



---

## **NIOSH HEALTH HAZARD EVALUATION REPORT**

**HETA #2005-0153-2997**

**Broward County Parks and Recreation Division,  
Markham Park  
Sunrise, Florida**

**April 2006**

---

**DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health**



## PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

## ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Judith Eisenberg and Bradley King of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Perianan Periakaruppan. Analytical support was provided by Pacific Toxicology Laboratory and DataChem Laboratories, Inc. Desktop publishing was performed by Elaine Moore. Editorial assistance was provided by Ellen Galloway.

Copies of this report have been sent to employee and management representatives at Markham Park and the OSHA Regional Office. This report is not copyrighted and may be freely reproduced. The report may be viewed and printed from the following internet address: <http://www.cdc.gov/niosh/hhe>. Copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161.

**For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.**

## Highlights of the NIOSH Health Hazard Evaluation

### Evaluation of Arsenic and Lead Exposures at a County Park

The National Institute for Occupational Safety and Health (NIOSH) received a union request for a health hazard evaluation (HHE) at Markham Park in Sunrise, Florida. The request cited union concerns about employees' potential exposure to arsenic and lead while tending the park grounds and in outdoor firing ranges. NIOSH investigators conducted an evaluation in July 2005.

#### What NIOSH Did

- We checked park grounds for potential arsenic and lead exposures.
- We looked at range hygiene and work practices.
- We looked at chemical storage practices.
- We evaluated employee training programs.
- We interviewed grounds crew and range workers.
- We took blood samples to test for lead and urine samples to test for arsenic.
- We took surface wipe samples for lead.

#### What NIOSH Found

- Accumulation of lead dust in areas of the firing range.
- Dry sweeping the firing range may increase employees' exposure to lead dust at the firing range.
- There was no standard employee training for handling and applying pesticides.
- No employee reported health effects consistent with either arsenic or lead poisoning.
- No employee had high inorganic arsenic levels in their urine.
- No employees had high blood lead levels.

#### What Markham Park Managers Can Do

- Enforce range personal hygiene practices, such as handwashing after the work shift.
- Improve storage, labeling, and disposal practices for chemicals used at the park.
- Improve training programs for employees who handle pesticides and herbicides.
- Evaluate heat stress and start a training program, if needed.
- Evaluate noise exposures. If noise levels are high, train all grounds crew and range employees in the proper use of hearing protection and provide task-appropriate protective equipment.

#### What Markham Park Employees Can Do

- Obtain blood lead levels for lead and non-provoked urinary testing for arsenic if you are concerned about exposure.
- Wash face and hands when leaving the range and before eating, drinking, or smoking.
- Handle only chemicals for which you've had the appropriate training.
- Follow manufacturer's guidelines for personal protective equipment when handling chemicals.
- Take breaks in shaded or air-conditioned areas as needed and drink more non-caffeinated and low-sugar beverages.
- Use hearing protection during noisy tasks.



**What To Do For More Information:**  
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report # 2005-0153-2997



**Health Hazard Evaluation Report 2005-0153-2997  
Broward County Parks and Recreation Division,  
Markham Park  
Sunrise, Florida  
April 2006**

**Judith Eisenberg, MD  
Bradley King, MPH, CIH**

---

---

## **SUMMARY**

On March 2, 2005, the National Institute for Occupational Safety and Health (NIOSH) received a confidential union request for a health hazard evaluation at Markham Park in Sunrise, Florida. The request concerned potential exposure to lead, arsenic, pesticides, herbicides, and cleaning chemicals. Employees were concerned about lead exposure from the Park's shooting range and from old painted signs. Arsenic exposure was a concern due to the reported use of an arsenic containing ant-killer and chromated copper arsenate (CCA) treated lumber. Two employees had reportedly been diagnosed with heavy metal poisoning.

On July 5-6, 2005, NIOSH investigators conducted surface wipe samples for lead in and around the shooting ranges, and from the hands of shooting range personnel. All workers were invited to participate in medical testing, which included an interview and collection of blood and urine specimens for lead and arsenic, respectively.

Surface wipe sampling for lead on table and floor surfaces in the shooting range revealed lead levels ranging from 94.7 micrograms lead per 100 square centimeters (mcg/100 cm<sup>2</sup>) to 519.7 mcg lead/100 cm<sup>2</sup>. Lead levels on table and floor surfaces in the firing range clubhouse were approximately 10 times lower (range: 9.3 mcg/100 cm<sup>2</sup> to 55.7 mcg lead/100 cm<sup>2</sup>). Surface lead levels in the recreation areas of the clubhouse were the lowest (5.3 mcg lead/100 cm<sup>2</sup> on the picnic table in the clubhouse covered patio area and 1.7 mcg lead/100 cm<sup>2</sup> on the floor of the clubhouse conference room). Lead levels on the hands of two range attendants ranged from 27.7 to 88.7 mcg lead. No federal standards for lead contamination of surfaces in occupational settings exist.

