Health Consultation
Public Comment Draft

Former Bloom's Nursery
(aka Middle River Terrace Park [MRTP])

Ft. Lauderdale, Broward County, Florida

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Florida Department of Health
Division of Disease Control and Health Protection
Under Cooperative Agreement with
U. S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Table of Contents

Foreword

The Florida Department of Health (DOH) evaluates the public health risk of hazardous waste sites through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ASTDR) in Atlanta, Georgia. This is a state report, meaning DOH health professionals reviewed it. DOH prepared this report using the same guidelines and equations we use for US Environmental Protection Agency (EPA) sites that ATSDR reviews by mandate. This health consultation is part of an effort to evaluate health effects associated with soil and fruit from the former Bloom's Nursery site. The DOH evaluates site-related public health issues through the following processes:

Evaluating exposure: DOH scientists review available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is on the site, and how human exposures might occur. The Florida Department of Environmental Protection (DEP) provided the data for this assessment.

Evaluating health effects: If we find evidence that exposures to hazardous substances are occurring or might occur, DOH scientists next determine whether that exposure could be harmful to human health. We focus on potential health effects for the community as a whole. We base our conclusions and recommendations on current scientific information.

Developing recommendations: DOH lists its conclusions regarding any potential health threat posed by groundwater, air, and soil. DOH then offers recommendations for reducing or eliminating human exposure. The role of the DOH in dealing with hazardous waste sites is primarily advisory. Our public health assessments will typically recommend actions for other agencies including the US Environmental Protection Agency (EPA) and the DEP. If a health threat is actual or imminent, DOH will issue a public health advisory warning people of the danger and will work with the regulatory agencies 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 any conclusions about the site with the groups and organizations providing the information, and we ask for feedback from the public.

If you have questions or comments about this report, please write to us at

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Summary

INTRODUCTION	At the former Bloom's Nursery (aka Middle River Terrace Park [MRTP]) site, the Florida Department of Health's (DOH) top priority is to ensure nearby residents have the best information to safeguard their health. The former Bloom's Nursery/MRTP site is at 1329 NE 7th Avenue in Fort Lauderdale, Broward County, Florida. In the past, the site was used as a plant nursery and is currently a park. After a consultant detected arsenic on an adjacent property (1325 NE 7th Avenue), a nearby resident expressed concern about the safety of park visitors using the site and consuming fruit growing in the park. DOH reached the following four conclusions:
CONCLUSION #1	DOH concludes that incidental ingestion (swallowing) of pollutants in on-site surface soils is not likely to harm workers' health.
BASIS FOR DECISIONS #1	Based on 24 samples, pollutants in the on-site surface soils are below levels likely to harm health. Contact with these levels would result in, at most, an "extremely low" increased cancer risk for workers.
CONCLUSION #2	DOH concludes that incidental ingestion of pollutants in on-site surface soils is not likely to harm the health of MRTP visitors.
BASIS FOR DECISIONS #2	Based on 24 samples, pollutants in the on-site surface soils are below levels likely to harm park visitors' health.
CONCLUSION #3	DOH concludes that if park visitors consume fruit from the park, it is not likely to harm their health.
BASIS FOR DECISIONS #3	Based on the relatively low levels of pollutants found in the surface soil that would potentially reach the fruit, pollutants in the on-site fruit are likely below levels that would harm health.

CONCLUSION #4	DOH concludes that incidental ingestion of pollutants in surface soils is not likely to harm the health of future residents at 1325 NE 7th Avenue.
BASIS FOR DECISIONS #4	Based on 44 samples, pollutants in the off-site surface soils are below levels likely to harm residents' health. Contact with these levels would result in, at most, a "very low" increased cancer risk.
FOR MORE INFORMATION	If you have concerns about your health or the health of your children, you should contact your health care provider. You may also call the DOH toll-free at 877-798-2772 and ask for information about the former Bloom's Nursery or MRTP site.

Background and Statement of Issues

The purpose of this health consultation report is to assess the public health threat from toxic chemicals in soil at the former Bloom's Nursery site (aka MRTP) (Photo 1) and adjacent property at 1325 NE 7th Avenue (Photos 2 and 3). The Florida Department of Environmental Protection (DEP) requested this assessment. A concerned citizen brought this site to the attention of DEP and Broward County. The site is at 1329 NE 7th Avenue, Ft. Lauderdale, Broward County, Florida, 33304 (Figures 1 and 2).

Health scientists look at what chemicals are present and in what amounts. They compare those amounts to national guidelines. These guidelines are set far below known or suspected levels associated with health effects. Florida Department of Health (DOH) uses guidelines developed to protect children. If chemicals are not present at levels high enough to harm children, they would not likely harm adults.

