ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

THE LINCOLN PARK COMPLEX
FT. LAUDERDALE, BROWARD COUNTY, FLORIDA
EPA FACILITY ID: FLN000407550
OCTOBER 25, 2005

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.

Agency for Toxic Substances & Disease Registry ..... Julie L. Gerberding, M.D., M.P.H., Administrator
Howard Frumkin, M.D., Dr.P.H., Director

Division of Health Assessment and Consultation…. ..... William Cibulas, Jr., Ph.D., Director
Sharon Williams-Fleetwood, Ph.D., Deputy Director

Health Promotion and Community Involvement Branch ..... Lisa Calhoun Hayes, P.E., DEE, Acting Chief

Exposure Investigations and Consultation Branch ..... Susan M. Moore, Ph.D., Chief

Federal Facilities Assessment Branch ..... Sandra G. Isaacs, B.S., Chief

Superfund and Program Assessment Branch ..... Richard E. Gillig, M.C.P., Chief

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

Additional copies of this report are available from:
National Technical Information Service, Springfield, Virginia
(703) 605-6000

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR
or
Visit our Home Page at: http://www.atsdr.cdc.gov

PUBLIC HEALTH ASSESSMENT

THE LINCOLN PARK COMPLEX

FT. LAUDERDALE, BROWARD COUNTY, FLORIDA

EPA FACILILTY ID: FLN000407550

Prepared by:

Florida Department of Health, Bureau of Community Environmental Health
Under cooperative agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Table of Contents

Summary and Statement of Issues 1
Background 3
Site Description and History 3
Demographics 4
Land Use 4
Natural Resource Use 5
Site Visits 5
Community Health Concerns 5
Lincoln Park Site Assessment Meeting 5
Addressing Community Health Concerns from DEP's Lincoln Park Site Assessment Meeting 6
Community Concerns Expressed to DEP in the summer of 2003 7
Lincoln Park Complex Site Assessment Testing Results Meeting 8
Addressing Community Health Concerns from DEP's Lincoln Park Site Assessment Testing Results Meeting 8
Environmental Contamination 10
Community Health Concerns 10
Off-site Contamination 14
Quality Assurance and Quality Control 15
Exposure Pathways 15
Public Health Implications 17
Child Health Considerations 23
Conclusions 24
Public Health Action Plan 25
Authors, Technical Advisors 27
References 28
Appendix A - TEQs for PAHs and Dioxins/Furans 30
Appendix B - Figures and Tables 31
Appendix C. Public Health Activities 55
Appendix D. Public Comments 60
Glossary of Environmental Health Terms 64

Foreword

This document summarizes public health issues for a former incinerator and nearby properties owned by the City of Ft. Lauderdale. The Florida Department of Health evaluates site-related public health issues through the following processes:

- Evaluating exposure: 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 occurs on the site, and how people might be exposed to it. Usually, 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 public.
- Evaluating health effects: If there is evidence that people were–, are–, or could be exposed to hazardous substances, DOH scientists will determine whether that exposure could be harmful to human health. We base this report on existing scientific information and focus on public health; that is, the health impact on the community as a whole.
- Developing recommendations: In this evaluation report, DOH outlines its conclusions regarding any potential health threat posed by the Lincoln Park Complex site, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of 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, an immediate health threat exists or is imminent, 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. 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. We share our conclusions about the site with the groups and organizations providing the information. Once an evaluation report has been prepared, DOH seeks feedback from the public. *If you have questions or comments about this report, we encourage you to contact us.*

Please write to: Connie Garrett
Health Assessment Section
Bureau of Community Environmental Health/Florida Department of Health
4052 Bald Cypress Way, Bin # A-08
Tallahassee, FL 32399-1712

Or call us at: (850) 245-4299, or toll-free during business hours: 1-877-798-2772

Summary and Statement of Issues

The 16.5-acre Lincoln Park Complex is in a commercial and light industrial area on the northern side of Sistrunk Boulevard between NW 18th Avenue and Interstate 95, in Ft. Lauderdale (Broward County), Florida. The complex includes the former municipal incinerator, the former Lincoln Park School, and the Lincoln Park properties.

From the late 1920s until the mid 1950s, the City of Fort Lauderdale ("the City") operated an incinerator for municipal wastes on the western 9 acres of the complex. In 1969, the City built a domestic wastewater treatment plant on the former incinerator site. This plant operated until the mid-1990s when the City closed and dismantled it. The City used the western part of the former incinerator property as a transfer station for recyclable household trash until the summer of 2004. The eastern part of the incinerator property is a fenced grassy field. Lincoln Park is 2.5 acres on Sistrunk Boulevard across NW 19th Avenue from the incinerator site. The former Lincoln Park Elementary School property is on 5 acres immediately north of the park. Air emissions, residues from the incinerator and from wastewater sludge dewatering vats, and residue from flooding that occurred while the wastewater treatment plant was in operation could all be sources of chemicals measured in soil on and off the site.

Currently the site presents **"no apparent public health hazard"**. The former Lincoln Park Elementary School portion of the site was remediated in 2003 and 2004. Most of the remainder of the site is fenced, which prevents ash exposure. Soil tests show that where it exists, this ash lies approximately 1 foot below the surface, and deeper. Current exposure pathways include incidental soil ingestion (and inhalation of dust) in rights-of-ways adjacent to the site and in off-site soil.

To evaluate residents' exposures using the soil data from samples DEP collected in July 2004, we separated the off-site soil data into non-yard and yard soil. Both non-yard and yard soils (0 to 3 inches deep) contained arsenic and carcinogenic congeners of polynuclear aromatic hydrocarbons (PAHs) and dioxins above the residential Soil Cleanup Target Levels. DEP measured higher levels of arsenic, and toxicity equivalent (TEQ) PAHs and dioxins in soil samples from the rights-of-way, City-owned properties, and vacant lots than they measured in yards. Although the highest chemical levels were not measured at the same locations, we added together the cancer risks for the highest measured levels in yard and non-yard areas. The theoretical cancer risks we estimated for daily, long-term, ingestion and inhalation of chemicals in yard soils totaled six in one million. For non-yard soil, the theoretical cancer risks we estimated totaled three and one-half in 100,000. DOH spoke individually to the residents who had their soil tested. We went door-to-door with DEP and the Broward County Health Department to tell residents their yard soil test results on December 15 and 16 (Wednesday and Thursday), 2004. Because off-site soil contamination is not well characterized, DOH suggested residents might want to use the good gardening practices outlined in the pullout in Appendix C. The City applied for (and was awarded) a grant to fund additional off-site soil sampling to be carried out by DEP. DEP plans to collect additional off-site soil samples in November 2005.

Ash from the incinerator contained metals and by-products of burning. DEP was able to identify ash layers, mostly in soil deeper than one to two feet below the surface on the site. Recent analyses of surface soil (0 to 6 inches) measured arsenic, copper, TEQ dioxins, and TEQ PAHs slightly above their screening levels. People's recent exposures to surface soil (6 inches deep and less) are unlikely to have caused non-cancer health effects. Totaling the theoretical increases in

cancer risk using the highest levels of all the chemicals measured in 0 to 6 inch soil on the site comes to about two in 100,000.

On-site soil samples from 6 to 24 inches and below 24 inches showed higher chemical levels. Therefore, past exposures to the ash itself or to the ash layers before they were covered (especially if exposures occurred daily, over long periods) could have caused non-cancer health effects from ingestion of arsenic, copper and lead. Past ash exposures could have increased cancer risks moderately (to one theoretical case in 1,000) due to arsenic ingestion. At this time, the **health hazards for past exposures are indeterminate** because we do not know if, or for how long, people were exposed to this ash, or at what levels the exposures could have occurred. Lincoln Park and the former municipal incinerator portions of the complex could present a **future public health hazard** if people had long-term exposures to the highest levels of lead, copper, TEQ PAHs or arsenic measured in on-site ash, primarily in soil deeper than 2 feet below land surface.

In the Discussion section of this report, we explain exposure pathways and possible disease associations for daily long-term exposure to the highest levels of seven chemicals measured above their health-based screening levels on and near the site. DOH recommends people avoid dust inhalation or hand-to-mouth contact with contaminated soil on the site, especially subsurface soil that contains visible debris and ash or is deeper than 2 feet below the surface. We also recommend controlling dust generation and monitoring air quality for metals at Lincoln Park or the former municipal incinerator during any future cleanup activities, remodeling, utilities installation, construction, or other work that would create dusty conditions while disturbing this deep soil.

DOH cautions residents with regard to our evaluation of site-related environmental chemical exposures: not only is the information available on exposure pathways and chemical levels incomplete, but resident's total exposures and sensitivities are likely to be different. People may contact chemicals at their jobs, through their hobbies, or from other off-site sources. In addition, scientists' understandings of the causal links between chemical exposures and diseases are incomplete. For these reasons, DOH recommends that persons who feel ill, especially with persistent symptoms, should see their doctors. They should tell their doctors about any concerns they might have about environmental exposures.

Municipal water is currently used by homes and businesses in the area, and drinking water wells are not likely to have been a past exposure pathway. However, residents do currently use irrigation wells. Although site-related contamination has not been measured in off-site groundwater, irrigation wells may be shallow and could pull in surface water. Because surface water may contain bacteria, DOH recommends people should not drink water from shallow irrigation wells or use it for bathing, cleaning food contact surfaces (like grills, dishes, or grilling utensils), or for gutting fish.

The City will take remedial actions on the park and incinerator properties under the DEP-directed Brownfields program. The City's contractor, Evans Environmental & Geosciences, submitted a final cleanup plan for Lincoln Park to the Southeast DEP District in March 2005. Pending DEP's approval, City officials hope to complete the clean up and to re-open the park by January 2006. The City's conceptual park redevelopment plan includes a public plaza, a butterfly garden, pavilions, a second basketball court, and a bus stop on Sistrunk Boulevard with a canopy.

DOH released this document for public comment on January 26, 2005 at a City of Ft. Lauderdale Open House, which was requesting citizens input on renovating the Lincoln Park portion of the property (Appendix D shows flyer the City sent to about 5,000 utility customers). We spoke to about 50 residents at the meeting about our findings and noted their comments and health concerns. We also spoke to several media representatives. When the newspaper reports about the Open House failed to mention our report had been released for public comment, DOH sent a direct-mail fact sheet to about 450 residents asking for public comments on the report. We listed a toll-free number to call to request a copy of the report and a link to the report on our web site. We also sent a copy of this report to a prominent community activist, who has had long-term involvement with this and other area sites. DOH received written comments from Legal Aid Services of Broward County. The concerns expressed at the January 26, 2005 meeting and in the Legal Aid Services of Broward County letter are listed and addressed in (Appendix D). DOH staff asked community members about their health concerns and about their knowledge of past exposure pathways at other meetings held by DEP and Representative Hastings. We address these concerns and public comments in the Community Concerns section of this report.

DOH will evaluate any follow-up soil sampling test results as they become available and will continue to work with DEP and the City to inform and educate nearby residents about the public health issues associated with this site.

Background

Site Description and History

The Lincoln Park Complex is on the northern side of Sistrunk Boulevard (NW 6th Street) between NW 18th Avenue and Interstate 95 (I-95) in Fort Lauderdale, Broward County, Florida (Figures 1 and 2). The complex includes three properties: the adjacent former municipal incinerator and Lincoln Park properties along Sistrunk Boulevard, and the former Lincoln Park Elementary School property directly north of the park (Figure 3).

The 9-acre former municipal incinerator property has chain-link fencing on all sides. Access is through a lockable gate on Sistrunk Boulevard. The City of Fort Lauderdale ("the City") used the western two-thirds of the property as a recyclable residential waste separation and transfer station from 1995 until the summer of 2004. The eastern third of this property is a grassy field that was the site of a municipal incinerator (late 1920s to mid-1950s) and later a municipal wastewater treatment plant (1969 to mid-1990s).

Archival aerial photographs of the 2.5-acre Lincoln Park property show from 1946 to 1969, a house occupied the southeast corner and in 1946 what were apparently two equipment buildings in the west (center). Before 1958, most of the Lincoln Park property was used to stage and landfill municipal waste and incinerator ash; therefore, whether the mounds present on the park property in 2003 were the result of park construction or former landfill activities is unknown. Although the aerial photos show a park at this location from 1958 to 1969, the park was re-landscaped between 1984 and 1992. The City closed the park in early 2003.

Aerial photography of the 5-acre former school property shows buildings, possibly residences, on the site in 1959, but not in 1946. These aerial photos and file information do not indicate incinerator or landfill activities were conducted on the school property. Lincoln Park Elementary School was built in the 1960s and operated until the 1980s. Until recently, the school facilities and property were used for an after-school program and a small print shop. The property had

chain-link fencing on all sides, but gates on NW18th and19th Avenues were unlocked, and the property was apparently accessible at all times. In May 2003, the City demolished the school.

Demographics

In 2000, about 19,643 persons lived within a 1-mile radius of the site. Approximately 39% were 19 years of age or less. Approximately 88% were black, 8% were white, and less than 3% were Latino/Hispanic. American Indian/Alaska Native, Asian/Pacific Islander, and all other racial/ethnic groups made up about 1% of the population (US Census Bureau 2000).

Land Use

Although properties along Sistrunk Boulevard (NW 6th Street) are commercial and light industrial, much of the area north and south of Sistrunk is residential. The nearest residences are north of the former incinerator site, west, north, and east of the former Lincoln Park Elementary School, and east of Lincoln Park. Interstate 95 borders the site on the west, and residential and industrial areas are west of I-95. According to aerial photographs, most of the residential development occurred after 1946 (E&E 2003).

The former Wingate Road Incinerator, a Superfund National Priorities List hazardous waste site, is 1½ miles northwest of this site. Other nearby hazardous waste sites include:

- City Bumper, Inc. ¾ mile east,
- Engineered Finishes ¾ mile southeast,
- Everglades Fertilizer Company Fire Site ½ mile south,
- Ft. Lauderdale Gasification Plant ¾ mile southeast, and
- North American Plating Corporation, ¾ mile northwest,

Schools and Day Care facilities near the Lincoln Park Complex include

- Dillard Elementary and High Schools ¾ miles northwest,
- Dillard Day Care 1 mile northwest,
- Lauderdale Manors School 1 mile northeast,
- Good Day School 1 mile northeast,
- Sunland Elementary School ½ mile northeast,
- Ascension Child Care Center ½ mile northeast,
- Cradle Nursery ⅓ mile east,
- Walker School ½ mile southeast,
- North Fork School ½ mile south,
- Westside School 1 mile southeast, and
- Sabal Palm Elementary School ¾ miles west.