Of 19 employees, 11 volunteered for medical evaluation (interview and specimen collection) while four other employees provided interviews only. None had elevated urinary inorganic arsenic levels. Four of the range employees had minimally elevated blood lead levels and all others were nondetectable. None of the interviewed employees described adverse health effects they considered work related aside from possible heat stress and hearing loss.

At the time of this site visit, arsenic did not present a health hazard. There was evidence of minimal exposures to lead for the firing range staff but not for the groundskeeping staff. The presence of lead on the hands of range attendants highlights the importance of proper personal hygiene practices, as hand-to-mouth ingestion of lead dust could be the cause of the low levels of lead detected in the blood of some of the range staff. Recommendations are made regarding employee training, proper handling of chromated copper arsenate (CCA) treated lumber, proper range housekeeping, proper storage and handling of onsite chemicals, and further evaluation of heat stress and noise exposures.

Keywords: NAICS 712190 (Nature Parks and Other Similar Institutions) lead, arsenic, firing range, pesticides, herbicides, cleaning chemicals, CCA lumber

# Table of Contents

Preface.....	ii
Acknowledgments and Availability of Report.....	ii
Highlights of the Health Hazard Evaluation .....	iii
Summary.....	iv
Introduction.....	1
Background .....	1
Workplace Description .....	1
Methods.....	1
Industrial Hygiene .....	1
Medical.....	2
Urinary Arsenic Levels.....	2
Blood Lead Levels .....	2
Review of Records.....	3
Evaluation Criteria .....	3
Arsenic .....	3
Lead.....	4
Results .....	5
Industrial Hygiene .....	5
Medical.....	6
Review of Records.....	6
Discussion and Conclusions .....	6
Recommendations.....	8
References.....	8

## INTRODUCTION

In March 2005, the National Institute for Occupational Safety and Health (NIOSH) received a confidential union request for a Health Hazard Evaluation (HHE) at the Broward County Parks and Recreation Division, Markham Park in Sunrise, Florida. The request noted concerns by maintenance staff at the park regarding exposures to a variety of substances including lead, arsenic, pesticides, herbicides and cleaning chemicals. The potential arsenic sources were decaying pressure treated lumber that had been removed from public use but had not been removed from the park grounds, and an ant killer that purportedly contained arsenic. The potential lead sources were lead dust generated on the firing ranges and lead-containing paint used on older park signs. The request was prompted by two employees who had reportedly been diagnosed with "heavy metal poisoning." Review of their medical records found that these diagnoses were made via nonstandard testing methodologies.

On July 5-6, 2005, NIOSH medical and industrial hygiene investigators conducted a site visit. An opening conference was held with management and employee representatives to discuss the HHE request. Following the conference, the industrial hygienists participated in a thorough walk-through survey of the site, accompanied by management and union representatives as well as two employees who wanted to direct them to certain areas in the park. While the industrial hygienists participated in the walk-through survey, the medical personnel interviewed employees and collected biological specimens for urinary arsenic and blood lead. These interviews spanned the 2 days of the site visit. All current employees in the targeted job descriptions (Range Attendants, Range Officers, Groundskeepers, Park Aides I and II, Equipment Operators I and II, Maintenance Workers I and II and a Grounds Maintenance Supervisor) were invited to participate. On the second day, the industrial hygienists collected surface lead wipe samples in and around the shooting ranges. On August 26, 2005, workers who participated in the study

were sent individual notification letters informing them of their urinary arsenic levels and blood lead levels.

## BACKGROUND

### *Workplace Description*

Markham Park, a 666-acre park located in Sunrise, Florida, is part of the Broward County Parks and Recreation Division. The park has interlocking fishing lakes, a model airplane field, a swimming pool complex, a 3-acre dog park, and trails for jogging, hiking, biking, and horseback riding. Two outdoor firing range complexes were built in 1984—one target range for rifles and pistols and a separate clay skeet shooting range. The rifle and pistol ranges are divided into 50-yard and 100-yard target alleys. The skeet and trap areas include a mile-long automated clay course. There are five combination skeet and trap fields and a five stand sporting clay course. Markham Park currently employs 19 Groundskeepers and maintenance staff along with a separate contingent of Range Officers and range maintenance crews.

