional Health Guidelines (Acute) EMEG / MRL

Table 5. Potential Exposure Pathways

Pathway Name	Potential Exposure Pathway Elements					Time
	Source	Media	Point of Exposure	Route Of Exposure	Exposed Population	
Airborne Vapors	Excavation	Air	Breathing Zone	Inhalation	About 31 residents	December 2000 to July 2001
Airborne Dust	Excavation	Air	Breathing Zone	Inhalation	About 31 residents	December 2000 to July 2001

Table 6. Calculated Average Daily Dose (ADD)

Contaminant of Concern	Air (mg/cu m)		Groundwater (mg/kg/day)		Sediment (mg/kg/day)	
	Child	Adult	Child	Adult	Child	Adult
Ethylbenzene	10.42	10.42	2000	857	0.021	0.004
Toluene	5.28	5.28	ND	ND	0.036	0.008
Xylenes (mixed)	ND	ND	1067	457	0.033	0.007
1,2,4-Trimethylbenzene	NA	NA	1600	686	0.007	0.002

These doses were calculated using Risk Assistant software and accepted exposure parameters (EPA, 1991).
N.D.- Not detected
N.A.- Not analyzed
mg/kg/day = milligrams per kilogram per day
mg/cu m = milligrams per cubic meter

APPENDIX D. RISK OF ILLNESS

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, Florida DOH uses 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 persons 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. Nevertheless, 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, to relying only on animal studies. For example, scientists have found some hazardous contaminants are associated with cancer in animals but lack evidence of a similar association in humans. In addition, humans and animals have differing abilities to protect themselves against low levels of contaminants, and most animal studies test only the possible health effects of high exposure levels. Consequently, the possible effects on humans of low-level exposure to hazardous contaminants are uncertain when information is derived solely from animal experiments.

Dose Response/Thresholds

The focus of 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 is used 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. One important difference exists between the dose-response curves used to estimate the risk of noncancer illnesses and those curves used to estimate the risk of cancer: threshold dose. A threshold dose is the highest exposure dose at which there is no risk of illness. The dose-response curves for noncancer 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. It is estimated from information gathered in human

and animal studies. By contrast, the dose-response curves used to estimate the risk of cancer assume no threshold dose (or, in other words, the cancer threshold dose is zero). This assumes a single contaminant molecule could be sufficient to cause a clinical case of cancer. Such an assumption is very conservative; indeed, many scientists also believe a threshold dose greater than zero exists for the development of cancer.

Uncertainty

All risk assessments, to varying degrees, require the use of assumptions, 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 can cause risk to be overestimated or underestimated. And 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 Royal Oaks community 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. These errors can be controlled to some extent by increasing the number of samples collected and analyzed and by sampling the same locations over several different periods. These actions tend to minimize any uncertainty caused by random sampling errors.

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

Also, data gaps and uncertainties exist 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). A mathematical formula cannot be applied to estimate the dose. These data gaps can tend to underestimate the actual risk of illness. In addition, great uncertainties exist 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, great uncertainties exist 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 the extent to which the actual risks are overestimated and what the resultant risk estimates really mean.

APPENDIX E. FLORIDA DEP NO FURTHER ACTION LETTER

Department of Environmental Protection

Jeb Bush
Governor

Central District
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David B. Struhs
Secretary

BY ELECTRONIC CORRESPONDENCE
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OCD-WCU-03-0229

Volusia County - Waste Cleanup
Royal Oaks Subdivision
Edgewater, Florida
No Further Action Approval

Dear Mr. McAllister:

The Department has reviewed the "Monitor Well Closure" letter received on August 29, 2003 and concludes that it provides reasonable assurance that the ground water monitoring wells used in the contamination assessment have been properly abandoned. Therefore, pursuant to the Department's letter dated August 8, 2003, you are released from any further obligation to conduct corrective actions in the drum excavation area and in the ground water that is encompassed by ground water monitoring wells MW-2, MW-3, MW-4, and piezometer PZ-1 as depicted in Figure A-1 of the "Groundwater Flow Survey" submitted on August 6, 2003 at the Royal Oaks Subdivision site located at Latitude N 28° 59' 10.08", Longitude W 80° 55' 0.85", Edgewater, Volusia County, Florida. However, this letter does not certify that the entire site is clean, and the Department reserves the right to initiate appropriate actions at this site if contamination is discovered in the future.