Provident Hospital is ¼ mile east and West Broward County Hospital is ¾ mile southeast of the Lincoln Park Complex.

Natural Resource Use

Groundwater in the surficial aquifer under the site is generally less than 6 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. The nearest City municipal water treatment plants are Fiveash and Peele-Dixie. None of the wells for these water treatment plants is within 2 miles of the site. There are a few inactive private wells within 1 mile of the site, but they are all hydraulically upgradient of the Lincoln Park Complex site (E&E 2003) (groundwater flow direction is east-southeast, toward the coast). Residents told DOH that homeowners used private well water in this area from about 1961 to 1970.

Site Visits

On January 27, 2003, Connie Garrett, Florida Department of Health (DOH), Bureau of Community Environmental Health, visited the site and attended a public meeting at the former Lincoln Park Elementary School. At this meeting, Florida Department of Environmental Protection (DEP) detailed its plans for environmental testing. On November 13, 2003, Connie Garrett and Beth Copeland (of the DOH, Bureau of Community Environmental Health) attended a second DEP meeting held to discuss site-testing results with the community. Connie Garrett and Howard Rosen (Broward County Health Department) attended a Neighborhood Open House at Delevoe Park hosted by the City of Ft. Lauderdale on January 25, 2005. In the following section, we detail community members' concerns expressed at these meetings, to the Southeast DEP district staff at times other than these meetings, and to the DOH report author in writing at our request for input on the public comment draft of this document.

Community Health Concerns

Lincoln Park Site Assessment Meeting

DEP held a Lincoln Park Site Assessment meeting on January 27, 2003 to let the community know about the upcoming site assessment. Nearly 50 persons attended. One of the first to speak introduced himself as an employee of an environmental consulting firm and identified information missing from the Preliminary Contamination Assessment Report (PCAR). The City later informed DOH that their consultant had some of the missing information available and shared it with this person after the meeting.

Several community members were concerned whether the school grounds and park are safe for children (or were safe in the past when they themselves attended the school). One resident commented that children attending the after-school programs included children of all ages and included more children during the summer. Residents also asked about asbestos exposure inside the school. They wanted to know when, or whether, the asbestos had been removed.

A long-time resident was concerned that stormwater runoff had moved contaminants from the incinerator area to people's yards. Other citizens mentioned flooding from the wastewater treatment plant in the late 1980s and asked if their yards could be tested.

Addressing Community Health Concerns from DEP's Lincoln Park Site Assessment Meeting

Preliminary Contamination Assessment Report Data Quality

When the January 2003 community meeting was held, the City's PCAR had the only available site data. Some PCAR errors were items left out: monitoring-well water levels and Organic Vapor Analyzer (OVA) readings were omitted. In addition, the field samplers did not sign some sample chain-of-custody documents and forgot to report some sampling dates and times. While such errors may not affect the quality of the laboratory analytical data, they do call into question the meticulousness of the field samplers and the thoroughness of the report authors. Nonetheless, DOH compared the PCAR analytical results with those reported by DEP's contractor (Ecology and Environment 2003). The PCAR data were comparable to data from samples DEP's contractor collected in 2003.

Removal of Asbestos from the School

After the meeting, Connie Garrett (DOH), called a member or the Broward County School Board and verified that asbestos had been removed from inside the school. She asked the Broward County Health Department to test the drinking water at the school for lead—leaded solder in older plumbing can be a source of lead exposure. Broward County Health Department water samplers took workshop drinking fountain, restroom faucet, and office water samples. Analyses showed none of the drinking water samples contained lead above the current Primary Drinking Water Standard for lead.

Safety of the Soil on the School Property

Evaluation of all the soil data collected on the Lincoln Park School property showed four instances of two chemicals measured above their screening values. Three instances were arsenic and one instance was toxicity equivalent (TEQ) polycyclic aromatic hydrocarbons (PAHs). PAHs are products created by burning organic compounds. Both arsenic and PAHs have low screening values because they are carcinogenic from some exposure routes. Nether chemical was measured at levels likely to cause non-cancer health effects. The calculated increases in cancer risk for each chemical when added together round up to 1 additional possible case of cancer over the expected number in 100,000 persons. However, the assumptions DOH made for these calculations might not be met, for example, such a small increase might not be apparent in the potentially exposed population, and children might not ingest 200 milligrams of soil, daily, that contained the highest measured levels of arsenic or PAHs, for longer than a year.

During the meeting, DOH told parents who were worried that their children might be exposed to elevated lead in soil—that lead exposures could be quantified from blood-lead levels. Because environmental testing at the time was insufficient, DOH recommended blood-lead testing to concerned parents. DOH asked Broward County Health Department to facilitate blood lead testing for children in the former Lincoln Park Elementary School after-school program. On May 15, 2003, the Broward County Health Department mailed letters to the parents or caregivers of 90 after-school participants (Appendix C). The Health Department did not have any responses to these letters, and as it turned out the analytical results of DEP's soil samples from the school property did not measure lead in surface soil at levels above the Florida residential Soil Cleanup Target level.

The Broward County Health Department offered blood-lead testing again in April 2004 to anyone who was concerned they might have had exposure to lead-contaminated soil on other parts of the complex. The County Health Department publicized this free testing (for children six years of age and younger, living in the 33311 zip code) through a press release to major and community media outlets. They provided the testing at the Sunrise Health Center—Edgar P. Mills Multipurpose Center at 900 NW 31st Avenue in Fort Lauderdale. Testing was available on Wednesday April 7, 2004 from 8:00 a.m. to 11:00 a.m. and Thursday, April 8, 2004 from 4:00 p.m. at 7:00 p.m. Approximately 50 persons were tested, but none had elevated blood lead levels.

A law firm representing about 25 neighborhood families recommended testing children for arsenic exposure in addition to lead. DOH did not offer testing for arsenic and did not recommend testing children's blood for arsenic levels for two reasons. First, the body does not sequester arsenic in the same manner as lead—the body excretes most ingested arsenic within 2 to 3 days (ATSDR 2000a). Second, blood tests do not differentiate between organic and inorganic arsenic. Seafood and other foods can contain organic arsenic, which is not as toxic as inorganic arsenic.

Safety of the Soil on the Lincoln Park Property

According to a City Engineer—who has worked for the City for many years—fill was spread and sod was grown on Lincoln Park before it was used for a park in 1958. DOH has not seen any documentation of how much fill was applied and when it was applied. Nor can we verify that the fill was never breached. Nevertheless, the available soil sampling results show that sandy fill (about one foot thick) seems to have remained in place on the site. Based on the samples of the shallowest soil, this fill layer could have prevented direct contact with concentrated incinerator wastes, unless activities carried out there dug down through it.

Community Concerns Expressed to DEP in the summer of 2003

Florida DOH staff spoke with DEP Southeast District personnel in West Palm Beach, about the status of the site in late August 2003. At that time, the "One Stop Shop" building construction was proceeding under Brownfields regulations. When the City dewatered the former school site to install utilities in July 2003, neighborhood residents reportedly became upset about 24-hour pump noise and flooding. Sediments in the pumped groundwater clogged storm drains; a pond formed on off-site properties, and children played in the pond. Because the confirmatory results of DEP's site assessment had not been released when the school site was dewatered, residents were concerned about what children were exposed to in the pond. Now that the testing results have been released, it does not seem likely that the children's exposure to any pond sediments would cause illness.

Staff from the DEP Southeast District's air program attended the school building demolitions to assure that there were no difficulties with air quality. City contractors removed soil-containing debris on the southern part of the elementary school property as they prepared the land for the new municipal building. They took post-removal soil samples below the area where debris was removed (and from borings around trees that were left on the site). The contractor's lab did not find arsenic above DEP's Soil Cleanup Target Levels. Construction activities uncovered the underground fuel tank that the City contractor's geophysical survey had been unable to locate. Contractors excavated and disposed of the tank. Reportedly, this tank had not leaked while underground. Staff from the DEP Southeast District office handled the tank post-closure activities.

Lincoln Park Complex Site Assessment Testing Results Meeting

DEP held a community meeting on November 13, 2003, to let the residents near the site know what they had found when sampling the Lincoln Park Complex. Connie Garrett and Beth Copeland attended the meeting for DOH. Approximately 20 community members and media, and about 20 government officials and employees attended the meeting. In addition to reiterating the issues of pump noise, flooding, and children's exposures to water from the site during summer construction on the school site, community members expressed the following health concerns at this meeting.

Residents were concerned that the workers who had removed debris-containing soil from the site had not worn protective gear or clothing. They were concerned that dust from this soil had escaped from the uncovered dump trucks and that no one had warned the community. Others were afraid that the construction trucks and equipment might injure neighborhood children. Other community members claimed the school site had been a trash disposal area, and that their yards (north of the complex) have trash and debris in them. One resident asked why deeper monitoring wells had not been installed, and another resident asked if sprinklers could be routes for exposure. One meeting attendee asked who would do the cleanup of the Lincoln Park parcel and of the incinerator parcel.

Nearby residents also asked about past exposures. One community member who had roller-skated on the incinerator ramps as a child inquired about possible past exposures. The community member also wondered what their children (who grew up across the street from the incinerator) had been exposed to, in the air as well as in the dust and soil. Two of these adult children have cancer. Another community member mentioned seeing needles and glass in trash remains on the school property. Still another community member expressed concern that the City had begun assessing environmental contamination on the sites in 1997, but had only released the results of the testing in October 2002, and had not closed the park until 2003.

Addressing Community Health Concerns from DEP's Lincoln Park Site Assessment Testing Results Meeting

Former Lincoln Park Elementary School Site Construction

Before DEP released their results at this November 13, 2003 meeting, DOH had not communicated to the community that levels of chemicals in the debris on the former school property were unlikely to present risks for non-cancer illness. DOH calculated dose estimates for children and adults using the highest levels of chemicals measured on the school property. While our calculations did not show a risk for non-cancer illnesses, we also looked at increased cancer risks from carcinogenic chemicals. The statistical increases we calculated assumed cancer risks would come from daily, long-term exposures to the highest levels of chemicals measured. Because workers, nearby residents, or children may not have these total amounts of exposure, (and because our calculations predict 1 additional case in 100,000 persons) we might not expect to see increased occurrences of former school site-related cancer, even for daily exposures lasting longer than 1 year. City contractors removed the debris-containing contaminated material from the former school property when they built the "One-Stop Shop".

During the November 13, 2003 meeting, DEP staff explained that they used a portable x-ray fluorescence instrument on the former schoolyard property to field screen 17 additional soil locations (at two 2-foot intervals) to measure approximate levels of arsenic and lead. They collected intervals showing the most elevated levels for more precise laboratory analyses for the

former school property and the other two parts of the complex. While DEP and their contractor only submitted one surface soil sample for the former schoolyard, the x-ray fluorescence instrument readings for arsenic and lead levels that were similar to those determined in earlier sample analyses done by the City's contractor.

DOH acknowledges the possible risks to children from increased traffic and recommends that the community should work with the City to have speed limits lowered, have sidewalks installed, or to have other traffic-calming measures installed when the "One-Stop" permit shop is open. DEP has asked the City for additional assessment information for the park and former incinerator/waste-water treatment portions of the site.

Trash and Debris

Photographs DEP took of the construction site did not show trash or debris in areas other than the southern part of the site where debris-containing soil was removed (Photos 5 and11-14). DEP staff that have been on the construction site did not report seeing buried trash or debris on other parts of the former elementary school site. DEP staff spoke with residents who reported having found buried trash in their yards. DEP sampled soil from these yards in July 2004.

Groundwater

To answer why intermediate and deeper monitoring wells had not been installed and sampled at this complex, DEP staff explained during the meeting that early shallow monitoring wells did not show groundwater contamination on the site. Therefore, DEP did not expect to find contamination in deeper groundwater. He explained that some contaminants are denser than water and sink in groundwater. He said if such contaminants had been identified on the site, intermediate depth and deeper wells would have been installed. In late 2004 and early 2005, the City's contractor found shallow groundwater contamination on the Lincoln Park part of the site. DEP will likely require the City's contractor to address shallow groundwater contamination in their Brownfield remedial action plan. There are currently no known exposure pathways to contaminated shallow groundwater and municipal water is available for drinking and other purposes. The neighborhood does have irrigation wells. Because many shallow, irrigation wells are not constructed to prevent direct contact with surface water and the potentially harmful bacteria surface water may contain, DOH recommends people should not drink water from their irrigation wells or use it for bathing, cleaning food contact surfaces (like grills, dishes, or grilling utensils), or for gutting fish.

Past Exposures

DOH has little information on people's past exposures to chemicals that may be site-related. This situation is the same for many of the hazardous waste sites the DOH Health Assessment Team evaluates. Materials that remain on older sites are mostly those chemicals that sunlight or microbes do not readily break down. Usually the chemicals tested for are those associated with the types of operations that occurred on that site. On incinerator sites, agencies analyze the samples for things that do not burn, like metals, and the byproducts of burning, like PAHs and dioxins. If a person has exposures to these chemicals, some may stay in the body, and may be present years later. DOH cautions residents with regard to our evaluation of neighborhood environmental chemical exposures: not only is the information available on exposure pathways and chemical levels likely to be incomplete, but residents' total exposures and sensitivities are likely to be different. People may contact chemicals at their jobs, through their hobbies, or from other off-site sources. In addition, scientists' understandings of the causal links between

chemical exposures and diseases are incomplete. For these reasons, DOH recommends that persons who feel ill, especially with persistent symptoms, should see their doctors. They should tell their doctors about any concerns they might have about environmental exposures.