Markham Park grounds crew employees are divided into Park Aide I and II, Equipment Operator I and II, Grounds Maintenance Supervisor, Groundskeeper and Maintenance Worker I and II. Shooting ranges employees include Range Aide, Range Attendant, and Range Safety Officer.

## METHODS

### *Industrial Hygiene*

#### Herbicides, Pesticides and Cleaning Chemicals

Along with management and employee representatives, NIOSH investigators toured the park grounds. During the tour, employees identified several areas of concern and potential health hazards. One was the storage shed within the maintenance compound. The chemical storage was described as a concern to employees due to the presence of old chemicals, the high

environmental temperatures inside the storage shed, and the occasional “overpowering” odors. Discussions were held with employees both informally and during confidential interviews regarding the use and storage of the chemicals, and in particular, the training employees received and the personal protective equipment (PPE) commonly used. Material Safety Data Sheets (MSDSs) were reviewed for the pesticides and herbicides used on park grounds.

### **Arsenic and Lead**

During the walk-through survey of the park, benches, tables, and logs reportedly made from chromated copper arsenate (CCA) treated lumber were identified. Some were located in public areas of the park, while other items were in areas inaccessible to the public such as the maintenance compound area. Work practices and use of PPE were also discussed with employees.

After a walk-through of the park’s outdoor shooting range, 11 surface wipe samples were collected to determine the extent of surface contamination with lead and other elements at various locations in the range and adjacent clubhouse. Surface sampling locations included floor and table surfaces at various lanes of the shooting range, and floor and table surfaces in office, recreation, and eating spaces in the clubhouse. The samples were collected with pre-moistened Wash n’ Dry® towelettes according to the NIOSH Manual of Analytical Methods (NMAM) Method 9100. The procedure was as follows: 1) identify the area to be sampled; 2) put on pair of latex disposable gloves; 3) wipe the surface within a disposable 10 centimeter (cm) by 10 cm template using three to four horizontal S-strokes, side to side so that entire surface is covered; 4) fold the exposed side of the wipe in and wipe the same area with three to four vertical S-strokes; 5) fold the wipe once more and wipe the area with three to four horizontal S-strokes; 6) fold the pad, exposed side in and place in a container. A new template was used for each sample. The wipe samples were digested and analyzed for elements, including lead and arsenic, according to NMAM Method 7300.

Hand-wipe samples were taken from two Range Attendants to assess lead contamination on skin. At the end of their shifts, the employees were instructed to wipe their hands (including between the fingers) for approximately 30 seconds using pre-moistened Wash n’ Dry® towelettes, which were then placed into a sterile plastic container. The samples were digested and analyzed for elements, including lead, according to NMAM Method 7300.

### ***Medical***

The medical officer interviewed 15 employees. These interviews covered occupational and medical history, and employees were encouraged to discuss any health issues they believed were work related. Based on job title, description of duties, and duration of employment at the park, we identified 11 of the 15 interviewed employees as having an increased risk for lead and arsenic exposures. These employees were asked to participate in biological sampling for those two heavy metals. All questions regarding participation were answered prior to obtaining informed consent to participate in biological sampling, which consisted of urinary arsenic and blood lead measurements. Medical records of the two employees who reported being diagnosed with heavy metal poisoning were reviewed.

### **Urinary Arsenic Levels**

Urine samples were collected in acid-washed specimen cups. All urine samples were speciated to separate the organic and inorganic arsenic components. Organic arsenic is commonly found in the body due to its presence in dietary sources such as seafood and is not associated with adverse health effects. Arsenic poisoning is due to inorganic arsenic entering the body; for this reason it is helpful to perform the speciation. Total urinary arsenic results were reported as micrograms of inorganic arsenic per gram of creatinine (mcg/g/cr) while the inorganic component was reported as micrograms per liter (mcg/L).

### **Blood Lead Levels**

Venous blood was collected into navy blue top test tubes provided by the NIOSH contract

laboratory for blood lead level analysis. Blood lead levels were reported as micrograms per deciliter (mcg/dL).

## Review of Records

Medical records from two men who previously worked at Markham Park accompanied the HHE request. One was a former Parks employee and the other was currently employed at another Broward County Park. A NIOSH medical officer reviewed the OSHA 300 logs of illness and injury for the past 5 years.

## EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increases the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1)

NIOSH Recommended Exposure Limits (RELs),<sup>1</sup> (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),<sup>2</sup> and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).<sup>3</sup> Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91-596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

### Arsenic

Arsenic is an element found naturally in low levels in the environment. The inorganic form can cause adverse health effects when too much is taken up in the body. Organic arsenic is not associated with adverse health effects. It is found in common dietary sources such as seafood. Speciation is the process by which a laboratory separates the total arsenic level into the inorganic and organic components. Inorganic arsenic has many industrial uses, and low levels of inorganic arsenic can occur naturally. Inorganic arsenic may be found as a contaminant in well water when wells are dug into soil containing inorganic arsenic. The concentration of inorganic arsenic in the urine of persons not

exposed to arsenic in the workplace is variable.<sup>4</sup> Background levels of urinary arsenic are less than 20-25 mcg/L.<sup>5</sup> The ACGIH recommends a biological exposure index (BEI) for arsenic (as inorganic arsenic) in urine of 35 mcg/L.<sup>2</sup>

## **Lead**

Lead is ubiquitous in U.S. urban environments due to the widespread use of lead compounds in industry, gasoline, and paints during the past century. Exposure to lead occurs via inhalation of dust and fume and via ingestion through contact with lead-contaminated hands, food, cigarettes, and clothing. Absorbed lead accumulates in the body in the soft tissues and bones. Lead is stored in bones for decades, and may cause health effects long after exposure as it is slowly released in the body.

Symptoms of lead exposure include weakness, excessive tiredness, irritability, constipation, anorexia, abdominal discomfort (colic), fine tremors, and "wrist drop".<sup>6,7,8</sup> Overexposure to lead may also result in kidney damage, anemia, high blood pressure, infertility and reduced sex drive in both sexes, and impotence. An individual's blood lead level (BLL) is a good indication of recent exposure to, and current absorption of lead.<sup>9</sup> The frequency and severity of symptoms associated with lead exposure generally increase with the BLL. The overall geometric mean BLL for the U.S. adult population (ages 20-74 years) declined significantly between 1976 and 1991, from 13.1 to 3.0 micrograms per deciliter of blood (mcg/dL). This decline is most likely due primarily to the reduction of lead in gasoline. More than 90% of adults now have a BLL of <10 mcg/dL, and more than 98% have a BLL <15 mcg/dL.<sup>10</sup>

Under the OSHA general industry lead standard (29 CFR 1910.1025), the PEL for airborne exposure to lead is 50 micrograms per cubic meter (mcg/m<sup>3</sup>) for an 8-hour TWA.<sup>11</sup> The standard requires lowering the PEL for shifts exceeding 8 hours, medical monitoring for employees exposed to airborne lead at or above the action level of 30 mcg/m<sup>3</sup> (8-hour TWA), medical removal of employees whose average BLL is 50 mcg/dL or greater, and economic protection for medically removed workers. Medically removed workers cannot return to jobs involving lead exposure until

their BLL is below 40 mcg/dL. NIOSH has an REL for lead of 50 mcg/m<sup>3</sup> averaged over a 8-hour work shift. ACGIH has a TLV for lead of 50 mcg/m<sup>3</sup> (8-hour TWA), with worker BLLs to be controlled to or below 30 mcg/dL, and designation of lead as an animal carcinogen.<sup>2</sup>

The occupational exposure criteria are not protective for all the known health effects of lead. For example, studies have found neurological symptoms in workers with BLLs of 40 to 60 mcg/dL, and decreased fertility in men with BLLs as low as 40 mcg/dL. BLLs are associated with increased blood pressure, even at levels less than 10 mcg/dL. Fetal exposure to lead is associated with reduced gestational age and low birth weight with maternal BLLs as low as 10 to 15 mcg/dL. BLLs at 10 mcg/dL have been associated with decreased intelligence and impaired neurobehavioral development.<sup>12</sup> Men and women planning to have children should limit their exposure to lead.

In homes with a family member occupationally exposed to lead, care must be taken to prevent "take home" of lead, that is, lead carried into the home on clothing, skin, hair, and in vehicles. High BLLs in resident children, and elevated concentrations of lead in the house dust have been found in the homes of workers employed in industries associated with high lead exposure.<sup>13</sup> Particular effort should be made to ensure that children of persons who work in areas of high lead exposure receive a BLL test. The current CDC screening guidelines for children use 10 mcg/dL as a "level of concern" in order to intervene and prevent long-term cognitive deficits.<sup>14</sup>

Lead-contaminated surface dust represents a potential source of lead exposure, particularly for young children. This may occur either by direct hand-to-mouth contact, or indirectly from hand-to-mouth contact with contaminated clothing, cigarettes, or food. Previous studies have found a significant correlation between resident children's BLLs and house dust lead levels.<sup>15</sup> In the workplace, generally there is little or no correlation between surface lead levels and employee exposures because ingestion exposures are highly dependent on personal hygiene practices and

available facilities for maintaining personal hygiene. No current federal standard provides a permissible limit for lead contamination of surfaces in occupational settings. The Environmental Protection Agency (EPA) currently recommends meeting the following clearance levels for surface lead loading after residential lead abatement or interim control activities: floors, 40 micrograms per square foot (mcg/ft<sup>2</sup>); interior window sills, 250 mcg/ft<sup>2</sup>; window troughs, 400 mcg/ft<sup>2</sup>.<sup>16</sup> These levels have been established as achievable through lead abatement and interim control activities. They are not based on projected health effects associated with specific surface dust levels.