This assessment considers health concerns of nearby residents and explores possible associations with site-related contaminants. It requires the use of assumptions, judgments, and incomplete data. These factors contribute to uncertainty in evaluating the health threat. Assumptions and judgments in this assessment err on the side of protecting public health and may overestimate the risk.

This assessment estimates the health risk for individuals exposed to the highest measured level of contamination. At this site it is uncertain if anyone contacted contamination in soil where consultants measured the arsenic and pesticides levels. Therefore, the health risk for most workers, park visitors, and nearby residents is less than the health risks estimated in this report. Those without exposure have no health risk from this site.

Site Description

The former Bloom's Nursery site is now a 3.6 acre park called Middle River Terrace Park (MRTP). Past use/disposal of plant pesticides may have polluted soil and groundwater. MRTP has open grassy areas, pavilions, picnic areas and walking/jogging trails. The City of Fort Lauderdale constructed the MRTP (Photo 1) sometime between 2000 and 2001. The historic Annie Beck House (Photo 4) is also on the MRTP property. The Annie Beck House is not a residence. However, the house is used sometimes for community meetings. No summer or after-school activities reportedly take place at the MRTP property. The park is closed from 9:00 PM to 8:00 AM. A gate is at the entrance road into the park, however, walking access to the park is unrestricted. Residential properties border the park to the east, south, southwest and west. Apartments or condominiums are to the west and east. Vacant land is to the north (Figure 2) [AMEC 2015].

As a result of their site screening investigation, DEP believes that the former Bloom's Nursery operated only on the 1329 NE 7th Ave property. Therefore, the adjacent 1325 NE 7th Ave property is not considered to have been a part of the former Bloom's Nursery site [DEP 2014].

Demographics

DOH examines demographic and land use data to identify sensitive populations, such as young children, the elderly, and women of childbearing age, to determine whether these sensitive populations are exposed to any potential health risks. Demographics also provide details on population mobility and residential history in a particular area. This information helps DOH evaluate how long residents might have been exposed to contaminants.

Approximately 16,000 people live within one mile of the site. Forty-nine percent (49%) are white, 34% are African-American, 11% are Hispanic, 3% are Asian and 3% are other. Eighteen percent (18%) are less than 18 years old. Approximately twenty-one (21%) are women of child-bearing age (15-44 years old). Forty-two percent (42%) have a high school diploma or less and 39% have at least two years of college. Sixty-eight percent (68%) speak only English and 59% have a household income of less than $50,000 a year [EPA 2010a].

Land Use

Residential properties border the park to the east, south, southwest and west. Apartments or condominiums are west and east. Vacant land is north of the park.

Community Health Concerns

At least one nearby resident is concerned about soil contamination in the park and the risk of eating fruit grown at the site.

Discussion

Environmental Data

1325 NE 7th Avenue Property

In 2007, the City of Fort Lauderdale tested soil and ground water at 1325 NE 7th Avenue prior to buying the property to expand the MRTP. They found levels of arsenic above the State Soil Cleanup Target Level (SCTL) and Groundwater Cleanup Target Level (GCTL) criteria [AMEC 2015].

Between 2007 and 2012, DEP advanced 44 soil borings (SB-1 through SB-44) at the off-site property (Figure 3). They collected discrete interval soil samples for arsenic analysis. DEP analyzed three samples (SB-1, SB-2 & SB-3) for organochlorine pesticide and herbicide contamination (Table 4). They found the highest levels of arsenic in SB-42 (34.6 mg/kg). This arsenic concentration exceeded the State SCTL under both the residential criteria of 2.1 mg/kg and the commercial/industrial criteria of 12 mg/kg. DEP

collected these soil samples from the southeastern part of the 1325 NE 7th Avenue property, just south of the one story residence.

For this health consultation, consultants for the DEP and responsible parties have adequately characterized surface soil quality for the unoccupied property at 1325 NE 7th Avenue.

Former Bloom's Nursery/MRTP and Adjacent Properties

In September 2014, DEP collected soil samples from 29 locations (BN001 through BN028, BN031) for laboratory analysis (Figure 4). They advanced boring locations BN002 through BN023 on the MRTP property while boring samples BN001 (background) and BN024 through BN028 and BN031 were collected from offsite properties. DEP collected surface soil samples from each of the borings from 0 to 0.5 feet below land surface (bls) and the subsurface soil samples on the MRTP property from 0.5 to 2 feet bls. They collected subsurface soil samples from offsite properties at 0.5 to 1-foot bls. DEP sampled three depth intervals (0 to 0.5) including two different subsurface depth intervals (0.5 to 1 and 0.5 to 2 feet) at the background location to correlate with the two different subsurface soil intervals collected at onsite and offsite locations. They analyzed for metals and chlorinated pesticides (Table 5).