One resident reported seeing metal (needles) and glass on the former Lincoln Park Elementary School. Children and adults could have been exposed to such physical hazards in the past. During the construction of the "One Stop" permitting facility, the contractor removed the debris from the school property. Remediation of the other parts of the complex should address future exposures to physical hazards.

Cleanup of the Lincoln Park and Former Municipal Incinerator Parcels

DEP staff explained the City is proceeding with redevelopment and cleanup through the requirements of the Brownfields program. He said that the testing results did not indicate that the Lincoln Park Complex would qualify as a Superfund site. At the meeting, City officials expressed a willingness to keep the land use of Lincoln Park as a park.

Discussion

In this section, DOH reviews the available groundwater and soil data to identify current levels of chemicals on (or near) the site. Next, we review possible ways people might encounter these chemicals and determine whether the measured levels of chemicals might cause adverse health effects to exposed people.

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

Environmental Contamination

This section provides a review of environmental data collected at and near the site since 1997. We evaluate the sampling adequacy and identify contaminants of concern. This section refers to tables that list the maximum concentration and detection frequency for each contaminant of concern in the groundwater and soil. We selected the contaminants of concern by considering the following factors:

1. Concentrations of contaminants found on and off the site. We only eliminate contaminants 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 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 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. We use these standard comparison values to select site contaminants for further evaluation. We do not use these values to predict health effects or to establish clean-up levels. When we find site contaminants to have media concentrations that are above ATSDR's chemical-specific standard comparison values, we select the contaminant for further evaluation. This does not necessarily mean that a contaminant represents a health risk. Site contaminants that fall below standard comparison values are unlikely to be associated with illness, and we do not evaluate them 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, 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 one excess cancer per one 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.

In addition to the above criteria, DOH used DEP groundwater cleanup target levels (GCTLs) and soil cleanup target levels (SCTLs) for chemicals that did not have ATSDR screening values. Using these screening criteria, we selected the following contaminants of concern for further evaluation: arsenic, chromium, copper, di (2-ethylhexyl) phthalate, dioxins (by Toxicity Equivalence (TEQ, Appendix A)), lead, and polycyclic aromatic hydrocarbons by TEQ (Appendix A).

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 we select a contaminant of concern in one environmental medium at a site, we also report the measured level of this contaminant in the other environmental media. In the following sections, we evaluate the contaminants of concern at the Lincoln Park complex and discuss whether long-term, daily exposures would be likely to cause illness or to increase the risk of cancer.

On-site Contamination

In this section, 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. For this public health assessment, we define *on-site* as the area within the Lincoln Park complex property boundaries (Figure 2, Appendix B).

On-site Groundwater

Between 1997 and 2003, contractors for the City and for DEP collected and analyzed 16 groundwater samples from 13 on-site monitoring wells (EE&G 2002; E&E 2003). Not all samples were analyzed for all contaminants of concern. The City's contractor EE&G analyzed samples from four monitoring wells on the incinerator property for metals (but not copper), volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). EE&G also analyzed samples from three monitoring wells on the elementary school property for metals (but not copper), VOCs, and SVOCs. EE&G tested monitoring well #3 for metals, volatile organic aromatics, total petroleum hydrocarbons, and polycyclic aromatic hydrocarbons. DEP's contractor E&E installed and sampled six additional on-site monitoring wells and tested for target compound list metals, VOCs, SVOCs, and dioxins. In 2004, the City's contractor, EE &G, installed additional monitoring wells on the Lincoln Park property. In late 2004 and early 2005, EE & G sampled 13 monitoring wells and 1 irrigation well on the park for a total of 20 new sets of groundwater metals data.

DOH considered the groundwater sample results from these shallow wells together. A summary of the results appears in Table 3, Appendix B. On the elementary school property, the City's contractor found lead and chromium at levels above screening guidelines. On the municipal incinerator property, they found lead and arsenic in groundwater at levels above screening guidelines. DEP's contractor, however, found the levels of lead, chromium, and arsenic in these same wells **below** screening guidelines. It appears the presence of these metals may have been due to sediment or soil suspended in the water samples. In the 2004-2005 groundwater samples from the park, the City's contractor found antimony, arsenic, and manganese above groundwater target cleanup levels. While these data are sufficient for this health assessment because we know of no one who might drink or otherwise use this shallow groundwater, DEP will require additional groundwater characterization for remediation purposes.

On-site Surface Soil

Between 1997 and 2003, contractors for the City and for DEP sampled and analyzed 57 surface soil samples (EE & G 2002, E&E 2003). In addition, before collecting their samples, DEP's contractor screened soil at 48 on-site locations at two depths using L-level x-ray fluorescence and a total vapor analyzer to assure they collected soil containing the highest levels of contamination. After this screening, DEP's contractor collected six samples and analyzed for target compound list metals, SVOCs, VOCs, and dioxins. No on-site soil samples collected from

0–6 (or 0–3) inches below land surface contained lead above the residential soil cleanup target level.

Although people are more likely to be exposed to contaminants in the top 3 inches of soil, DOH also evaluated composite soil samples collected from 0–6 and 0–24 inches below land surface as surface soils (Table 1, Appendix B). DEP and the City's contractors did not analyze all samples for all contaminants of concern. The most contaminated surface soil areas of the complex appear to be on the former incinerator property.

Former incinerator property

The City's contractor collected one 0–2 foot soil sample in the northeastern part of the site in which their lab measured lead above the residential (and industrial) screening values. However, the highest lead levels measured coincided with a 2–4 foot layer of soil interlayered with crushed glass and brick in the northeastern part of the site, in what DOH calls subsoil. One 0–3 inch soil sample E&E took for DEP had TEQ dioxins, arsenic, copper, and PAHs above their residential soil screening levels. The other surface soil sample they collected from the eastern part of the former municipal incinerator only exceeded the arsenic screening value.

DEP has asked the City to provide additional soil data to characterize the former incinerator property.

Lincoln Park Elementary School

The City's contractor, EE&G, found buried debris including broken glass fragments (melted and charred), metal fragments and concrete in the upper 2 to 3 feet of soil in the southwest corner of the schoolyard. Three soil samples exceeded the screening value for arsenic and one soil sample exceeded the screening value for PAHs (TEQ). EE&G found a vent pipe for an underground storage tank on the east side of the school. This tank was uncovered and removed in the summer of 2003 during excavation activities for the "One Stop Shop" building foundation.

During the "One Stop Shop" construction activities, City contractors removed soils containing visible debris, and tested the underlying soil for metals. Based on the available data, soil on this part of the complex now meets Florida Soil Cleanup Target Levels.

Lincoln Park

The City's contractor describes a 1-foot thick sand layer covering the entire park property. Below that, they found a 1 to 3 foot thick layer of debris in the northwestern and southwestern parts of the park and a 1 to 6 foot thick layer of debris in the central and northeastern parts of the park. None of the 0–3 inch deep samples or 0–6 inch deep samples measured lead in excess of the DEP residential target cleanup level. Three of the 0 to 2 foot deep samples did have lead above this value and six of the deep (2-4 foot) samples taken by the City and DEP had lead above this value. Arsenic levels in the top 6 inches were just above the soil cleanup target level, as were PAH levels. PAH levels were just above the screening levels off the site (including the background sample).

In late 2004 and early 2005, EE&G, collected and analyzed 30 additional soil samples to support the City's Lincoln Park site remediation. EE&G had all these samples analyzed for metals and PAHs and only measured arsenic, barium and PAHs above residential soil target cleanup levels in the 0 to 2 foot composited samples. They also analyzed two soil samples for TEQ dioxins; the measured TEQ dioxin levels were not above the residential soil target cleanup level.

DEP has asked the City to provide additional soil data to characterize Lincoln Park.

On-site Subsurface Soil

DOH evaluated data from 15 on-site subsurface soil samples. These data are important because they show higher levels of metals in the deeper soil, especially in samples from western and central Lincoln Park and the northeastern part of the former incinerator site. A summary of the subsurface soil analytical results appears in Table 2, Appendix B.

On-site Air

No air data are available for the period when the incinerator was operating. Although chemicals were likely present in incinerator gases when the site was operating, a current route for air exposure is not apparent. Most of the soil on the former incinerator and park properties are grassed or covered with asphalt, so dust generation is unlikely under current conditions. The City's contractor removed debris-containing material from the former elementary site, and much of this area has been resurfaced, paved or landscaped. An air monitoring station, operated by Broward County Department of Planning and Environmental Planning, has been located on the former incinerator or former school portion of the site, from April 1971 until the present. This site measures carbon monoxide, sulfur dioxide and large particulate matter (PM10). More recently, this air-monitoring site has also detected atmospheric mercury. No exceedences for these parameters have been recorded.

Off-site Contamination

For this public health assessment, we define off-site as the area outside the Lincoln Park complex property boundaries (Figure 2, Appendix B).

Off-site Groundwater

In 2003, contractors for the DEP sampled four off-site groundwater-monitoring wells (E&E 2003). One upgradient monitoring well, north of the site, had contamination above a drinking water standard (Table 6). Only one monitoring well was down gradient (east) of the site, and this down gradient well did not show contamination. In addition, DOH does not know of anyone who is using shallow groundwater near the site for drinking or other purposes. However, based on recent Lincoln Park shallow groundwater test results, DEP may require additional off-site sampling for remediation purposes.

Off-site Soil

Between 2002 and 2003, contractors for the City and DEP analyzed seven off-site surface soil samples and one off-site subsurface soil sample (EE&G 2002, E&E 2003). DEP's contractor, E&E, analyzed for target compound list metals, SVOCs, VOCs, and TEQ dioxins. The City's contractor analyzed for arsenic, barium, and lead. E&E found all the off-site surface soil samples contained PAHs slightly above the screening value (Table 4). Only one off-site surface soil sample contained any other contaminant of concern, (they measured arsenic at a residence north of the site). The off-site subsurface soil samples did not have any chemicals above screening values (Table 5).

Community members asked the DEP to investigate the occurrence of waste materials in their yards. In July 2004, DEP and their contractor sampled offsite soils (0 to 3 inches) for metals, PAHs, (and other semi-volatile chemicals) and dioxins. In half the 22 yards sampled, the

laboratory measured chemicals at levels slightly above their residential Soil Cleanup Target Levels:

- Four yards had arsenic and TEQ PAHs,
- Four had arsenic,
- One had arsenic and TEQ dioxins,
- One had TEQ PAHs, and
- One had TEQ dioxins.

DEP and their contractor also sampled soil from road rights-of ways, off-site City property, and vacant lots. Their lab measured arsenic, PAHs, and TEQ dioxins in these off-site, non-yard locations above screening values. In some cases, the non-yard levels were higher than the levels of these same chemicals measured in yards.

Quality Assurance and Quality Control

DOH used existing environmental data to prepare this public health assessment. We assumed these data are valid. Governmental consultants, or consultants overseen by governmental agencies, collected and analyzed the environmental samples. The completeness and reliability of the referenced environmental data determine the validity of the analyses and conclusions drawn for this public health assessment. 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.

Physical Hazards

DOH did not observe any physical hazards during its January 27, 2002 site visit. Both DOH and DEP personnel attended the public meetings where the community reported physical hazards (see the Community Health Concerns Section above). Nearby residents also reported to Southeast District DEP personnel that children started and drove heavy construction equipment left on site with keys in the ignition.

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 to assess the public health significance of the contaminants.

We examine human exposure pathways to determine whether people can come into contact with contaminants at or from a site. 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 well 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 that might contact the contaminants.

We eliminate an exposure pathway from consideration if one or more of these parts is not present and is unlikely ever to be present. Exposure pathways that are not eliminated in this way are either completed 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.

In the past, City workers may have been exposed to metals, PAHs, and TEQ dioxins in soil or dust by inhalation or incidental ingestion or both. DOH does not have any worker personal monitoring data to assess the threat to worker's health. The chemical levels measured on the site now can only give us information on those site-related chemicals that did not break down since site releases stopped. Long-time community members or former workers may have information on past work practices.

Completed Exposure Pathways

In the past, former workers may have been exposed to contaminants in on-site soil. Former workers at the incinerator or wastewater treatment facilities may have been exposed via inhalation, ingestion, or dermal contact to debris, emissions, residue, or sludge contaminated with metals, PAHs, and/or dioxins (Table 7, Appendix B).

Potential Exposure Pathways

If incinerator wastes on the Lincoln Park property were at the surface in the past (rather than covered with one foot of clean fill as they are now), children or adults could have been exposed to elevated levels of metals, PAHs, and dioxins.

Residents' past off-site exposures to soil wastes or air emissions are potential exposure pathways. No information is available to confirm the presence of chemicals in off-site air when the incinerator facility was operating. The contaminated areas of the former incinerator site are currently fenced and covered with vegetation. No vehicles are using dirt roads on the site; therefore, the creation of large amounts of dust through everyday activities is unlikely. However, if in the future soil at the former incinerator site is disturbed and dust generation is not controlled, nearby residents could be exposed to dust containing metals, PAHs, and possibly dioxins.

In the future, remediation, construction, or landscaping workers on the former municipal incinerator site or Lincoln Park could be exposed to metals, PAHs, and dioxins through incidental ingestion or skin contact with contaminants in on-site surface soil or through inhalation of contaminated dusts (Table 8, Appendix B).

Incomplete Exposure Pathways

Because municipal water is available for drinking purposes, we classify on- and off-site groundwater as an incomplete pathway (Table 9). DOH was unable to locate any nearby private drinking-water wells that are currently in use.

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. We discuss these chemicals by media—chemicals that were measured at levels below their screening values are not discussed. For example, if a chemical was measured in soil above its screening value and in groundwater below its screening value, only the possible health effects of exposure to soil are discussed. Insufficient information on waste type, waste location, or exposure pathways could limit this evaluation.

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 one-pound rat will also cause toxicity in a one-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. Accordingly, 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 body weight.

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, and other factors needed for dose calculation (ATSDR 2004; EPA 1997). In calculating the dose, we assumed people are exposed daily to the maximum concentration measured at the site for each contaminant in each environmental medium. ATSDR's toxicological profiles 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 of exposure. Acute exposures are those with duration of 14 days or less; intermediate exposures are those with duration of 15–364 days; and chronic exposures are those that occur for 365 days or more (or an equivalent period 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 and groundwater, DOH used the following assumptions (EPA 1997):

1. children 1–4 years of age ingest an average of 200 mg of soil and drink 1 liter of water per day,
2. adults ingest an average of 100 mg of soil and drink 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 soil and groundwater at the maximum concentration measured for each contaminant.