## RESULTS

### ***Industrial Hygiene***

#### **Herbicides, Pesticides and Cleaning Chemicals**

Chemicals for which MSDSs were reviewed included:

- chlorpyrifos (Dursban™) - an organophosphate insecticide
- oryzalin or 3,5,-Dinitro-N4,N4-dipropylsulfanilamide (Surflan™) – an herbicide
- bifenthrin (Talstar®) – an insecticide combination of pyrethrins with piperonyl butoxide
- triclopyr or 3,5,6-trichloro-2-pyridoxyacetic acid (Garlon™) – an herbicide
- abamectin (Varsity™ Fire Ant Bait) – an insecticide

Many of the MSDSs state that for brief contact, no precautions other than clean body-covering clothing should be needed, but that impermeable gloves are recommended for prolonged or frequent contact. At least one, Talstar®, recommends wearing rubber, neoprene, or polyvinyl chloride (PVC) gloves during use and to thoroughly wash the outside of gloves with soap and water prior to removal.

The park management's hazard communication, training, and PPE programs include safety classes and individual training for maintenance

and grounds-keeping personnel involved in mixing and applying pesticides, as well as training in the proper selection and use of gloves. The park requires the use of nitrile rubber gloves, long sleeves, shoes, socks, and safety glasses for pesticide application. However, during confidential interviews, employees reported inconsistent use of PPE.

A consistent complaint among workers was the heavy chemical odor said to be present in the chemical storage shed. No discernable odor was noticed at the shed on the day of the site visit. Although no indoor temperature readings were taken, the interior temperature felt hot to the NIOSH team as would be expected on a typical Florida summer day. The interior temperature of the shed raised a concern with employees because many of the manufacturers of the stored chemicals specifically recommend storage in a cool, dry location. Inspection of the storage shed revealed a variety of pesticides, herbicides, paints, and other stored chemicals, both those identified for current use and those that were no longer used. Additionally, there were several unmarked barrels outside the storage shed.

#### **Arsenic and Lead**

During discussions of work practices with employees, many reported cutting, drilling, building, and moving tables of CCA-treated lumber. Typically, the work was performed without respiratory protection or gloves. The level of potential exposure to arsenic compounds during these activities is unknown. The EPA does stress that it “has not concluded that CCA-treated wood poses any unreasonable risk to the public or the environment. Nevertheless, arsenic is a known human carcinogen and, thus, the Agency believes that any reduction in the levels of potential exposure to arsenic is desirable”.<sup>17</sup>

Surface wipe sampling in and around the shooting ranges confirmed the presence of lead as shown in Table 1. Table and floor surfaces of the outdoor range had the highest levels, ranging from 94.7 micrograms lead per 100 square centimeters (mcg/100 cm<sup>2</sup>) to 519.7 mcg lead/100 cm<sup>2</sup>. Lead levels on table and floor surfaces in the firing range clubhouse

offices were approximately 10 times lower (9.3 mcg/100 cm<sup>2</sup> to 55.7 mcg lead/100 cm<sup>2</sup>). Levels of lead in recreation areas of the clubhouse were the lowest, ranging from 1.7 mcg lead/100 cm<sup>2</sup> to 5.3 mcg lead/100 cm<sup>2</sup>. Lead levels on the hands of two Range Attendants ranged from 27.7 to 88.7 mcg lead.

### **Medical**

Interviews conducted with 15 park employees covered employment history, medical history, description of current job duties, potential job related health concerns, and overall impression of worker safety at the park. Length of employment of interviewed employees ranged from 18 months to over 30 years. Nine of the eleven employees who participated in testing had employment durations of over 10 years. Three stated they remembered having blood lead levels done in the past by the park but stated they were not informed of the results. The work-related health concerns voiced during these interviews included: heat stress, hearing loss, mold exposure in one of the older restrooms, and a strong “chemical odor” inside the storage shed. Most employees stated that they felt Markham Park was a safe place to work. During these confidential employee interviews, work practices were discussed, including the use of PPE, such as gloves and masks, when working with the chemicals. Reported glove use ranged from never to always using gloves when handling cleaning chemicals, pesticides or herbicides.