For this health consultation, consultants for the DEP and responsible parties have adequately characterized surface soil quality.

DOH was unable to locate the results of any testing of mango fruit growing on the site. This is an environmental data gap.

Pathway Analyses

Chemical contamination in the environment can only harm someone's health if he or she contacts those contaminants. If there is no exposure, there can be no associated harm to health. If exposure does occur, how much of the contaminants someone contacts (concentration), how often the contaminants are contacted (frequency), for how long they are contacted (duration), and the danger of the contaminant (toxicity) all contribute to the risk of harm.

To assess any contaminant's public health importance, we estimate the frequency with which people could have contact with that contaminant. The method for assessing whether people face a health risk is to determine whether a completed exposure pathway connects them to a contaminant source, and whether exposures to that contaminant source are high enough to be of health concern.

The Exposure Pathway

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at contact with the human body. A completed exposure pathway consists of five elements:

1. Source of contamination, such as a hazardous waste site;
2. An environmental medium such as air, water, or soil that can hold or move the contamination;
3. A point where people come into contact with a contaminated medium, such as water at the tap or soil in the yard;
4. An exposure route, such as ingesting (contaminated soil or water) or breathing (contaminated air); and
5. A population, such as people who live near or work on a contaminated waste site.

Generally, ATSDR/DOH consider three exposure categories:

- Completed exposure pathways—all five elements of a pathway are present;
- Potential exposure pathways—one or more of the elements might not be present, but information is insufficient to eliminate or exclude the element; and
- Eliminated exposure pathways—at least one element is not present and will not likely be present.

Exposure pathways evaluate specific ways in which people were, are, or might be exposed to environmental contamination in the past, present, and future.

Completed exposure pathways

DOH evaluated three completed human exposure pathways: worker ingestion of on-site soil, park visitor ingestion of on-site soil, and park visitors eating fruit from on-site trees (Table 1).

Incidental ingestion of arsenic and pesticides in on-site soil by workers is a completed exposure pathway. The former Bloom's Nursery is the source. On-site surface soil (0 to 0.5 feet deep) is the medium and point of exposure. Incidental ingestion is the route of exposure and workers are the exposed population. Workers were exposed in the past, are being exposed now, and may be exposed in the future (Table 1).

Incidental ingestion of arsenic and pesticides in on-site soil by park visitors is also a completed exposure pathway. The former Bloom's Nursery is the source. On-site surface soil is the medium and point of exposure. Incidental ingestion is the route of exposure and park visitors are the exposed population. Park visitors were exposed in the past, are being exposed now, and may be exposed in the future (Table 1).

Ingestion of arsenic in fruit (mango) from on-site trees by park visitors is another completed exposure pathway. The former Bloom's Nursery is the source. On-site fruit is the exposure medium. On-site mango trees are the point of exposure. Ingestion is the route of exposure and park visitors are the exposed population. People who eat this fruit were exposed in the past, are being exposed now, and may be exposed in the future (Table 1).

Potential exposure pathways

For this assessment, DOH evaluated the potential long-term health threat from incidental ingestion (swallowing) of very small amounts of arsenic and pesticides in surface soil from residential properties adjacent to the former Bloom's Nursery/ MRTP. One property is at 1325 NE 7th Avenue and unoccupied. DEP collected additional surface soil samples from properties to the south and east of the 1325 NE 7th Avenue property (Figure 4).

For the 1325 NE 7th Avenue property, the source of contamination is unknown. It is uncertain if the former Bloom's Nursery/MRTP site is the source, since soil and groundwater levels for arsenic were higher here than on the former Bloom's Nursery/MRTP site. The sources for contamination at the additional residential properties are also unknown. Surface soil is the medium and the points of exposure would be the individual properties. Ingestion would be the exposure route and future residents would be the exposed population (Table 2).

Eliminated exposure pathways

DOH concludes that incidental ingestion of sub-surface soil (0.5 to 2 feet deep) and drinking or showering with water from local private or municipal drinking water wells are eliminated exposure pathways (Table 3).

There is no evidence of exposure to subsurface soils or sediments on or near the site. There are currently no businesses conducting excavation or other activities that might regularly expose people to subsurface soil or sediments on or near the site.

Drinking and showering with water from nearby private or municipal wells are also eliminated exposure pathways. Nearby residents receive municipal water that is routinely tested and is safe to drink. No private wells were located within a 4-mile radius of the site [DEP 2014].

Public Health Implications

Health scientists look at which chemicals are present and in what amounts. They compare those amounts to health guidelines. These guidelines are set far below known or suspected levels associated with health effects.