Between the 1920s and the mid-1990s, workers or trespassers on the site may have been exposed to other chemicals in addition to the metals, PAHs and dioxins measured on the site since 1998. Our evaluation of health risks for chemical exposure levels using future residential site use assumptions may also be applicable to past exposures to the measured levels of metals, PAHs and dioxins. Determining the probability for illness from exposures to other chemicals would be difficult however, because no personal worker exposure or other data exist. Although no air data are available for the period when the incinerator was operating, Broward County Department of Planning and Environmental Protection operated an air monitoring station on the former incinerator or former school property from April 1971 to the present. This site monitors for carbon monoxide, sulfur dioxide and large particulate matter (PM10). More recently, this air-monitoring site has also detected atmospheric mercury. No exceedences for these parameters were recorded

Tables 10–16, Appendix B show the maximum estimated exposure doses calculated using the highest measured levels of contaminants on and off the site.

Incomplete Exposure Pathway: To avoid repeating that no one is currently using the salty shallow groundwater for drinking or other purposes but still address why groundwater remediation may be necessary, we note the following levels of chemicals measured in shallow groundwater exceeded drinking water standards:

- The highest measured level of **arsenic** in on-site groundwater exceeded the arsenic drinking water standard and if ingested daily could theoretically increase cancer risk: for children the increase might be 3 in 10,000 persons, for adults the increase might be 1 in 1,000 persons.
- One shallow on-site groundwater monitoring well showed **antimony** above the drinking water standard.
- One early sample of shallow groundwater measured **chromium** above the chromium screening value (in the southwestern part of the former Lincoln Park Elementary School) but was not confirmed by later groundwater analyses. Suspended sediment in this early sample may have contained chromium. Later samples taken using quiescent sampling did not show chromium above the drinking water standard.

- One groundwater sample from an off-site up-gradient monitoring well showed **di (2-ethylhexyl) phthalate** above its screening level. Di (2-ethylhexyl) phthalate is a chemical used in plastic to make it bendable. Long-term ingestion of the measured level of di (2-ethylhexyl) phthalate at this level might increase "apparent" risks for developing cancer—to about one additional cancer case in 100,000 persons. Inhalation of di (2-ethylhexyl) phthalate volatilized from water at the measured level is not likely to cause illness. No studies of animals or people showed systemic, skin, or eye effects for direct exposure to di (2-ethylhexyl) phthalate.
- One shallow on-site groundwater monitoring well showed **manganese** above the drinking water standard.

Groundwater sampling by DEP's contractor did not confirm the presence of lead in on-site groundwater above the drinking water standard. We discuss the potential health effects for chronic exposures to soil contaminants in the following sections, by chemical.

Arsenic

Children's or adults' daily, long-term inhalation or ingestion exposures to the highest level of arsenic measured in on- or off-site ***surface soil*** is not likely to cause non-cancer illnesses. The theoretical cancer risk for the highest arsenic level measured in on-site surface soil is about 1 additional cancer* case in 100,000 exposed persons. The highest measured off-site, soil arsenic level might increase cancer† risk by 3 cases in 100,000 if all the assumptions we make for residential exposures were fulfilled (although this level was measured in a sample from a non-yard property).

Subsurface soil at Lincoln Park, near Sistrunk (2–4 feet below the surface) had the highest-measured arsenic level on the complex. The dose DOH calculated for daily ingestion of soil with the highest measured arsenic level equals a dose documented to cause non-cancer illness in people who drink arsenic-contaminated water daily. The theoretical increased cancer risk for this highest measured arsenic level is 1 in 1,000 persons. However, people are unlikely to ingest soil containing this level of arsenic, daily, for longer than a year, because the sample came from soil 2 to 4 feet below the surface. In addition, the confirmation analysis (the value measured when another part of this soil sample was reanalyzed) only found about half the amount of arsenic measured in the first soil sample run.

Copper

The City and DEP found the highest level of copper in **surface soil** on the former incinerator property: the dose calculated for this level is unlikely to cause illness. They measured the highest level of copper in **subsurface soil** under the Lincoln Park property: children accidentally ingesting soil containing this level of copper (for 14 days or less) could experience

---

∗ From lowest to highest dose cancer effect levels, chronic arsenic exposures in people have been linked to lung cancer, basal and squamous cell skin cancers, liver cancer (haemangioendothelioma), urinary tract cancers (bladder, kidney, ureter, and all urethral cancers), and intraepidermal cancers. Intraepidermal is the name for the early pre-invasive form of squamous cell skin cancer. Pre-invasive means that the cancer cells are confined to the outermost layer of skin, the epidermis. At this stage, the cancer cells are unlikely to have spread to the lymph nodes, but they can spread along the skin surface. If left untreated, these cells can develop into an invasive cancer and spread into the lymphatic system.

†Non-yard samples gave higher arsenic values than yard samples, same comment as above footnote for cancers linked to arsenic.

gastrointestinal problems including nausea, vomiting, diarrhea, and abdominal pain. Because incinerator wastes on Lincoln Park are covered with a foot of sand, it is less likely persons could be regularly exposed to it than persons might be to surface soil on a residential property (ATSDR 2002c).

Dioxins

One surface soil sample on the former incinerator property had dioxins above the ATSDR environmental media evaluation guide for children. Most human health effects from dioxin exposure are known from high-level accidental or occupational exposures. The exposure dose calculated for incidental ingestion of soil from the former incinerator property was much lower than those doses associated with illness in people. In addition, the child's exposure we calculated (should the incinerator land with this level be used for residential use) is sixty thousand times less than the smallest dose showing adverse health effects in animal studies. While this smallest dose caused altered social behavior and reproductive effects[§] in rhesus monkeys (ATSDR 1998b), dioxin exposure has been linked with many other adverse health effects at higher levels. The dose DOH calculated for children and adults exposed daily for long periods of time to the highest dioxin soil level measured on the site is close to the "no significant"[†] increased cancer risk[Ω,] or about 1 in 1 million[★]. The part of the former municipal incinerator property with elevated dioxins is currently fenced and not accessible to the public, although people could have been exposed to it in the past.

We evaluated the highest measured off-site dioxin values similarly, by assuming daily long-term exposure for children and adults. We found the highest measured dioxin level in an off-site **yard** sample might present about a 1 in 1 million increased risk of cancer for children and adults, and a **non-yard** sample could present a an increased risk of about 2 in 1 million persons. While 2,3,7,8-TCDD has been demonstrated to be a carcinogen in laboratory animals, studies in humans found increases in cancer mortalities (all types combined), but only in highly exposed workers with long latency periods. The data on specific types of cancers are inconclusive. Many studies reported only small relative risks, and the possible impact of confounding factors was not sufficiently evaluated (Pohl et al 2002).

Lead

The City's contractor collected surface soil between 0 and 24 inches below ground surface and later collected confirmation samples between 0 and 6 inches below ground surface. At DOH's request, DEP's contractor collected surface soil samples between 0 and 3 inches below ground

§ Moderate endometriosis.

† One additional cancer case in 100,000 people may not be apparent in the population that could have exposure to the site, thus the name "no apparent" (ATSDR 2000a).

Ω Statistically significant increases in risks for all cancers were found in workers highly exposed to dioxins with longer latency periods. Although the estimated Standardized Mortality Ratios are low <Standardized Mortality / Morbidity Ratios (SMR) are a widely used method of reporting death or disease which adjusts for differences in age and sex across regions, they are a measure of premature mortality. Instead of giving an adjusted rate, the SMR gives a ratio that is a direct comparison with a standard (e.g. the entire state>, they are consistent across studies with the highest dioxin exposures. The evidence linking doses with site-specific cancers is weaker, with some data suggesting a possible relationship between soft-tissue sarcoma, non-Hodgkin's lymphoma, or respiratory cancer. In mice and rats, (depending on species and sex), dioxin exposure has been linked with cancers of the liver, lung, thyroid, and oral cavity.

★ DOH estimated theoretical cancer risks by multiplying the Lifetime Average Daily Dose by the EPA cancer slope factor for dioxin (1.56×10^5/ mg/kg/day) (EPA 2003).

surface. People, but especially children, are more likely exposed to the top 3 inches of soil. In total, the City and DEP analyzed 84 surface soil samples for lead. Of these 84, only four had lead above the residential soil cleanup target level. These four samples were composited from soil collected between 0 and 24 inches below the surface. One of the four was on the northwestern part of the former municipal incinerator property. The remaining three were on the Lincoln Park Property (along the northwestern boundary). Neither the 0–6 inch samples nor the 0–3 inch samples on the Lincoln Park Property contained lead above the residential soil cleanup target level.

For lead, estimated blood levels more accurately predict health effects than traditional dose estimates. DOH used a simple model to estimate blood lead levels and likely health effects (ATSDR 1999) for exposures to the highest measured levels of lead in soil. This model takes into account children and adults' exposures to lead from sources other than the site. Using this model, DOH assumed people could be exposed to lead-contaminated soil eight hours per day. However, thick grass covers the soil in the park, the former municipal incinerator site is fenced, and only deep surface soil samples (0–2 feet) showed elevated lead levels while shallow surface soil samples (0–3 inch) did not. For these reasons, it is unlikely children or adults would have had sufficient long-term exposures to media that would have been likely to increase their blood lead levels.

DOH modeled the highest measured lead values to predict possible health effects if, in the future, land use changed and construction or other activities exposed residues and debris in the deeper soil so that people might have daily contact with it. Blood system, neurological, metabolic, developmental, reproductive, kidney, and increased blood pressure effects might occur with daily long-term exposures to the highest measured lead levels (ATSDR 1999). We discuss such predictions in the following section and in the table. Table 1 lists the values estimated for the highest measured lead exposure level in on and off-site media. Lead in the bloodstream interferes with the body's ability to make new red blood cells (ATSDR 1999). Too few red blood cells (anemia) means the body's uptake of energy from food and oxygen from air are less efficient. The processes leading to anemia are seen at all levels of lead exposure: there is no threshold for this effect. There also may be no threshold for adverse neurological effects of lead in children: intelligence, balance, hearing, and attention deficit/hyperactivity disorder (ATSDR 2000b).

Table 1: Modeled Blood Lead Levels Assuming Daily Ingestion of Soil with Highest Lead Levels

Media	Children Blood (µg/dl)	Adults Blood (µg/dl)
Highest at School (top 24 inches) 267 ppm	1 - 3	1 - 3
Highest at Park (top 6 inches) 298 ppm	2 - 3	1 - 3
Highest at Park (top 24 inches) 1,760 ppm	2 - 11	1 - 10
Highest on-site Subsurface Soil (below 24 inches) 3,240 ppm	3 - 19	2 - 18
Highest off-site Surface Soil 120 ppm	1 - 2	0.3 - 2

(Model assumptions contained in Tables 15 and 16, Appendix B)

Table 2: Likely Health Effects at Blood Lead Levels Between 1–200 Micrograms per Deciliter (µg/dl).

Children Blood (µg/dl)	Adults Blood (µg/dl)	
No threshold	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.
1 - 17 µg/dl		Alterations in visual evoked potentials‡.
6.5 µg/dl		(Average value at 24 months of age) - Lower cognitive function test scores in children 5 to 10 years of age.
6 - 200 µg/dl		Decreased neurobehavioral function; slightly decreased performance on IQ tests and other measures of neuro-psychological function.
≥ 9 µg/dl		Impaired motor developmental in 6 year olds.
	5.5 µg/dl (average)	Decreased performance on neurobehavioral tests.
7 - 80 µg/dl	80 µg/dl	Decreased Pyrimidine 5' nucleotidase§.
10 - 15 µg/dl		Impaired mental and physical development.
11.9 µg/dl	36 (mean) µg/dl	(Geometric mean) - Dizziness when standing (postural disequilibrium).
12 -17 µg/dl		Reduced birth weight and/or reduced gestational age. Increased incidence of stillbirth and neonatal death.
	≥10 µg/dl	Increased incidence of miscarriages and stillbirths.
12 - 120 µg/dl		Decreased vitamin D metabolism.
>15 µg/dl		Increased zinc protoporphyrin (ZPP) that can lead to anemia.
	7 - 38 µg/dl	Increased blood pressure most prominent in middle-aged white men.
	18 - 26 µg/dl	Renal impairment with gout or hypertension.

Studies have not established a link between elemental lead and cancer in humans. High level, long-term exposure to lead acetate and lead phosphate causes kidney cancer in rats and mice.

Polycyclic Aromatic Hydrocarbons (PAHs)

DOH evaluated all PAHs measured in on- and off-site soils for toxic-equivalence (TEQ) to benzo(a)pyrene (Appendix A). Neither ingestion of soil nor inhalation of dust is likely to result in non-cancer illness at the highest measured levels (ATSDR 1995). Long-term worker PAH exposures (for much greater exposure levels than those calculated for theoretical residential site use) have been linked with many non-cancer health effects. These include skin and eye irritation, photosensitivity, respiratory irritation (with cough and bronchitis), leukoplakia[Ω], precancerous

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

§ "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).

Ω Leukoplakia is a common, potentially pre-cancerous disease of the mouth that involves the formation of white spots on the mucous membranes of the tongue and inside of the mouth. Despite the increased risk associated with having leukoplakia, many people with this condition never get oral cancer.

skin growths enhanced by exposure to sunlight, erythema[€], skin burns, acneiform lesions, mild hepatoxicity, and haematuria[†]. Several PAH compounds are immunotoxic, and some suppress selective compounds of the immune system. Workers' studies also show that although direct dermal contact may be of concern at high exposure levels, lower levels are not likely to cause significant skin irritation (Goodfellow et al. 2001).

The highest PAH (TEQ) level measured on the complex was from surface soil on the southeastern part of the former Lincoln Park Elementary School. The theoretical increased cancer risk for this highest PAH TEQ level is about 6 in 1 million for children and adults, between "no apparent" and "no significant" increased risk[‡].