Eleven employees participated in biological sampling. Six of these were Groundskeepers while the other five were range employees. The contract laboratory reference range for inorganic arsenic was less than 20 mcg/L. None of the participants had inorganic arsenic levels above the reference range. Ten of the eleven employees had nondetectable levels and one employee had an inorganic arsenic level of 12 mcg/L. Seven of the eleven participating employees (64%) had no detectable lead in their blood. The remaining four (two range attendants and two range officers) were below 10 mcg/dL.

### **Review of Records**

Review of the OSHA 300 logs revealed primarily musculoskeletal injuries. There were no reports of specific chemical exposures.

Of the two men whose medical records were reviewed, one was not eligible to participate in our evaluation since he was no longer a current employee of the Broward County Parks and Recreation Department. The second employee who was eligible did not participate in the medical testing conducted as part of this HHE. Both men were diagnosed with heavy metal poisoning by nonstandard testing modalities such as hair testing and provoked urine testing. Neither of these employees had ever had a blood lead level performed, which is the gold standard for diagnosing lead poisoning or a non-provoked urine test for arsenic, which is the standard method for assessing body burden of arsenic.

## **DISCUSSION AND CONCLUSIONS**

The potential sources of arsenic suggested by the HHE requestors were decaying pressure-treated lumber that had been removed from public use but had not been removed from the park grounds and an ant killer that purportedly contained arsenic. MSDSs obtained for the insecticides and herbicides currently in use at the park did not reveal any that contained arsenic. Discarded pressure-treated lumber was observed on park grounds but employees reported minimal contact with this material. Finally, biological testing did not reveal any cases of inorganic arsenic poisoning. However, the potential for future exposure during work conducted by park employees on CCA-treated lumber present on the park grounds can still be minimized. The EPA has the following handling precautions for inorganic arsenical pressure-treated wood:<sup>18</sup>

- Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing, sanding, and machining treated wood, wear a dust mask. Whenever possible, these operations should be

performed outdoors to avoid indoor accumulations or airborne sawdust from treated wood.

- When power-sawing and machining, wear goggles to protect eyes from flying particles.
- Wear gloves when working with the wood. After working with the wood, and before eating, drinking, toileting, and use of tobacco products, wash exposed areas thoroughly.

Although the use of leaded paint could not be excluded by the employees, test results for the grounds crew revealed non-detectable blood lead levels. Blood lead was detected only in employees who worked in the shooting ranges, but these levels were all below intervention levels for adults. This would indicate that the primary source of lead exposure at the park is lead dust generated by the use of leaded ammunition. Lead dust was found on surfaces in and around the shooting range. The levels found on surfaces around the firing line were higher than in the offices and recreation areas of the clubhouse. The presence of lead on two Range Attendants' hands revealed the importance of personal hygiene practices, particularly thoroughly cleaning hands using soap and water after each work shift. Observation of work practices revealed ways to reduce aerosolized lead dust exposure to employees. One of these practices observed was the dry sweeping of the floor at the firing line with a broom. This practice can increase potential inhalation of lead dust. Wet methods or high-efficiency particulate air (HEPA) filtered vacuuming are preferred work practices to dry sweeping. The blood lead levels found in Markham Park's range employees indicate a need to reduce exposures to lead dust by improving work practices.

The two employees on whose behalf the union submitted this HHE request were diagnosed with heavy metal poisoning solely based on nonstandard testing modalities, i.e., hair testing. In a 2001 statement, the Agency for Toxic Substances and Disease Registry (ATSDR) stated that hair testing is an unacceptable modality for diagnosing heavy poisoning, as too

little is known about hair deposition toxicokinetics or how these levels correlate to clinical presentations. At best, hair testing may be an indicator of past exposure to metals.

Toxicologists consider blood lead levels (BLL) the gold standard for diagnosing lead poisoning and monitoring its treatment. BLL are ideal, as they directly measure metal within the body.

Arsenic levels, on the other hand, can be tested using blood or urine. Testing for arsenic using urinary spot levels (as opposed to collecting and testing a 24-hour urinary specimen) is an acceptable method of testing. Provoked urinary testing (in which a chelating agent is given prior to collection urine and measuring it for metals) is not recommended. Provoked urinary testing has resulted in many patients being falsely diagnosed with arsenic poisoning because the test measured the arsenic content of the diet. A false positive diagnosis of heavy metal poisoning can have serious results if these patients are then treated with chelators. Chelators have the potential for life-threatening adverse health effects.