If you have any questions concerning this correspondence, please contact Dale Melton at our Orlando offices by telephone at (407) 893-3331 or by email at dale.melton@dep.state.fl.us.

Sincerely,

F. Thomas Lubozynski, P.E., CIH for
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Date: September 3, 2003

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Glossary of Environmental Health Terms

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

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

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

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

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

ATSDR: The Agency for Toxic Substances and Disease Registry. ATSDR is a federal health agency in Atlanta, Georgia, that deals with hazardous substance and waste site issues. ATSDR provides information about harmful chemicals in the environment and how people can protect themselves from contact with chemicals.

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

Biota: As used in public health, things that humans would eat—including animals, fish and plants.

CAP: See Community Assistance Panel.

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

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

CERCLA: See Comprehensive Environmental Response, Compensation, and Liability Act.

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

Completed Exposure Pathway: See Exposure Pathway.

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

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

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

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

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

Contaminant: See Environmental Contaminant.

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

Dermal Contact: A chemical getting onto one's skin. (see Route of Exposure).

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

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

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

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

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

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

Epidemiology: The study of the factors that determine how often, in how many people, and in which people disease will occur.

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

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

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

ATSDR defines an exposure pathway as having five parts:

- Source of Contamination,
- Environmental Media and Transport Mechanism,
- Point of Exposure,
- Route of Exposure, and
- Receptor Population.

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

Finished Water: This is a term used to refer to water that has been chlorinated, aerated and is ready for use by the public. "Finished Water" is usually filtered through air-stripping towers to remove chlorinated solvents and their breakdown products.

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

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

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

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

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

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

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

LOAEL: Lowest Observed Adverse Effect Level. The lowest dose of a chemical in a study, or group of studies, that has caused harmful health effects in humans or animals.

Malignancy: See Cancer.

MRL: Minimal Risk Level: An estimate of daily human exposure—by a specified route and length of time—to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used as a predictor of adverse health effects.

NPL: The National Priorities List: (Which is part of Superfund.) A list kept by the U.S. Environmental Protection Agency (EPA) of the most serious, uncontrolled or abandoned hazardous waste sites in the country. An NPL site requires investigation or clean up, or both, to determine whether people can be exposed to chemicals from the site.

NOAEL: No Observed Adverse Effect Level: The highest dose of a chemical in a study, or group of studies, that did not cause harmful health effects in people or animals.

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

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

PHA: Public Health Assessment. A report or document that looks at chemicals at a hazardous waste site and determines whether people could be harmed from coming into contact with those chemicals. The PHA also determines whether possible further public health actions are needed.

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

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

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

PRP: Potentially Responsible Party: A company, government or person that is responsible for causing the pollution at a hazardous waste site. PRP's are expected to help pay for the cleanup of a site.

Public Health Assessment(s): See PHA.

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

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

(a) Urgent Public Health Hazard
(b) Public Health Hazard
(c) Indeterminate Public Health Hazard
(d) No Apparent Public Health Hazard
(e) No Public Health Hazard

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

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

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

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

SARA: The Superfund Amendments and Reauthorization Act in 1986 amended CERCLA and expanded the health-related responsibilities of ATSDR. Among other things, CERCLA and SARA direct ATSDR to look into the health effects from chemical exposures at hazardous waste sites.

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

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

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

Superfund Site: See NPL.

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

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

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

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

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

Uncertainty Factor: See Safety Factor.

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

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

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

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