Child Health Considerations

ATSDR and 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 adults are for certain kinds of exposures 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 exposures 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 developed the chemical screening values DOH used for children's exposures in preparing this report. Although children have special susceptibilities to lead exposures, testing of soil samples from the schoolyard did not show elevated levels of lead. While higher lead values were measured in deeper park soil, the 0-3 inch and 0-6 inch samples did not contain lead levels above the DEP soil cleanup target levels for residential land use. Therefore, the currently available information does not indicate that children playing in the park were very likely to have been exposed to elevated soil lead levels. In the past, a sand filled area surrounded some of the playground equipment but it contained sand brought in for that purpose, it was not material from the site.

Other susceptible populations may have different or enhanced responses to toxic chemicals than will most persons exposed to the same levels of that chemical in the environment. Reasons may include genetic makeup, age, health, nutritional status, exposure to other toxic substances (like cigarette smoke or alcohol), or possibly a combination of these factors. These factors may limit a persons' ability to detoxify or excrete harmful chemicals or may increase the effects of damage to their organs or body systems.

€ Erythema nodosum is an inflammation of fat tissue beneath the skin.
† Haematuria is passage of blood in the urine.
‡ Worker exposures to high levels of PAHs show cancers (skin, bladder, lung and gastrointestinal) are the most significant endpoint of PAH toxicity.

Conclusions

Currently the Lincoln Park Complex site presents **"no apparent public health hazard"**. The City remediated the former Lincoln Park Elementary School portion of the site in 2003 and 2004. Most of the remainder of the site is fenced, which prevents ash exposure. Soil tests show that where it exists, this ash lies approximately one to two feet below the surface, and deeper. Current exposure pathways include incidental soil ingestion (and inhalation of dust) in rights-of-ways adjacent to the site and in off-site soil.

At this time, the **health hazards for past exposures are indeterminate** because we do not know if, or for how long, people may have been exposed to ash and other site-related contaminants, or at what levels these exposures occurred. According to the City, they spread fill and grew sod on Lincoln Park before it was used for a park in 1958. Much of the grassed area on the incinerator property was under wastewater treatment vats from the 1969 to the mid 1990s. Lincoln Park and the former municipal incinerator portions of the complex could present a **future public health hazard** if people had long-term exposures to the highest levels of lead, copper, TEQ PAHs or arsenic measured in on-site ash, primarily in soil one to two feet below land surface, or deeper.

In the Discussion section of this report, we explain exposure pathways and possible disease associations for daily, long-term exposures to the highest levels of seven chemicals measured above their health-based screening levels on and near the site. For the following conclusions about such daily, long-term exposures, we give correspondingly numbered recommendations in the **Recommendations** section that follows.

1. On-site soil samples from six to 24 inches and below 24 inches showed higher chemical levels primarily due to ash content. Ingestion of ash could cause non-cancer health effects due to the highest measured levels of arsenic, copper and lead. Ingestion of ash could moderately increase theoretical cancer risks (to about one theoretical case in 1,000) due the arsenic content.
2. Inhalation of ash dust could increase theoretical cancer risks (to almost one theoretical case in 10,000, a "low" increased risk) due the arsenic content.

The following conclusions address the ***potential for exposures*** and have precautionary recommendations that residents may take "to be on the safe side".

3. Off-site soil contamination is not well characterized.
4. Although chemical contamination of off-site groundwater in irrigations wells has not been established, off-site shallow irrigation wells may intercept surface water, which may contain potentially harmful bacteria.
5. Available information on exposure pathways and chemical levels for the site is incomplete. Resident's total exposures and sensitivities are likely to be different. People may contact chemicals at their jobs, through their hobbies and from other non site-related sources. Adding to the unknown, scientists' understandings of the causal links between chemical exposures and diseases are incomplete.

Ingestion of contaminated groundwater is not a current exposure pathway, is not expected to be a future pathway, and is not known to be a past exposure pathway. Municipal water is currently available for residential and commercial use in this area.

Recommendations

1. Workers and others should avoid contact with contaminated *subsurface* soil (deeper than 6 inches) under Lincoln Park and former incinerator portions of the complex, especially soil that contains debris or ash. If the park remediation method does not remove the contaminated ash, DEP should not permit horseshoes pits or other activity stations that might disturb soil in the Park reuse options.
2. Workers and nearby residents should avoid dust inhalation during any future cleanup, remodeling, utilities installation, construction, or other work that disturbs soils or removes vegetation in Lincoln Park or the former incinerator portion of the complex especially the soil that contains ash. Firms conducting any future remediation, utilities installation, construction, or other work that disturbs soils or removes vegetation in Lincoln Park or the former incinerator portion of the complex should control dust generation or monitor air quality for metals.

DOH makes the following recommendations so nearby residents can "be on the safe side" as part of prudent public health practice:

3. Residents nearest the site can follow the safe gardening practices in the Appendix C pullout to avoid potentially ingesting contaminated soil.
4. People should not drink irrigation well water or use it for bathing, cleaning food contact surfaces (like grills, dishes, or grilling utensils), or for gutting fish.
5. Persons who feel ill, especially with persistent symptoms, should see their doctors. They should tell their doctors about any concerns they might have about environmental exposures

Public Health Action Plan

The DOH's evaluation has identified workers or others who might dig down into deeper buried soil as the populations at highest risk of exposure to incinerator wastes. Dust from such activities could also expose passers by to excavated waste materials. DOH staff discussed these issues with a City Public Information official. The City of Ft. Lauderdale has committed to keeping the community around the Lincoln Park complex informed of the remediation process as it evolves. The City's Department of Public Information will work closely with the community to disseminate information and answer questions; DOH suggests notification by direct mail of upcoming remediation projects or procedures. Additionally, the City will coordinate the work of contractors at the site to implement dust suppression measures and educate site workers regarding appropriate safety procedures. DOH suggests making one on-site supervisor responsible for safety measures.

Because residents asked for information on possible offsite soil contamination, DEP sampled 22 residential properties and 8 "other" locations in June 2004. The "other" properties included road right-of-ways, vacant properties, and off-site properties that the City owns. DEP sampled both surface soil and deeper soils. Surface soils had the highest measured levels of TEQ dioxins, PAHs, and arsenic, while subsurface soil from the incinerator property and the lot north of the site had the highest measured lead and barium levels. DOH evaluated the surface soil results and found the measured contaminant levels are unlikely to cause non-cancer illnesses, and might only slightly increase cancer risks to exposed individuals. We handed out guidelines for good gardening practices for those yards with chemical(s) measured above the DEPs soil cleanup

target levels (Appendix C), just to be on the safe side, should someone be raising food crops, until better information is available on the location and levels of off-site contamination. The City will do further investigation of those areas that exceeded residential or industrial SCTLs and will work with DEP to assure appropriate remedial actions are taken.

DEP, DOH, and City staff walked door-to-door to deliver residents' soil testing results (and the good gardening practices card) on December 15 and 16, 2004.

The City hosted a Lincoln Park Open House at Delevoe Park on January 25, 2005. The City had additional soil testing results from their contractor, DEP communicated what they found in the neighborhood, and DOH shared the Public Comment draft of their Public Health Assessment.

The site is currently fenced to restrict access. Temporary measures have been discussed to limit access to contaminated soil along the rights-of-way (19th Ave and 7th Street) near the site. The City may temporarily cap these areas with six inches of soil and sod or asphalt. These areas will be remediated along with the incinerator site. The City has obtained funding to further address off-site contamination in yards.

Past Public Health Involvement—In May 2003, the Broward County Health Department mailed letters to the parents of 90 children who attended the after-school program at the former Lincoln Park School, offering blood lead testing (letter included in Appendix C). The county health department also publicized a second offer for blood lead testing, through a press release in major and community media outlets, and did some lead testing in the spring of 2004. The county health department tested approximately 50 persons, with none showing abnormal blood-lead levels.

In addition to going door-to-door with DEP and Broward Co. Health Department staff in December 2004, DOH Health Assessment Team staff have met with Durrs community members four times. We attended DEP's presentation of their work plan for sampling the Lincoln Park complex site on January 27, 2002, and DEP's presentation of the sampling results on November 13, 2003. We attended Representative Alcee Hastings Town Hall Meeting on June 28, 2004, and the Lincoln Park Open House at Delevoe Park on January 25, 2005. We plan to continue working with the community and their representatives to address their concerns about the public health threats associated with this site.

Authors, Technical Advisors

Florida Department of Health Author

Connie Garrett

Bureau of Community Health
Division of Environmental Health
(850) 245-4299

Florida Department of Health Designated Reviewer

Randy Merchant

Bureau of Community Health
Division of Environmental Health
(850) 245-4299

ATSDR Technical Advisor

Jennifer Freed

Technical Project Officer
Division of Health Assessment and Consultation

References

[ATSDR] Agency for Toxic Substances and Disease Registry. 1992. Toxicological profile for antimony. Atlanta: US Department of Health and Human Services. Publication No.: PB/93/110641/As.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1995. Toxicological profile for polycyclic aromatic hydrocarbons. *Update.* Atlanta: US Department of Health and Human Services. Publication No.: PB/95/264370.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1998. Guidance on including child health issues in division of health assessment and consultation documents: Washington DC: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1998b. Toxicological profile for chlorinated dioxins. Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1999. Toxicological profile for lead. *Update.* Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2000a. Toxicological profile for arsenic. *Update.* Atlanta: US Department of Health and Human Services. Publication No.: PB/2000/108021

[ATSDR] Agency for Toxic Substances and Disease Registry. 2000a. Toxicological profile for chromium. *Update.* Atlanta: US Department of Health and Human Services. Publication No.: PB/2000/108022

[ATSDR] Agency for Toxic Substances and Disease Registry. 2000b. Toxicological profile for manganese. *Update.* Atlanta: US Department of Health and Human Services. Publication No.: PB/2000/108021

[ATSDR] Agency for Toxic Substances and Disease Registry. 2001. Soil and water comparison values. Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2002a. Toxicological profile for di (2-ethylhexyl) phthalate. Lead Toxicity. Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2002b. Case study in environmental medicine. Lead toxicity. Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2002c. Toxicological profile for copper. *Update.* Atlanta: US Department of Health and Human Services.

Cresanta, J. 2002. October 14. 2002 email to Randy Merchant in response to information in a newspaper article titled “Opinion: Fort Lauderdale ignoring landfill peril”

[DEP] Department of Environmental Protection. 1999. Development of soil cleanup target levels, for chapter 62-777, F.A.C. Tallahassee, FL: Division of Waste Management.

[DEP] Department of Environmental Protection.2005 letter from Mary Jean Yon, Director of DEP Division of Waste Management (2/21/05) to Sharron Bourassa, Legal Aid Services of Broward County, Inc., Director of Special Project’s for Governor Bush

[E&E] Ecology and Environment. 2003. Site inspection report, Lincoln Park Complex/ former City of Fort Lauderdale incinerator site, Fort Lauderdale, Broward County, Florida. Tallahassee, FL: Florida Department of Environmental Protection, Site Screening Superfund Subsection.

[E&E] Ecology and Environment. 2004. pages of Lincoln Park data and maps from report submitted to DEP.

[EE&G] Evans Environmental and Geosciences. 2002. Preliminary contamination assessment report for Lincoln Park Complex, NW 19th Avenue and Sistrunk Boulevard, Fort Lauderdale, Florida. West Palm Beach, FL.

[EE&G] Evans Environmental and Geosciences. 2003. Source Removal Report for Proposed CFL One-Stop Shop (former Lincoln Park Elementary School), NW 19th Avenue and Sistrunk Boulevard, Fort Lauderdale, Florida. Prepared for the DEP, 400 North Congress Avenue, West Palm Beach Florida 33401, prepared on behalf of the City of Fort Lauderdale, 100 North Andrews Avenue, Fort Lauderdale, Florida

[EE&G] Evans Environmental and Geosciences. 2005. Tables from March 2005 report for Lincoln Park and the former incinerator site, prepared for the DEP, 400 North Congress Avenue, West Palm Beach Florida 33401, on behalf of the City of Fort Lauderdale, 100 North Andrews Avenue, Fort Lauderdale, Florida

[EPA] Environmental Protection Agency. 1997. Exposure factors handbook, Volumes I, II, and III. Washington, DC: EPA/600/P-95/002F a, b, c.

[EPA] Environmental Protection Agency Region III. Risk based concentrations. Available at: http://www.epa.gov/reg3hwmd/risk/index.htm. Last Accessed August 1, 2003.

Goodfellow FJL, Murray VSG, Ouki SK, Iversn A, Sparks A, Bartlett T. 2001. Public health response to an incident of secondary chemical contamination at a beach in the United Kingdom. Occup Environ Med 58: 232–8 (April).

Patel, P. 2005. July 22, 2005 email to Connie Garrett providing the limitations for Florida Cancer Data System review limitations discussed in February 21, 2005 meeting.

Kamrin MA. 1988. Toxicology—a primer on toxicology principles and applications. Chelsea, Michigan: Lewis Publishers.

Pohl HR, Hicks HE, Jones DE, Hansen H, DeRosa C. Public Health Perspectives on Dioxin Risks: Two Decades of Evaluations. Human Ecol Risk Assess 2002:2:233–250.

US Census Bureau. 2000. LandView 5 software. Washington: U.S. Department of Commerce.

Appendix A - TEQs for PAHs and Dioxins/Furans

TEQs for PAHs Analytical Results are Multiplied by the following factors and then added together to obtain one number to be compared with the screening value for Benzo[a]pyrene

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

Source: ATSDR, 1995b.

TEQs for Dioxins/Furans: Analytical Results are Multiplied by the following factors and then added together to obtain one number to be compared with the screening value for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), EPA adds ½ the detection level for all congeners, if any congeners are detected.

Dioxin/Furan	Toxicity Equivalency Factor
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.0001

Source: WHO, 1998 TEF.