Although there is evidence that range employees have minimal lead exposures, there is no evidence either by biological testing or via employee histories that there have been cases of either lead or arsenic poisoning at Markham Park.

Management should focus its attention on the storage and use of herbicides, pesticides and cleaning chemicals. During discussions with employees, it appeared that the training they received did not ensure correct work practices associated with handling such chemicals. The presence of old chemicals and non-labeled, chemical-containing barrels, indicates the need for improved inventory and disposal practices at the park.

Although not evaluated as part of this HHE, heat stress and noise may be potential health hazards. These issues were repeatedly brought up during discussions with employees. The potential for heat stress arises from the extensive amount of

labor conducted outdoors in the heat of the summer months. Ensuring proper hydration, work-rest cycles, and acclimatization are important components of a heat stress program that can help prevent potential heat-related injuries. Noise exposures can occur during the use of equipment such as saws and mowers. A noise evaluation by park management can best determine the noise levels as well as the proper hearing protection that would be required should these levels exceed current occupational exposure limits.

## RECOMMENDATIONS

### Lead

- Stop dry sweeping of shell casings. Use wet cleaning or HEPA vacuuming methods for this task.
- Wash hands prior to eating and at the end of the shift.
- Prohibit eating, drinking, or smoking on the range.

### Arsenic

- Remove discarded pressure treated lumber from park grounds.
- Perform work on the CCA-treated lumber still present on park grounds according to EPA handling precautions.

### Chemical Handling and Storage

- Ensure that all workers are knowledgeable about the chemicals with which they are working and about any PPE required by park management; ensure that the use of such PPE is consistent among the employees.
- Ensure that all chemicals on the park property are properly inventoried, labeled, stored in a cool, dry location, and disposed of according to manufacturers' recommendations.

### Heat stress

- Evaluate worker exposure to heat stress to determine if preventive actions are needed, such as a training program for

employees regarding the signs and symptoms of heat stress.

- Encourage frequent breaks in shaded or air-conditioned areas.
- Increase availability of water fountains and encourage increased fluid intake.

### Noise

- Evaluate noise exposures to determine if it is necessary to institute a hearing conservation program and to supply task-appropriate hearing protection.

## REFERENCES

1. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.
2. ACGIH [2005]. 2005 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. CFR [2003]. 29 CFR 1910.1000. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
4. Lauwerys RR and Hoet P [2001]. Industrial Chemical Exposure: guidelines for biological monitoring. Third Edition. CRC Press LLC, Boca Raton, Florida. pp. 202-218
5. Smith TJ, Crecelius EA, and Reading JC [1977]. Airborne arsenic exposure and excretion of methylated arsenic compounds. *Env Health Persp* 19: 89-93.
6. Hernberg S, et al. [1988]. Lead and its compounds. In: Occupational medicine. 2nd ed. Chicago, IL: Year Book Medical Publishers.

7. Landrigan PJ, et al. [1985]. Body lead burden: summary of epidemiological data on its relation to environmental sources and toxic effects. In: Dietary and environmental lead: human health effects. Amsterdam: Elsevier Science Publishers.
8. Proctor NH, Hughes JP, Fischman ML [1996]. Lead. In: Chemical hazards of the workplace. 4th ed. New York, NY: Van Nostrand Reinhold, New York, pp 371–375.
9. NIOSH [1978]. Occupational exposure to inorganic lead. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 78–158.
10. Pirkle JL, et al. [1994]. The decline in blood lead levels in the United States, the National Health and Nutrition Examination Surveys (NHANES). JAMA, 272:284–291.
11. Code of Federal Regulations [2000]. OSHA lead standard. 29 CFR, Part 1910.1025. Washington, DC: U.S. Government Printing Office, Federal Register.
12. ATSDR [1990]. Toxicological profile for lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. DHHS (ATSDR) Publication No. TP–88/17.
13. Grandjean P, Bach E [1986]. Indirect exposures: the significance of bystanders at work and at home. Am Ind Hyg Assoc J 47(12):819–824.
14. Preventing Lead Poisoning in Young Children. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control. Publication date: 10/01/1991
15. Farfel MR and Chisholm JJ [1990]. Health and environmental outcomes of traditional and modified practices for abatement of residential lead-based paint. Am J Pub Health, 80:10, 1240–1245.
16. Code of Federal Regulations [2001]. EPA Identification of Dangerous Levels of Lead. 40 CFR, Part 745. Washington, DC: U.S. Government Printing Office, Federal Register.
17. US Environmental Protection Agency [2005]. Chromated Copper Arsenate (CCA): Health and Safety Information. [[http://www.epa.gov/oppad001/reregistration/cca/health\\_safety.htm](http://www.epa.gov/oppad001/reregistration/cca/health_safety.htm)] Date accessed: November 2005.
18. US Environmental Protection Agency [2005]. Chromated Copper Arsenate (CCA): Consumer Safety Information Sheet: Inorganic Arsenical Pressure-Treated Wood. [[http://www.epa.gov/oppad001/reregistration/cca/cca\\_consumer\\_safety.htm](http://www.epa.gov/oppad001/reregistration/cca/cca_consumer_safety.htm)] Date accessed: November 2005.