This public health assessment also considers health concerns of nearby residents and explores possible associations with site-related contaminants. This assessment requires the use of assumptions and judgments, and relies on incomplete data. These factors contribute to uncertainty in evaluating the health threat. Assumptions and judgments in the assessment of the site's impact on public health err on the side of protecting public health and may overestimate the risk.

DOH estimates the health risk for individuals exposed to the highest measured level of contamination. Use of the highest measured level of contamination is appropriate for an initial health determination to insure it does not underestimate the risk.

DOH provides site-specific public health recommendations on the basis of toxicological literature, levels of environmental contaminants, evaluation of potential exposure pathways, duration of exposure, and characteristics of the exposed population. Whether a person will be harmed depends on the type and amount of contaminant, how they are exposed, how long they are exposed, how much contaminant is absorbed, genetics, and individual lifestyles.

Dose

After identifying contaminants of concern, DOH evaluates exposures by estimating daily doses for children and adults. Kamrin [1988] explains the concept of dose as follows:

> "…all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus, the amount of a chemical a person is exposed to is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they must consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant.
>
> Thus instead of using the amount that is administered or to which an organism is exposed, it is more realistic to use the amount per weight of the organism. Thus, 1 ounce administered to a 1-pound rat is equivalent to 2,000 ounces to a 2,000-pound (1-ton) elephant. In each case, the amount per weight is the same; 1 ounce for each pound of animal."

This amount per weight is the *dose*. Toxicology uses dose to compare toxicity of different chemicals in different animals. They use the units of milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day) to express doses in this assessment[1].

To calculate the daily doses of each contaminant, the DOH uses standard factors for dose calculation [ATSDR 2005; EPA 2011]. DOH assumes that people are exposed daily to the maximum concentration measured and makes the health protective assumption that 100% of the ingested chemical is absorbed into the body for most contaminants. DOH

[1] A milligram is 1/1,000 of a gram; a kilogram is approximately 2 pounds.

used 60% as the default relative bioavailability value for arsenic based on an EPA evaluation of available research [EPA 2010b, OSWER 2012]. The percent actually absorbed into the body is likely less. The general formula for estimating a dose is:
The general formula for estimating a dose is:

$$D = (C \times IR \times EF \times CF) / BW$$

Where:
D = exposure dose (mg/kg/day)
C = contaminant concentration (various units)
IR = intake rate (amount per day)
EF = exposure factor (unit less)
CF = conversion factor (10^{-6} kg/mg)
BW = body weight (kilograms or kg)

$$EF = F \times ED / AT$$

Where:
EF = exposure factor (unit less)
F = frequency of exposure (days/year)
ED = exposure duration (years)
AT = averaging time (days) (ED × 365 days/year for non-carcinogens; 78 years × 365 days/year for carcinogens)

ATSDR groups health effects by duration (length) 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 (swallowing) of contaminated soil, DOH uses the following standard assumptions:

1) Children ages 6 months to a year incidentally ingest an average of 60 milligrams (mg) and an upper percentile of ingestion of 100 mg of soil per day.
2) Children ages 1 to 21 years incidentally ingest an average of 100 mg and an upper percentile of ingestion of 200 mg of soil per day (about the weight of a postage stamp).
3) Adults incidentally ingest an average of 50 mg and an upper percentile of ingestion of 100 mg of soil per day.
4) Average weights vary with age: (0.5 to 1 year: 9.2 kg), (1 to 2 years: 11.4 kg), (2 to 6 years: 17.4 kg), (6 to 11 years: 31.8 kg), (11 to 21 years: 64.2 kg), (21 to 65 years: 80 kg), (65 and older: 76 kg).
5) The frequency of exposure is assumed to be 365 days per year.
6) The residential exposure frequency is 350 days per year.

7) The residential exposure duration for adults is 33 years.

DOH compares estimated soil and water exposure doses to ATSDR chemical specific minimal risk levels (MRLs). MRLs are comparison values that establish exposure levels many times lower than levels where scientists observed no effects in animals or human studies. ATSDR designed the MRL to protect the most sensitive, vulnerable individuals in a population. The MRL is an exposure level below which non-cancerous harmful effects are unlikely, even after daily exposure over a lifetime. Although ATSDR considers concentrations at or below the relevant comparison value reasonably safe, exceeding a comparison value does not imply adverse health effects are likely.

If contaminant concentrations are above comparison values, DOH further analyzes exposure variables (for example, duration and frequency), toxicology of the contaminants, past epidemiology studies, and the weight of evidence for health effects. DOH uses chronic MRLs where possible because exposures are usually longer than a year. If chronic MRLs are not available DOH uses intermediate length MRLs [ATSDR 2005].

For non-cancer illnesses, DOH first estimates the health risk for children. Because children are smaller and swallow more soil than adults, their exposure is higher. Therefore, if children are not at risk, then adults are not either.