Appendix B - Figures and Tables

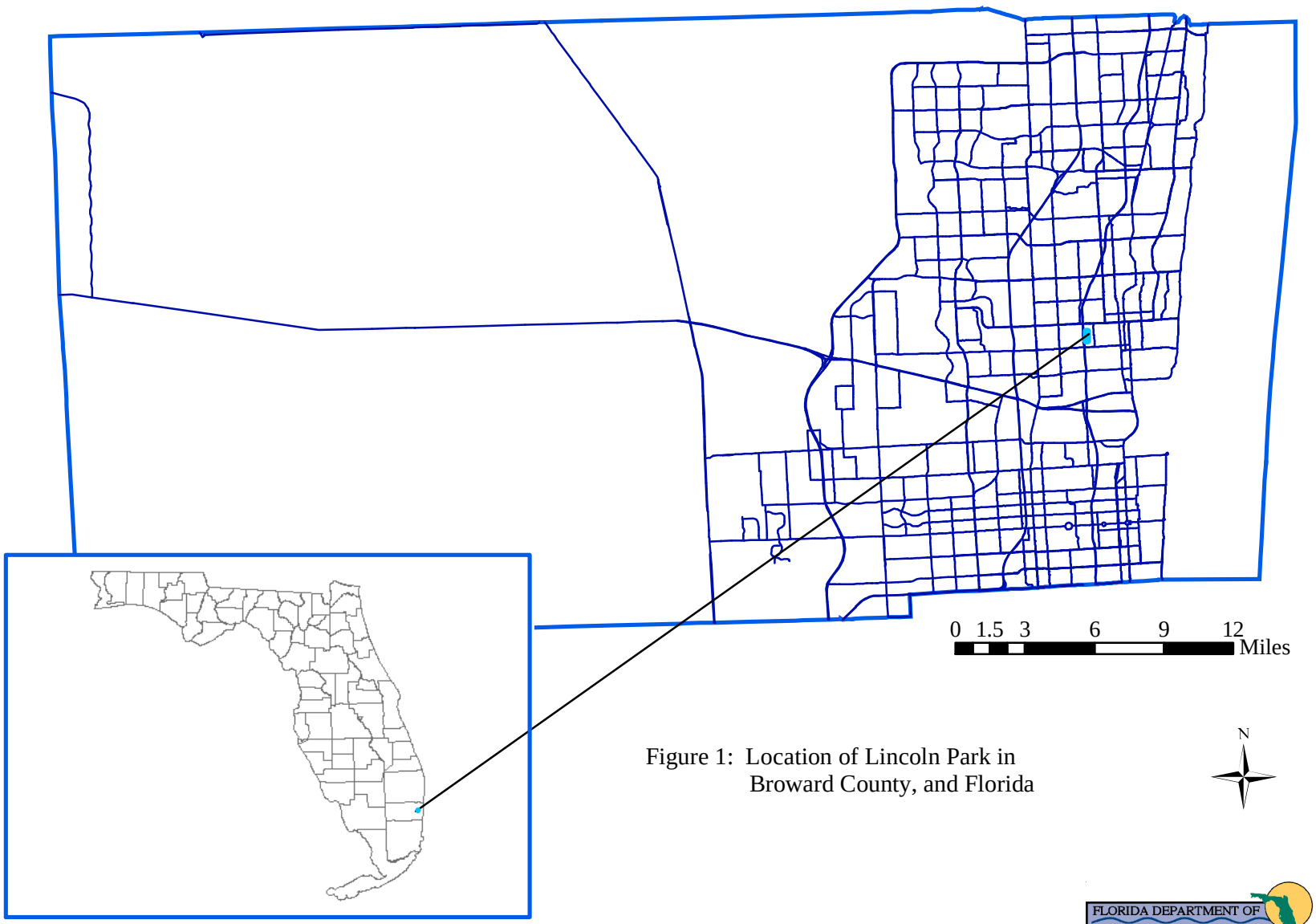


Figure 1: Location of Lincoln Park in Broward County, and Florida

FLORIDA DEPARTMENT OF HEALTH

FLORIDA DEPARTMENT OF HEALTH

0 0.125 0.25 0.5 0.75 1 Miles

N

Figure 2: Location of Lincoln Park in Ft. Lauderdale, Florida

1999 Aerial Photograph

Figure 3. Lincoln Park Complex

FLORIDA DEPARTMENT OF HEALTH

Photo 1: January\February 2003, showing DEP's contractor taking a surface soil sample.

Photo 2: January\February 2003, close-up view of the sampling hole.

Photo 3: January\February 2003, surface soil boring containing debris.

Photo 4: January\February 2003, former Lincoln Park School grounds, southern part of the site, before school buildings were demolished.

Photo 5: January\February 2003, monitor well head with quiescent sampling instrument on in the background.

Photo 6: January\February 2003, L-level x-ray fluorescence instrument used in soil screening.

Photo 7: January\February 2003, in the grassy field that was the site of the municipal incinerator and wastewater treatment plant, looking south.

Photo 8: January\February 2003, in the grassy field that was the site of the municipal incinerator and wastewater treatment plant, looking east.

Photo 9: May 2003, former Lincoln Park School grounds after school buildings were demolished.

Photo 10: May 2003, former Lincoln Park School grounds after school buildings were demolished.

Photo 11: May 2003, former Lincoln Park School grounds after school buildings were demolished.

Photo 12: May 2003, former Lincoln Park School grounds after school buildings were demolished.

.

Table 1. Maximum concentrations in on-site surface soil (8 were 0-3 inches, 49 were 0-2 feet deep)

Contaminants of Concern	Maximum Concentration (mg/kg)	Location of sample with maximum	# Greater Than Comparison Value/ Total # of Samples	Comparison Value☼	
				(mg/kg)	Source
Arsenic	10	FMI - North	20/57	0.5 CREG	ATSDR 2002
Chromium	BSL	-	0/57	200/2000 RMEG	ATSDR 2002
Copper	110J	FMI - North	1/57	110 SCTL[a]	DEP 1999
Di (2-ethylhexyl) phthalate	BSL	-	0/57	50 CREG	ATSDR 2002
Dioxins (TEQ)	0.00011223	FMI - North	1/57	0.00005/0.0007 EMEG	ATSDR 2002
Lead	267*/298**/1760***	LP - West	4/57	400 SCTL	DEP 1999
PAHs (TEQ)	1.4	FLPES - Southeast	11/52	0.1 CREG	ATSDR 2002

☼Comparison values are used to select chemicals for further scrutiny, not for determining the possibility of illness.
* Highest value on the school in the top two feet of soil ** Highest value on the Park in the top 6 inches. *** Highest on the Park in the top two feet.
BSL – below screening level
CREG- Cancer Risk Evaluation Guide
EMEG- Environmental Medial Evaluation Guide
FLPES - Former Lincoln Park Elementary School
FMI – Former Municipal Incinerator
mg/kg = milligrams per kilogram of soil
LP – Lincoln Park
PAH- polycyclic aromatic hydrocarbons are expressed in terms of benzo(a)pyrene equivalents
RMEG- Reference Dose Medial Evaluation Guide
SCTL- Soil Cleanup Target Level (SCTL[a] denotes a direct exposure value based o acute toxicity considerations)

Table 2. Maximum concentrations in on-site subsurface soil

Contaminants of Concern	Maximum Concentration (mg/kg)	Location of sample with maximum	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(mg/kg)	Source
Arsenic	1460	LP - South	13/15	0.5 CREG	ATSDR 2002
Chromium	BSL	-	0/15	200/2000 RMEG	ATSDR 2002
Copper	1500	LP- Central	1/15	110 SCTL[a]	DEP 1999
Di (2-ethylhexyl) phthalate	BSL	-	0/15	50 CREG	ATSDR 2002
Dioxins (TEQ)	BSL 0.0000145	FMI - North	0/15	0.00005/0.0007 EMEG	ATSDR 2002
Lead	3240	LP- Central	7/15	400 SCTL	DEP 1999
PAHs (TEQ)	0.1126	FMI - North	1/15	0.1 CREG	ATSDR 2002

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

BSL – below screening level hydrocarbons are expressed in terms of benzo(a)pyrene equivalents
CREG- Cancer Risk Evaluation Guide
EMEG- Environmental Medial Evaluation Guide
FLPES - Former Lincoln Park Elementary School
FMI – Former Municipal Incinerator
LP – Lincoln Park
mg/kg = milligrams per kilogram of soil
PAH- polycyclic aromatic
RMEG- Reference Dose Medial Evaluation Guide
SCTL- Soil Cleanup Target Level (SCTL[a] denotes a direct exposure value based o acute toxicity considerations)

Table 3. Maximum concentrations in on-site groundwater

Contaminants of Concern	Maximum Concentration (ug/L)	Location of sample with maximum	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(ug/L)	Source
Arsenic	59	LP - Southeast	10/34	10 MCL	ATSDR 2002
Antimony	26	LP - Northeast	1/34	6 MCL	ATSDR 2005
Chromium	150	FLPES- Southwest	1/14	3/100 RMEG	ATSDR 2002
Copper	BSL	-	0/14	1000 SDWS	DEP 1999
Di (2-ethylhexyl) phthalate	BSL	-	0/14	3 CREG	ATSDR 2002
Dioxins (TEQ)	BSL	-	0/14	0.00003 MCL	DEP 1999
Lead	39	FMI - Northwest	2/34	15 MCL	DEP 1999
Manganese	700	LP- South	1/20	300 LTHA	ATSDR 2005
PAHs (TEQ)	BSL	-	0/14	0.1 CREG	ATSDR 2002

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

BSL – below screening level
CREG- Cancer Risk Evaluation Guide
EMEG- Environmental Medial Evaluation Guide
GWCTL - Groundwater Cleanup Target Level
MCL - Maximum Concentration Level (Enforceable State of Florida Standards)
PAH- polycyclic aromatic hydrocarbons are expressed in terms of benzo(a)pyrene equivalents
RMEG- Reference Dose Medial Evaluation Guide
µg/L = micrograms per liter

Table 4. Maximum concentrations in off-site surface soil (0-6 inches below ground surface)

Contaminants of Concern	Maximum Concentration (mg/kg)	Location of sample with maximum	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(mg/kg)	Source
Arsenic	1.7	Hinton Res.	1/7	0.5 CREG	ATSDR 2002
Chromium	BSL	-	0/4	200/2000 RMEG	ATSDR 2002
Copper	BSL	-	0/4	110 SCTL[a]	DEP 1999
Di (2-ethylhexyl) phthalate	BSL	-	0/4	50 CREG	ATSDR 2002
Dioxins (TEQ)	BSL	-	0/4	0.00005/0.0007 EMEG	ATSDR 2002
Lead	BSL/120	Hinton Res.	0/7	400 SCTL	DEP 1999
PAHs (TEQ)	0.296	Hinton Res.	4/4	0.1 CREG	ATSDR 2002

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

BSL – below screening level
CREG- Cancer Risk Evaluation Guide
EMEG- Environmental Medial Evaluation Guide
mg/kg = milligrams per kilogram of soil
PAH- polycyclic aromatic hydrocarbons are expressed in terms of benzo(a)pyrene equivalents
RMEG- Reference Dose Medial Evaluation Guide
SCTL- Soil Cleanup Target Level

Table 5. Maximum concentrations in off-site subsurface soil

Contaminants of Concern	Maximum Concentration (mg/kg)	Location of sample with maximum	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(mg/kg)	Source
Arsenic	BDL	-	0/1	0.5 CREG	ATSDR 2002
Chromium	BSL	-	0/1	200/2000 RMEG	ATSDR 2002
Copper	BDL	-	0/1	110 SCTL[a]	DEP 1999
Di (2-ethylhexyl) phthalate	BDL	-	0/1	50 CREG	ATSDR 2002
Dioxins (TEQ)	BSL	-	0/1	0.00005/0.0007 EMEG	ATSDR 2002
Lead	BSL	-	0/1	400 SCTL	DEP 1999
PAHs (TEQ)	BDL	-	0/1	0.1 CREG	ATSDR 2002

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

BDL – below detection level
BSL – below screening level
CREG- Cancer Risk Evaluation Guide
mg/kg = milligrams per kilogram of soil
PAH- polycyclic aromatic hydrocarbons are expressed in terms of benzo(a)pyrene equivalents
RMEG- Reference Dose Medial Evaluation Guide
EMEG- Environmental Medial Evaluation Guide
SCTL- Soil Cleanup Target Level

Table 6. Maximum concentrations in off-site groundwater

Contaminants of Concern	Maximum Concentration (ug/L)	Location of sample with maximum	# Greater Than Comparison Value/ Total # of Samples	Comparison Value*	
				(ug/L)	Source
Arsenic	BSL	-	0/4	10 MCL	ATSDR 2002
Chromium	BSL	-	0/4	3/10 RMEG	ATSDR 2002
Copper	BSL	-	0/4	1000 SDWS	DEP 1999
Di (2-ethylhexyl) phthalate	47	Hinton Res.	1/4	3 CREG	ATSDR 2002
Dioxins (TEQ)	BSL	-	0/4	0.00003 MCL	DEP 1999
Lead	BSL		0/4	400 SCTL	DEP 1999
PAHs (TEQ)	BSL	-	0/4	0.1 CREG	ATSDR 2002

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

BSL – below screening level
CREG- Cancer Risk Evaluation Guide
EMEG- Environmental Medial Evaluation Guide
GWCTL - Groundwater Cleanup Target Level
MCL - Maximum Concentration Level (Enforceable State of Florida Standards)
PAH- polycyclic aromatic hydrocarbons are expressed in terms of benzo(a)pyrene equivalents
RMEG- Reference Dose Medial Evaluation Guide
µg/L = milligrams per kilogram of soil

Table 7. Completed exposure pathways

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental/ Exposure Media	Point of Exposure	Route of Exposure	Exposed Population and land use	
Contaminated on-site soil, dust and emissions	On-site facility residues	Wastes, surface soil, and air	Handling/transport of wastes, incidental soil contact, inhalation of contaminated dust	Incidental ingestion, inhalation, or skin contact	Former workers	Past

Table 8. Potential exposure pathways

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental/ Exposure Media	Point of Exposure	Route of Exposure	Exposed Population and land use	
Contaminated dust and emissions	Facility residues	Wastes, primarily subsurface soil, and subsurface soil dust	Incidental subsoil contact, inhalation of dust and other components in air	Incidental ingestion, inhalation, or skin contact	Nearby residents	Past
Contaminated on-site soil, dust	On-site facility residues	Wastes, subsurface soil, and subsurface soil dust	Construction, waste removal or other digging activities or vegetation removal which allows incidental subsoil or dust contact	Incidental ingestion, inhalation, or skin contact	Remediation, construction, or landscaping workers	Current/ Future