**Table 1. Surface wipe sampling for elements\*  
Broward County Parks and Recreation Division, Markham Park Shooting Range  
July 6, 2005**

Sample	Location	Al (mcg)	Ar (mcg)	Ca (mcg)	Cu (mcg)	Fe (mcg)	Pb (mcg)	Ph (mcg)	Ti (mcg)	Zr (mcg)
1	Table in range master's office of the 100-yard range	ND	ND	37	0.7	ND	<b>2.1</b>	ND	ND	0.5
2	Front table of lane 54 of the 100-yard range	88	ND	140	12.7	29	<b>95</b>	1.7	2.6	1.2
3	Rear table of lane 44 of 100-yard range	28	ND	130	14.7	971	<b>110</b>	0.7	5.6	0.9
4	Broom handle at lane 59 of 100-yard range	61	ND	37	8.2	23	<b>20</b>	3.7	0.7	1.4
5	Floor of lane 43 of 100-yard range	248	ND	2340	120	431	<b>520</b>	69	15	1.2
6	Chair surface at lane 39 of 100-yard range	81	ND	47	3.4	32	<b>23</b>	ND	3.4	0.6
7	Table surface in office of 100-yard range	55	ND	37	2.7	ND	<b>9.3</b>	1.7	0.9	1.8
8	Floor of office of 100-yard range	88	ND	607	10.7	55	<b>56</b>	11	1.3	0.9
9	Floor of clubhouse conference room	26	ND	270	0.8	ND	<b>1.7</b>	3.7	ND	1.0
10	Table surface in clubhouse	63	ND	37	0.4	ND	<b>0.5</b>	0.7	ND	0.7
11	Picnic table surface in clubhouse covered patio area	14	ND	130	1.7	ND	<b>5.3</b>	4.7	26	0.9
12	Hand wipe from range attendant after raking and picking up spent shells	118	ND	820	56	151	<b>89</b>	17	3.4	1.1
13	Hand wipe from range attendant supervising and loading skeet trap	328	ND	2040	18	311	<b>28</b>	37	2.6	0.5

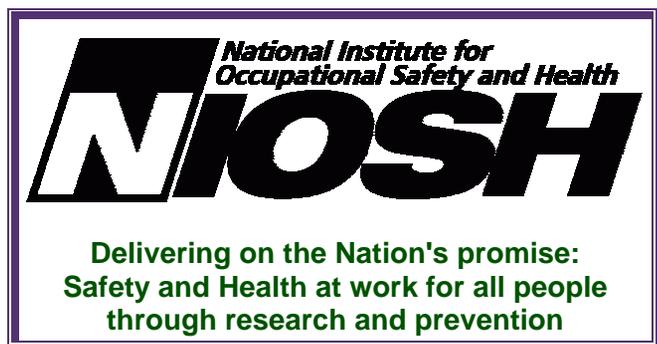
\* Surface area sampled = 100 cm<sup>2</sup>

† There are no standards for acceptable levels of various elements on surfaces in an occupational setting against which to compare these results. The following metals were below detection limits: beryllium, cadmium, cobalt, chromium, lithium, magnesium, manganese, molybdenum, nickel, platinum, selenium, silver, sodium, tellurium, thallium, vanadium, yttrium, and zinc.

‡ Al = Aluminum; Ar = Arsenic; Ca = Calcium; Cu = Copper; Fe = Iron; Pb = Lead; Ph = Phosphorus; Ti = Titanium; Zr = Zirconium  
ND = Not detectable

DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health  
4676 Columbia Parkway  
Cincinnati, OH 45226-1998

OFFICIAL BUSINESS  
Penalty for private use \$300



To receive NIOSH documents or information  
about occupational safety and health topics  
contact NIOSH at:

1-800-35-NIOSH (356-4674)  
Fax: 1-513-533-8573  
E-mail: [pubstaff@cdc.gov](mailto:pubstaff@cdc.gov)  
or visit the NIOSH web site at:  
<http://www.cdc.gov/niosh>

**SAFER • HEALTHIER • PEOPLE™**