For cancer, DOH quantifies the estimated increased risk by using the general formula:

$$\text{Risk} = D \times SF \times ADAF$$

Risk = Cancer risk
D = Age specific non-cancer dose (mg/kg/day)
SF = Slope factor $(\text{mg/kg-day})^{-1}$
ADAF = Age Dependent Adjustment Factor, for those chemical which are known to increase cancer risks due to early life exposures

This is a high estimate of the increased cancer risk. The actual increased cancer risk is likely lower. Because of large uncertainties in the way scientists estimate cancer risks, the actual cancer may be as low as zero. If there is no cancer slope (potency) factor, DOH/ATSDR cannot quantify the risk.

We usually estimate the cancer risk from lifetime (78 years) exposure. Studies of animals exposed over their entire lifetime are the basis for calculating cancer slope factors. Usually, researchers know little about the cancer risk in animals from less than lifetime exposures. Therefore, we also use lifetime exposure to estimate the cancer risk in people.

Identifying Contaminants of Concern

DOH compares the maximum concentrations of contaminants found at a site to ATSDR and other comparison values. Comparison values are specific for the medium contaminated (soil, water, air, etc.). We screen the environmental data using these comparison values:

- ATSDR Cancer Risk Evaluation Guides (CREGs)
- ATSDR Environmental Media Evaluation Guides (EMEGs)
- ATSDR Reference Media Evaluation Guides (RMEGs)
- DEP Soil Cleanup Target Levels (SCTLs)
- EPA Maximum Contaminant Levels (MCLs)
- EPA Lifetime Health Advisory (LTHA)
- EPA Reference Concentration for Chronic Inhalation Exposure (RfC)
- Other guidelines

When determining which comparison value to use, DOH follows ATSDR's general hierarchy and also uses professional judgment.

We select for further evaluation contaminants with maximum concentrations above a comparison value. Comparison values, however, are not thresholds of toxicity. We do not use them to predict health effects or to establish clean-up levels. A concentration above a comparison value does not necessarily mean harm will occur. It does indicate, however, the need for further evaluation.

Maximum contaminant concentrations below comparison values are not likely to cause illness and DOH/ATSDR does not evaluate them further.

Comparing the highest measured concentrations in soil to ATSDR and EPA screening guidelines, DOH selected arsenic, dieldrin and toxaphene as contaminants of concern (Tables 4 and 5). Selection of these contaminants does not necessarily mean there is a public health risk. Rather, DOH selected these contaminants for closer scrutiny. Concentrations of other contaminants are below screening guidelines, are not likely to cause illness, and DOH/ATSDR does not evaluate them further.

The following three sections describe the general toxicity of arsenic, dieldrin, and toxaphene. Not all health effects listed in these three sections are likely at the former Bloom's Nursery site. We describe health effects likely at this site in the Complete Human Exposure Pathways and Potential Human Exposure Pathways sections.

Arsenic

Arsenic is a naturally occurring metal widely distributed in soil. Scientists usually find it combined with oxygen, chlorine, and sulfur. Most arsenic compounds have no smell or special taste [ATSDR 2007].

Arsenic, like most metals, is not well absorbed through the skin. If you get arsenic-contaminated soil on your skin, only a small amount will go through your skin into your body, so skin contact is usually not a health risk [ATSDR 2007a]. The lack of air monitoring data prevents an evaluation of the risk from breathing arsenic-contaminated dust.

Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet. Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. Skin contact with inorganic arsenic may cause redness and swelling. Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. The Department of Health and Human Services (DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans.

There is some evidence that long-term exposure to arsenic in children may result in lower IQ scores. There is also some evidence that exposure to arsenic in the womb and early childhood may increase mortality in young adults [ATSDR 2007].

State and federal environmental agencies base their arsenic cleanup standards on workplace studies and laboratory animal studies. Because of uncertainties in these studies, their cleanup standards include large safety factors to ensure public health. Although concentrations slightly above these cleanup standards may not necessarily cause harm, the responsible party should clean up the soil to protect public health.

Dieldrin

Aldrin and dieldrin are insecticides with similar chemical structures. We discuss them together in this report because aldrin quickly breaks down to dieldrin in the body and in the environment. Pure aldrin and dieldrin are white powders with a mild chemical odor. The less pure commercial powders have a tan color. Neither substance occurs naturally in the environment. From the 1950s until 1970, aldrin and dieldrin were widely used pesticides for crops like corn and cotton. Because of concerns about damage to the environment and potentially to human health, EPA banned all uses of aldrin and dieldrin in 1974, except to control termites. In 1987, EPA banned all uses.