Table 9. Incomplete exposure pathways

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental/ Exposure Media	Point of Exposure	Route of Exposure	Exposed Population and land use	
Contaminated off-site soil, dust	Residential soil	Wastes, surface soil	Off-site property	Incidental ingestion and inhalation	Off-site residents/owners	Current/ Future
Shallow groundwater	None known	Shallow groundwater	On- or off-site property	Incidental ingestion and inhalation	Off-site residents/owners	Future

Model Parameters and Assumptions for Tables 10 - 14

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 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 Toxicological Profiles are given in these units. The air concentration is not a dose, therefore it is the same for adults and children.

mg/L = microgram per liter of water
mg/kg/day = milligrams per kilogram body weight per day
mg/M^3 = 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 period: 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/Child 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 Toxicological 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

Table 10. Estimated dose from exposure to on-site surface soil

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Soil/dust-Ingestion (mg/kg/day)		Soil/dust-Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Soil/dust-Inhalation (mg/m^3)
		Child	Adult	Child	Adult		Child and Adult
Arsenic (10 mg/kg)	0.0003 Chr	0.000133	0.000014	N.S.	N.S.	-	0.0000006
Chromium	-	-	-	N.S.	N.S.	0.00005	-
Copper (110J mg/kg)	-	0.0015	0.00016	N.S.	N.S.		0.000006
Di (2-ethylhexyl) phthalate	7 Acute 6 Int.	-	-	N.S.	N.S.	-	-
Dioxins (TEQ) (0.00011223 mg/kg)	-	0.000000002	0.0000000002	N.S.	N.S.	-	0.000000000006
Lead (1,760 mg/kg)	-	M	M	N.S.	N.S.	-	M
PAHs (1.4 mg/kg)	-	0.00002	0.000002	N.S.	N.S.	-	0.00000008

Acute- Acute exposure length of 0-14 days
Int - Intermediate exposure length of 15- 364 days
Chr – Chronic exposure length of more than 365 days
N.S. – Not Significant
mg/kg/day – milligram chemical per kilogram body weight per day
mg/m3 – microgram of chemical per cubic meter of air
M - values were modeled (tables follow)

Table 11. Estimated dose from exposure to on-site subsurface soil

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Soil/dust-Ingestion (mg/kg/day)		Soil/dust-Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Soil/dust-Inhalation (mg/m^3)
		Child	Adult	Child	Adult		Child and Adult
Arsenic (30 mg/kg)	0.0003 Chr	0.0004	0.00009	N.S.	N.S.	-	0.000002
Chromium	-	-	-	N.S.	N.S.	0.00005	-
Copper (1500 mg/kg)		0.02	0.004	N.S.	N.S.	-	0.00008
Di (2-ethylhexyl) phthalate	7 Acute 6 Int.	-	-	N.S.	N.S.	-	
Dioxins (TEQ) (0.000015 mg/kg)	-	0.0000000002	0.0000000004	N.S.	N.S.	-	0.000000000008
Lead (3,240 mg/kg)	-	M	M	N.S.	N.S.	-	M
PAHs (0.1126 mg/kg)	-	0.000002	0.0000004	N.S.	N.S.	-	0.000000007

Acute- Acute exposure length of 0-14 days
Int - Intermediate exposure length of 15- 364 days
Chr – Chronic exposure length of more than 365 days
N.S. – Not Significant
mg/kg/day – milligram chemical per kilogram body weight per day
mg/m3 – microgram of chemical per cubic meter of air
M - values were modeled (tables follow)

Table 12. Estimated dose from exposure to on-site groundwater

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Groundwater-Ingestion (mg/kg/day)		Groundwater-Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Groundwater-Inhalation (mg/m^3)
		Child	Adult	Child	Adult		Child and Adult
Arsenic (59 µg/l)	0.0003 Chr	0.004	0.0007	0.000001	0.000006	-	M.D.
Antimony (26 µg/l)	-	0.002	0.0003	0.000002	0.0000007		M.D.
Chromium (150 µg/l)	-	0.01	0.004	0.000014	0.00001	0.00005	M.D.
Copper	-	-	-	N.S.	N.S.	-	-
Di (2-ethylhexyl) phthalate	7 Acute 6 Int.	-	-	N.S.	N.S.	-	-
Dioxins (TEQ)	-	-	-	N.S.	N.S.	-	-
Lead (39 µg/l)	-	M	M	N.S.	N.S.	-	-
Manganese (700 µg/l)	-	0.05	0.009	0.00007	0.00002	0.00004	M.D.
PAHs	-	-	-	N.S.	N.S.	-	-

Acute- Acute exposure length of 0-14 days
Int - Intermediate exposure length of 15- 364 days
Chr – Chronic exposure length of more than 365 days
N.S. – Not Significant
mg/kg/day – milligram chemical per kilogram body weight per day
mg/m3 – microgram of chemical per cubic meter of air
M - values were modeled (tables follow)
M.D. – Missing Data

Table 13. Estimated dose from exposure to off-site surface soil

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Soil/dust-Ingestion (mg/kg/day)		Soil/dust-Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Soil/dust-Inhalation (mg/m^3)
		Child	Adult	Child	Adult		Child and Adult
Arsenic (1.7 mg/kg)	0.0003 Chr	0.000023	0.000005	N.S.	N.S.	-	0.00000079
Chromium	-	-	-	N.S.	N.S.	0.00005	-
Copper	-	-	-	N.S.	N.S.	-	-
Di (2-ethylhexyl) phthalate	7 Acute 6 Int.	-	-	N.S.	N.S.	-	-
Dioxins (TEQ)	-	-	-	N.S.	N.S.	-	-
Lead (120 mg/kg)	-	M	M	N.S.	N.S.	-	-
PAHs (0.3 mg/kg)	-	0.000004	0.0000009	N.S.	N.S.	-	0.00000002

Acute- Acute exposure length of 0-14 days
Int - Intermediate exposure length of 15- 364 days
Chr – Chronic exposure length of more than 365 days
N.S. – Not Significant
mg/kg/day – milligram chemical per kilogram body weight per day
mg/m3 – microgram of chemical per cubic meter of air
M - values were modeled (tables follow)

Table 14. Estimated dose from exposure to off-site groundwater

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Groundwater-Ingestion (mg/kg/day)		Groundwater-Dermal (mg/kg/day)		Inhalation MRL (mg/m^3)	Groundwater-Inhalation (mg/m^3)
		Child	Adult	Child	Adult		Child and Adult
Arsenic	0.0003 Chr	-	-	-	-	-	-
Chromium		-	-	-	-	0.00005	-
Copper	-	-	-	-	-	-	-
Di (2-ethylhexyl) phthalate (47 µg/l)	7 Acute 6 Int.	0.003	0.001	0.004	0.002	-	0.47
Dioxins (TEQ)	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-
PAHs	-	-	-	-	-	-	-

Acute- Acute exposure length of 0-14 days
Int - Intermediate exposure length of 15- 364 days
Chr – Chronic exposure length of more than 365 days
N.S. – Not Significant
mg/kg/day – milligram chemical per kilogram body weight per day
mg/m3 – microgram of chemical per cubic meter of air

Table 15 Estimated Blood Lead Concentrations in Children Ingesting On-Site (0 to 2 foot) Surface Soil (micrograms per deciliter - µg/dl)

Media	**Conc. ***		**Time**	**Slope'**		Low	High
	Low	High		Low	High		
Air (out) *	0.1	0.2	0.33	2.46	3.04	0.08118	0.20064
Air (in) *	0.3	0.6	0.33	2.46	3.04	0.24354	0.60192
Food*	5	5	0.33	0.24	0.24	0.396	0.396
Water*	4	4	0.33	0.16	0.16	0.2112	0.2112
Soil	1760	1760	0.33	0.002	0.016	1.1616	9.2928
Dust	0	0	0.33	0.004	0.004	0	0
Total						**2.09352**	**10.70256**

*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 16 Estimated Blood Lead Concentrations In Adults Ingesting On-Site (0 to 2 foot) Surface Soil (micrograms per deciliter - µg/dl)

Media	**Conc. ***		**Time**	**Slope'**		Low	High
	Low	High		Low	High		
Air (out) *	0.1	0.2	0.33	1.59	3.56	0.05247	0.23496
Air (in) *	0.3	0.6	0.33	1.53	3.56	0.15147	0.70488
Food*	5	5	0.33	0.016	0.0195	0.0264	0.032175
Water*	4	4	0.33	0.03	0.06	0.0396	0.0792
Soil	1760	1760	0.33	0.002	0.016	1.1616	9.2928
Dust	0	0	0.33	0.004	0.004	0	0
Total						**1.43154**	**10.344015**

*Default Value from ATSDR 1999a, Appendix D.
'These slopes 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 C. Public Health Activities

April 29, 2003

Dear Parent/Guardian,

The Florida Department of Environmental Protection (DEP) has tested samples of soil deep under the grass in Lincoln Park. Lead was found in some of the samples that were tested. Lead is a heavy metal that can cause health problems if too much enters your child's body. In order to be sure that this is not a problem to our community, more testing is being done.

Lead is everywhere in our environment and can be found in soil, gasoline, paint and certain types of pottery. Although all children are exposed to some lead from food, air, dust, and soil, lead based paint remains the most common source of lead exposure for children.

Children younger than 6 years of age have more "hand-to-mouth" behavior and therefore are more at risk for exposure to lead. If you are concerned that your child has had exposure to lead from Lincoln Park and would like your child tested, your child's doctor can order a simple blood test for lead. Some insurance companies pay for this test and some do not. Please check with your insurance company or you may contact the Broward County Health Department at (954) 467-4944 to schedule an appointment. The Broward County Health Department will bill your insurance company. If you do not have insurance, we will arrange for your child to be tested. You will be notified of the test results and of any follow-up that your child may need.

The Florida Department of Health and the Broward County Health Department are working together to assure the health and safety of our community. Please call us at (954) 467-4822 if you have any questions.

Sincerely,

Tammy L. Blankenship, M.D.

FACT SHEET: LINCOLN PARK COMPLEX
December 2004

This Fact Sheet Contains:

- ***Introduction***
- ***Lincoln Park Site History***
- ***Additional Soil Sampling Information***
- ***Contacts***

CONTACTS

Florida Department of Environmental Protection
Dodie Stephens, Community Liaison
(561) 681-6714
Dodie.Stephens@dep.state.fl.us

DEP Federal Programs Section
Joseph McGarrity & Jesus Diaz
(850) 245-8927
Joeseph.McGarrity@dep.state.fl.us
Jesus.Diaz@dep.state.fl.us

City of Fort Lauderdale
David Herbert, Public Information Officer
(954) 828-4746

Broward County Department of Health
Stephen Livesay, Public Information Officer
(954) 467-4784

Florida Department of Health
Connie Garrett, Public Health Assessor,
(877) 798-2772 toll free

Introduction

The Florida Department of Environmental Protection (DEP) in cooperation with the U.S. Environmental Protection Agency (EPA) is overseeing the City of Fort Lauderdale's clean up of soil contamination found at Lincoln Park and the City's former incinerator property. A site assessment is also being conducted in the surrounding neighborhood to address resident's concerns that contamination may have traveled offsite.

What is DEP?

DEP is the state's principal environmental agency. The agency's mission is to *protect, conserve and manage Florida's environment and natural resources*.

DEP's more than 3,000 employees:

- Enforce the state's environmental laws.
- Help to keep Florida's air and water clean.
- Clean up historical pollution.
- Regulate solid waste management.
- Promote pollution prevention.
- Acquire environmentally important land.
- Protect fresh and saltwater wetlands.

Background

The Lincoln Park Complex is comprised of three properties: the former City of Fort Lauderdale Incinerator property, Lincoln Park and the former Lincoln Park Elementary School property.

The former incinerator property is located on the north side of Sistrunk Boulevard, NW 6th Street, between 19th Avenue and I-95. Lincoln Park and the former Lincoln Park Elementary School property are located directly east and northeast of the former incinerator property, between 18th and 19th Avenues.

DEP initiated an environmental assessment of the three properties in the Lincoln Park Complex after receiving a written request from the Durrs Homeowners Association in February 2002.

Background continued
The environmental assessment, completed in January 2003, included soil and groundwater testing and a review of historical information and aerial photographs.

The results of the environmental sampling confirmed the presence of soil contamination above DEP soil screening criteria at the former incinerator property, Lincoln Park and the southern portion of the former elementary school property. The groundwater samples met primary safe drinking water standards. DEP and the Florida Department of Health held a public meeting in November 2003 to discuss the results with the community.

In cooperation with DEP, the City of Fort Lauderdale is developing a phased plan to clean up contamination at the south end of the former elementary school property, Lincoln Park and the former incinerator property. Both the park and the former incinerator site are currently fenced off as a measure of public safety.

Additional Soil Sampling Work
To address concerns regarding possible offsite contamination in the surrounding community, DEP conducted a preliminary assessment of the Lincoln Park residential neighborhood in July 2004. Approximately 40 soil samples were collected in 30 locations to evaluate the potential for contamination in areas surrounding the former incinerator site and Lincoln Park.

This assessment primarily focused on residential property immediately north of the former incinerator. Soil samples were also collected in neighborhoods east and south of the former incinerator and in locations surrounding Lincoln Park.

Residential Soil Sampling Results
The DEP received the results from its preliminary site assessment of the Lincoln Park residential neighborhood in December 2004. In some areas, elevated levels of arsenic and dioxins were found in the soil. Additional testing is required to fully determine the extent of contamination and to develop an effective clean up plan.

Based on the available information, the Florida Department of Health has determined that, at the levels detected, the substances do not pose a significant or immediate risk to public health.

The Department of Health does, however, advise residents living in urban areas to use safe gardening practices and to avoid any hand to mouth contact with soils to prevent unnecessary exposure to potential environmental contamination.