Aldrin and dieldrin affect health in similar ways. Health scientists have seen symptoms of aldrin and dieldrin poisoning in people who were exposed to very large amounts of these pesticides during their manufacture. They have also seen symptoms of poisoning in people who intentionally or accidentally ate or drank large amounts of aldrin or dieldrin. Most of these people experienced convulsions or other nervous system effects, and some had kidney damage. Some people who intentionally ate or drank large amounts of aldrin

or dieldrin died. Health effects in people exposed to smaller amounts of aldrin or dieldrin occur because levels of the chemicals build up in the body over time. Exposure to moderate levels of aldrin or dieldrin for a long time causes headaches, dizziness, irritability, vomiting, or uncontrollable muscle movements. Some sensitive people seem to develop a condition in which aldrin or dieldrin causes the body to destroy its own blood cells. The IARC has determined that aldrin and dieldrin are not classifiable as to their carcinogenicity to humans. Based on studies in animals, the EPA has determined that aldrin and dieldrin are probable human carcinogens [ATSDR 2002].

The federal government has developed regulatory standards and guidelines to protect people from the harmful health effects of aldrin and dieldrin. In 1974, EPA banned all uses of aldrin or dieldrin except as a termite killer. In 1981, EPA required labeling changes to warn against applying these chemicals near water supplies, heating ducts, or crawl spaces. They also warned against applying them too frequently. Even though EPA banned all uses of aldrin and dieldrin in 1987, the chemicals persist in the environment. EPA advises lifetime drinking water exposure concentration limits for aldrin and dieldrin of 0.001 and 0.002 milligrams per liter (mg/L), respectively, for protection against adverse non-cancer health effects, which assume all of the exposure is from drinking water. Regarding cancer risk, EPA advises a drinking water exposure concentration limit of 0.0002 mg/L for aldrin and dieldrin that would, in theory, limit the lifetime risk for developing cancer from exposure to each compound to 1 extra cancer case in 10,000 people.

Toxaphene

Toxaphene is usually found as a solid or a gas. In its original form, toxaphene is a yellow to amber waxy solid that has a piney odor. Toxaphene is a mixture of hundreds of different chlorinated compounds. It was one of the most heavily used pesticides in the Unites States until 1982, when EPA canceled it for most uses. EPA banned all registered uses by 1990. Farmers, primarily in the southern United States, used toxaphene to control insect pests on cotton and other crops.

Breathing, eating, or drinking high amounts of toxaphene could damage the nervous system, liver, and kidneys, and even cause death. However, since toxaphene is no longer used in the United States, most people would not be exposed to high levels of it. Studies showed that animals which ate food or drank water containing toxaphene had effects on the liver, kidneys, and immune system. It is not known whether toxaphene can affect reproduction in humans.

It is not known whether toxaphene would cause cancer in people. Toxaphene caused liver cancer in mice and possible thyroid cancer in rats that were given large amounts of toxaphene by mouth. The DHHS has determined that toxaphene is reasonably anticipated to be a human carcinogen. The IARC has determined that toxaphene is possibly carcinogenic to humans. The EPA has determined that toxaphene is a probable human carcinogen. Toxaphene would be expected to affect children in the same manner as adults. It is not known whether children are more susceptible than adults to the effects of toxaphene.

The EPA has determined that exposure to toxaphene in drinking water at concentrations of 0.004 milligrams per liter (mg/L) for up to 10 days is not expected to cause any adverse effects in a 10 kg child. The EPA has determined that lifetime exposure to 0.01 mg/L toxaphene in the drinking water is not expected to cause any adverse noncancer effects if the only source of exposure to toxaphene is the drinking water. The Food and Drug Administration (FDA) has determined that the concentration of toxaphene in bottled drinking water should not exceed 0.003 mg/L. The Occupational Safety and Health Administration (OSHA) set a legal limit of 0.5 mg/m3 for toxaphene in air averaged over an 8-hour work day [ATSDR 2014].

Completed Human Exposure Pathways

On-Site Surface Soil – Worker Exposure

In September 2014, consultants collected 24 on-site surface soil samples (BN002 – BN023) from 0 to 0.5 feet deep (Figure 4). DOH calculations used a soil intake rate of 100 mg/day, adult worker (outdoor with low soil contact) weighing 80 kg (approximately 176 pounds), exposed five (5) times per week with an exposure duration of 25 years. Based on these samples, DOH does not expect exposures to surface soil on the former Bloom's Nursery/MRTP site to harm workers' health. Estimated increased cancer risks are "extremely low", approximately 2 in 1,000,000.

Arsenic

DOH estimated adult worker exposure using a maximum on-site soil concentration for arsenic of 7.0 mg/kg and a bioavailability factor of 0.6 [EPA 2010b] for an exposure point concentration of 4.2 mg/kg.

Noncancer illnesses

A maintenance worker who incidentally ingests very small amounts of surface soil from the site with the highest arsenic levels is unlikely to develop noncancer illnesses. The maximum worker arsenic noncancer dose (4×10^{-6} mg/kg/day) is less than ATSDR's chronic MRL (3×10^{-4} mg/kg/day) and thus unlikely to cause noncancer illnesses (Table 6).

Cancer

Workers who incidentally ingest surface soil with the highest arsenic levels at the site over a 25-year period are at an "extremely low" increased estimated risk of cancer (Table 6). Multiplying the maximum arsenic cancer dose (1.2×10^{-6} mg/kg/day) by the EPA cancer slope factor (1.5 mg/kg/day^{-1}) results in an increased estimated cancer risk of approximately 2 in 1 million (0.0000018 or 1.8×10^{-6}).

To put this "extremely low" increased cancer risk into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 1,000,000 people, on average about 333,333 will get some form of cancer during their

lifetime. Exposure to this soil with the highest arsenic concentration would, at most, increase the lifetime cancer risk from 333,333 cases in 1,000,000 people to 333,335 cases in 1,000,000 people.

Dieldrin

DOH estimated adult worker exposure using a maximum on-site soil concentration for dieldrin of 0.23 mg/kg.

Noncancer illnesses

A maintenance worker who incidentally ingests very small amounts of surface soil from the site with the highest dieldrin levels is unlikely to develop noncancer illnesses. The maximum worker dieldrin noncancer dose (2.1×10^{-7} mg/kg/day) is less than ATSDR's chronic MRL (5×10^{-5} mg/kg/day) and thus unlikely to cause noncancer illnesses (Table 6).

Cancer

Workers who incidentally ingest surface soil with the highest dieldrin levels at the site over a 25-year period are at an "extremely low" increased estimated risk of cancer (Table 6). Multiplying the maximum dieldrin cancer dose (6.6×10^{-4} mg/kg/day) by the EPA cancer slope factor (17 mg/kg/day^{-1}) results in an increased estimated cancer risk of approximately 1 in 1 million (0.0000011 or 1.1×10^{-6}).

To put this "extremely low" increased cancer risk into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 1,000,000 people, on average about 333,333 will get some form of cancer during their lifetime. Exposure to this soil with the highest dieldrin concentration would, at most, increase the lifetime cancer risk from 333,333 cases in 1,000,000 people to 333,334 cases in 1,000,000 people.

Toxaphene

DOH estimated adult worker exposure using a maximum on-site soil concentration for toxaphene of 5.5 mg/kg.

Noncancer illnesses

A maintenance worker who incidentally ingests very small amounts of surface soil from the site with the highest toxaphene levels is unlikely to develop noncancer illnesses. The maximum worker toxaphene noncancer dose (4.9×10^{-6} mg/kg/day) is less than ATSDR's chronic MRL (2×10^{-2} mg/kg/day) and thus unlikely to cause noncancer illnesses (Table 6).

Cancer

Workers who incidentally ingest surface soil with the highest toxaphene levels at the site over a 25-year period are at an "extremely low" increased estimated risk of cancer (Table 6). Multiplying the maximum toxaphene cancer dose (1.6×10^{-6} mg/kg/day) by the EPA cancer slope factor (1.1 mg/kg/day^{-1}) results in an increased estimated cancer risk of approximately 2 in 1 million (0.0000017 or 1.7×10^{-6}).

To put this "extremely low" increased cancer risk into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 1,000,000 people, on average about 333,333 will get some form of cancer during their lifetime. Exposure to this soil with the highest toxaphene concentration would, at most, increase the lifetime cancer risk from 333,333 cases in 1,000,000 people to 333,335 cases in 1,000,000 people.

On-Site Surface Soil – Park Visitor Exposure

In September 2014, consultants collected 24 on-site surface soil samples (BN002 – BN023) from 0 to 0.5 feet deep (Figure 4). DOH calculations used a soil intake of 100 mg/day, park visitor weighing 45 kg (approximately 100 pounds), exposed four (4) times per week with an exposure duration of 10 years. Based on these samples, DOH does not expect exposures to surface soil on the former Bloom's Nursery/MRTP site to harm park visitors' health. DOH cannot calculate childhood cancer for park visitors at this site. Slope factors used to calculate cancer risk are based upon a chronic, lifetime exposure. It is not biologically plausible to shorten exposure duration and expect the same dose response. However, due to less exposure frequency and duration, the increased cancer risk for park visitors could be expected to be less than that for park workers.

Arsenic

DOH estimated park visitor exposure using a maximum on-site soil concentration for arsenic of 7.0 mg/kg and a bioavailability factor of 0.6 [EPA 2010b] for an exposure point concentration of 4.2 mg/kg.