All of the residences in the area evaluated are hooked up to the municipal water supply, which has not been affected by any of these substances of concern.

DEP has stringent guidelines for the detection and clean up of pollutants. While chemicals such as arsenic are naturally occurring in Florida, the Department will need to conduct further investigation in the area to understand the extent of contamination and the source of any pollutants detected.

DEP, EPA and the City are working together to develop plans for further assessment and clean up. With expanded analysis, an appropriate clean up plan can be designed.

Please contact the representatives listed on this sheet if you have questions or would like additional information.

Safe Gardening Tips

REMEMBER THESE FEW SIMPLE STEPS, IF YOU WANT TO BE SAFE IN THE GARDEN:

PREPARING YOUR GARDEN

- Add clean compost or soil to your garden.
- Be sure phosphate and pH levels do not fall below recommendations.
- Ask your county agriculture extension office to evaluate your soil.

WORKING IN THE GARDEN

- Be sure to wear gloves.
- Don't eat, drink or smoke while in the garden.
- Avoid dust. Use mulch and do not garden in dry soil when it is windy.
- Remove shoes before entering the house.
- Wash your hands and dirty clothing after gardening.

PREPARING FRUITS AND VEGETABLES

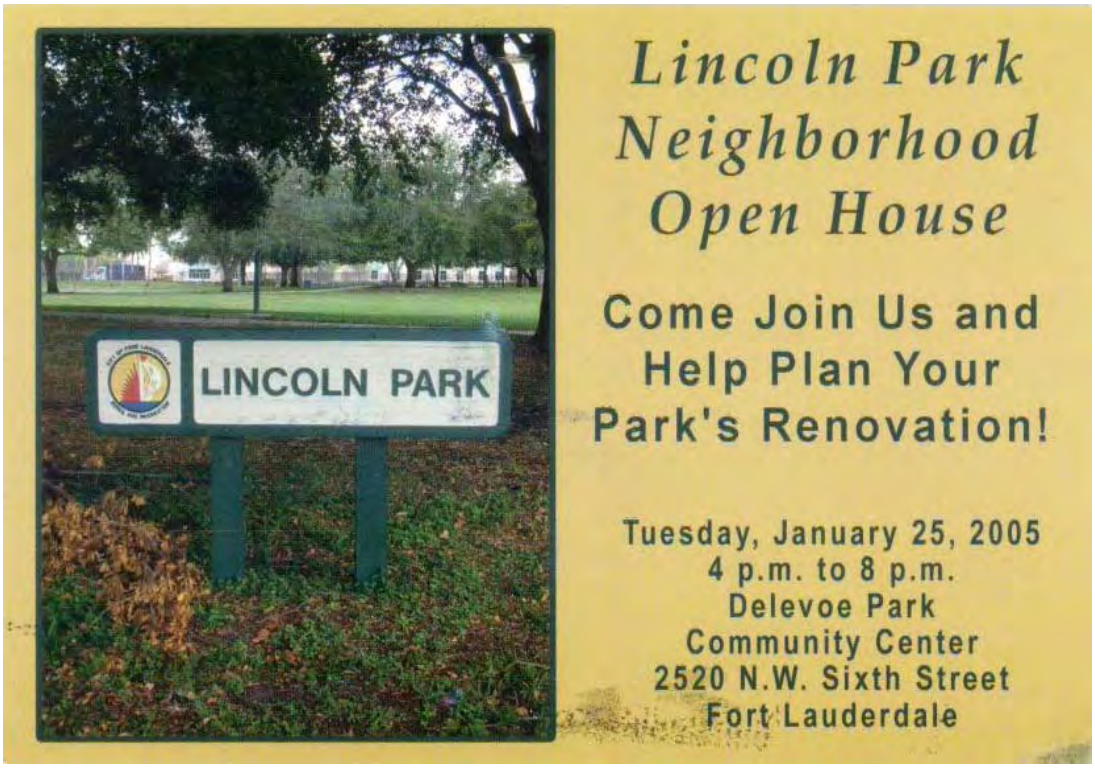
- Limit the amount of homegrown root crops you eat, especially carrots.
- Use raised beds of clean topsoil to grow root crops.
- Wash leafy vegetables growing close to the ground (like collards). Add a little vinegar to the wash water to help remove dirt.

FOR MORE INFORMATION see the Florida Department of Health website at: http://www.myfloridaeh.com/hsee/SUPERFUND/index.html. Or call toll-free during business hours at 877-798-2772.

FLORIDA DEPARTMENT OF HEALTH
DIVISION OF Environmental Health
ATSDR AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Appendix D. Public Comments

Open house Flyer



You are invited to attend the Lincoln Park Neighborhood Open House on Tuesday, January 25th to learn about the status of your park and participate in planning its future.

The event will be hosted by the City of Fort Lauderdale, the Department of Environmental Protection, Dorsey-Riverbend & Durrs Homeowners Associations, Evans Environmental & Geosciences, LLC, the State and County Health Departments and the U.S. Environmental Protection Agency.

By attending the Open House you can:

- Provide suggestions for the park's design, such as basketball courts, playground equipment and landscape.
- Talk to representatives about the development process and the environmental evaluation results.
- Learn about the process necessary to clean up the site and reopen the park.
- Enjoy light refreshments.

For more information, call the City's Public Information Department at 954-828-4746.

PRESORTED FIRST CLASS

U.S. POSTAGE

Connie Garrett, Public Health Assessor
Bureau of Community Environ. Health
4052 Bald Cypress Way, Bin A08
Tallahassee, FL 32399-1712

RECEIVED
JAN 25 2005
BUREAU OF COMMUNITY

Comments on the Public Comment draft of the Lincoln Park Complex Public Health Assessment and from the Lincoln Park Neighborhood Open House January 25, 2005

The City of Ft. Lauderdale hosted a Neighborhood Open House at the Delevoe Park indoor recreational facility January 25, 2005, from 4 to 8 pm. The announcement that the City sent out to about 5000 utilities customers is shown on the previous page. With the City were representatives from the Dorsey-Riverbend and Durrs Homeowners Associations, State and local Environmental Protection and Health Department staff, Evans Environmental & Geosciences LLC, and U.S. Environmental Protection Agency staff. The City asked residents to give their opinions on the facilities they wanted for the remediated and renovated Lincoln Park.

Connie Garrett (DOH Health Assessment Team) and Howard Rosen (Broward County Health Department) attended to answer resident's site-related health questions. Several residents asked DOH about their health problems and asked if they could be related to chemicals from the complex. One person who lived south of Sistrunk for 23 years had high blood pressure and her children had thyroid problems. Another resident has three neighbors that have pancreatic cancer. These two residents asked if a cancer cluster investigation could be done for the area. A man who grew up near the site who had attended the Lincoln Park school from the first to third grades reported problems moving his legs and other health problems that his doctor has had difficulty diagnosing and treating.

At this meeting, Connie Garrett also handed out about 50 copies of the Public Comment Draft of the Lincoln Park Complex Public Health Assessment and asked for readers' comments and questions. She gave some reports out to individuals, and she gave multiple copies to the Durrs Homeowners association president and to a Legal Aid Services of Broward County representative.

Legal Aid Services of Broward County staff responded on behalf of the firm and its Lincoln Park area clients. We report Legal Aid Services' site-related health concerns in the following section. At the January 25, 2005 meeting, a Legal Aid Service staff member told DOH they have information-documenting residents have illnesses and cancer. The representative summarizes these illnesses as neurological problems, kidney problems, tumors in reproductive organs, and difficult to diagnose skin problems in their written response. They report children and parents have cancer. In this written response, Legal Aid Services of Broward County staff asked that DOH evaluate children's exposures to chemicals in non-yard, off-site soils. They ask that we assume people were exposed to soil on the site and evaluate such exposures. They question the animal health effects we compared to the dioxin doses calculated for adults' and children's exposures to soil in their yards.

Addressing Community Health Concerns from the Lincoln Park Neighborhood Open House January 25, 2005 meeting and comments on the Public Comment Draft of Lincoln Park Complex Public Health Assessment

Evaluation of neighborhood illnesses and health effects

DOH Environmental Epidemiology staff agreed to evaluate health information collected by attorneys for the neighborhood. Health assessment team staff appreciate the attorneys' willingness to share this information. Although we did not include personal information for the persons reporting health effects we included in this report, we can share the self-reported information we gathered at neighborhood meetings with Epidemiology staff along with

information collected by residents' attorneys. This confidential health information cannot be released to outside parties, but it can be evaluated.

Evaluation of exposures to chemicals measured in non-yard, off-site soils

DOH did calculate doses and evaluate exposures for children's and adults' exposures to chemicals in non-yard, off-site soils prior to the January 25, 2005 meeting We used the same assumptions we would use for residential exposures—we explain these assumptions in the **Discussion** part of this report. In the following paragraph, we discuss those calculated doses.

Dose estimates: The estimated doses DOH calculated for children's and adults' daily, long-term, ingestion of soil (and inhalation of dust) containing the highest levels of chemicals measured in off-site, non-yard surface soil are not likely to cause *non-cancer* illness. We calculated the theoretical increased risks of cancer for arsenic, PAHs and dioxins in off-site, non-yard soil† for both soil ingestion and dust inhalation. Adding together these risks for children and adults, (estimated by adding together the risks for the highest chemical levels measured on different off-site properties) gives a theoretical increased risk of about 3 additional cancers in 100,000. ATSDR classifies this value as between "low" increased risk and "no apparent" increased risk. Most of the increased cancer risk accrues from the highest measured off-site, non-yard TEQ dioxin and arsenic values.

Because our calculations assume daily, long-term soil ingestion and inhalation, the calculated risk may not represent an actual threat to public health. A lack of information complicates dioxin toxicity estimates. While 2,3,7,8-TCDD has been demonstrated to be a carcinogen in laboratory animals, studies in humans found increases in cancer mortalities (all types combined), but only in highly exposed workers with long latency (time between exposure and cancer onset) periods. The data on specific types of cancers are inconclusive. Many studies reported only small relative risks, and the possible impact of confounding factors was not sufficiently evaluated (Pohl et al 2002). Current information about arsenic indicates its ingestion in soil may be less of a risk than ingestion in water. Recent studies have shown that the amounts of arsenic absorbed from ingested solids are less than the levels absorbed from water, the primary source for medical cases studying arsenic toxicity.

Cancer Cluster Investigation

DOH epidemiologists declined to evaluate cancer occurrences in the community near the Lincoln Park Complex (Patel 2005), with the following explanation. "According to the assessment report, the incinerator operated from the late 1920s until the mid 1950s. With some exceptions such as childhood cancers, whenever there is a significant exposure to carcinogens, it is generally thought that cancers take more than twenty years to develop. Therefore, cancers potentially caused by the exposure could start being diagnosed in 1940 onwards. Some limitations in cancer data analysis include:

- The cancers diagnosed before 1981 may not be identified, as the Florida Cancer Data System started operation during 1981.

† Since the Public Comment draft was released in January 2005, other ATSDR staff have used the EPA oral cancer slope factor (CSF) for dioxin in their site evaluations. The EPA based this slope factor on a linear, non-threshold cancer model (therefore, it will probably overestimate theoretical cancer risks). We estimated theoretical cancer risks by multiplying the Lifetime Average Daily Dose by the CSF for dioxin (1.56×10^5/ mg/kg/day) (EPA 2003). Because cancer risk screening is based on chronic exposure, only chronic doses were used for cancer screening purposes.

- Census data prior to 1990 is not available."

Site Exposures

Legal Aid Services of Broward County staff suggested that we should assume people were exposed to soil on the site. They suggested we should evaluate such exposures. The Public Comment draft of the report does evaluate such exposures. Even though persons working or trespassing on the site might not have had the same amount of exposure as residents, we used the same assumptions we use for residential exposure. We calculated daily, long-term child and adult doses for the highest levels of chemicals measured on-site and we evaluated the potential health effects (see the Toxicological Evaluation section for each chemical). Whether the exposures might have occurred in the past or may occur in the future, the doses we calculated would be the same because **we base our calculations on the highest levels of chemicals measured on the site; using the same amount of media, for the same lengths of time.** When we say we are unable to evaluate people's past exposures, this doesn't mean that current levels can't be used to look at past exposure rates, only that there is not way to quantify what additional chemicals (or even the same chemicals but at higher levels) people could have been exposed to in the past that are no longer measurable in the environment. This kind of information (a measured amount) cannot be obtained by interviewing people, and it may not even be available through tissue analysis.

Other Health Concerns:

DEP asked DOH to review the concerns of Legal Aid Services of Broward County staff regarding infant mortality rates (DEP 2005). A Broward County Health Department epidemiologist had previously looked at the issue of infant mortality for the 33311 and 33313 zip codes (Cresanta, 2002). He found the infant mortality rates for minority infants from these zip codes were the same as for minority infants born elsewhere in Broward County. He recommended further exploration of other fetal and infant mortality factors, giving as examples access to prenatal care and nutrition.

We appreciate Legal Aid Services of Broward County assistance in addressing environmental contamination for the communities near the Lincoln Park Complex.

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

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

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

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

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

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

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

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

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

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

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

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

Contaminant: See **Environmental Contaminant**.

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

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

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

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

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

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

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

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

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

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

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

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

ATSDR defines an exposure pathway as having 5 parts:

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

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

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

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

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

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

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

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

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

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

Malignancy: See **Cancer**.

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

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

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

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

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

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

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

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

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

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

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

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

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

- Urgent Public Health Hazard
- Public Health Hazard
- Indeterminate Public Health Hazard
- No Apparent Public Health Hazard
- No Public Health Hazard

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

Reference Dose (RfD): An estimate, with safety factors (see **safety factor**) built in, of the daily, lifetime 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:

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

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

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

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

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

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

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

Superfund Site: See **NPL**.

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

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

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

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

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

Uncertainty Factor: See **Safety Factor**.

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

CERTIFICATION

This Lincoln Park Complex 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. Editorial review was completed by the cooperative agreement partner.

Jennifer Freed
Technical Project Officer
Division of Health Assessment and Consultation (DHAC)
ATSDR

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

Alan Yarbrough
Chief, SPAB, DHAC, ATSDR