Noncancer illnesses

A park visitor who incidentally ingests very small amounts of surface soil from the site with the highest arsenic levels is unlikely to develop noncancer illnesses. The maximum park visitor arsenic noncancer dose (5.4×10^{-6} mg/kg/day) is less than ATSDR's chronic MRL (3×10^{-4} mg/kg/day) and thus unlikely to cause noncancer illnesses (Table 7).

Dieldrin

DOH estimated park visitor exposure using a maximum on-site soil concentration for dieldrin of 0.23 mg/kg.

Noncancer illnesses

A park visitor who incidentally ingests very small amounts of surface soil from the site with the highest dieldrin levels is unlikely to develop noncancer illnesses. The maximum visitor dieldrin noncancer dose (3×10^{-7} mg/kg/day) is less than ATSDR's chronic MRL (5×10^{-5} mg/kg/day) and thus unlikely to cause noncancer illnesses (Table 7).

Toxaphene

DOH estimated park visitor exposure using a maximum on-site soil concentration for toxaphene of 5.5 mg/kg.

Noncancer illnesses

A maintenance worker who incidentally ingests very small amounts of surface soil from the site with the highest toxaphene levels is unlikely to develop noncancer illnesses. The maximum worker toxaphene noncancer dose (7.1×10^{-6} mg/kg/day) is less than ATSDR's chronic MRL (2×10^{-2} mg/kg/day) and thus unlikely to cause noncancer illnesses (Table 7).

On-Site Fruit Trees – Park Visitor Exposure

A nearby resident expressed concern relating to the safety of eating fruit from trees growing in the MRTP. DOH concludes that eating fruit from these trees is not likely to harm park visitors' health.

In September 2014, consultants collected 24 on-site surface soil samples (BN002 – BN023) from 0 to 0.5 feet deep (Figure 4). The maximum concentration for the contaminants of concern was arsenic at 7.0 mg/kg (BN010). Since most of the arsenic would be concentrated in the roots, arsenic levels in the fruit would be extremely low [Environ 2013 and ATSDR 2007]. In 2009, DOH analyzed the results of test conducted on mangos grown in an area of Broward County with arsenic concentrations consistent with those found at the MRTP and concluded that there was no apparent health hazard from eating the fruit [DOH 2009].

Potential Human Exposure Pathways

Off-Site Surface Soil – Residential Exposure

Between 2007 and 2012, DEP advanced 44 soil borings (SB-1 through SB-44) at the 1325 NE 7th Avenue property (Figure 3). Florida DOH calculations used a soil intake of 100 mg/day, an adult weighing 80 kg (approximately 176 pounds), exposed seven (7) times per week with an exposure duration of 33 years. Based on these samples, Florida DOH does not expect exposures to surface soil on the 1325 NE 7th Avenue to harm residents' health. Estimated increased cancer risks are "very low", approximately 8 in 1,000,000.

Arsenic

DOH estimated exposure using a maximum surface soil concentration for arsenic of 34.6 mg/kg and a bioavailability factor of 0.6 [EPA 2010b] for an exposure point concentration of approximately 20.8 mg/kg.

Noncancer illnesses

A resident who incidentally ingests very small amounts of surface soil from the site with the highest arsenic levels is unlikely to develop noncancer illnesses. The maximum

residential arsenic noncancer dose (1.3×10^{-5} mg/kg/day) is less than ATSDR's chronic MRL (3×10^{-4} mg/kg/day) and thus unlikely to cause noncancer illnesses (Table 8). The greatest noncancer illness risk would be to children from 1-2 years of age. The noncancer dose for children of 1.8×10^{-4} mg/kg/day would still be less than the ATSDR's chronic MRL.

Cancer

Residents who incidentally ingest surface soil with the highest arsenic levels at the 1325 NE 7th Avenue property over a 33-year period are at a "very low" increased estimated risk of cancer (Table 8). Multiplying the maximum arsenic cancer dose (5.5×10^{-6} mg/kg/day) by the EPA cancer slope factor (1.5 mg/kg/day^{-1}) results in an increased estimated cancer risk of approximately 8 in 1 million (0.0000082 or 8.2×10^{-6}).

To put this "extremely low" increased cancer risk into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 1,000,000 people, on average about 333,333 will get some form of cancer during their lifetime. Exposure to this soil with the highest arsenic concentration would, at most, increase the lifetime cancer risk from 333,333 cases in 1,000,000 people to 333,341 cases in 1,000,000 people.

Child Health Considerations

This assessment takes into account the special vulnerabilities of children. It specifically considered the health risk for children playing in the surface soil or eating fruit from the MRTP site. Due to the low levels of pollutants, DOH finds no apparent public health hazard to children who use the site.

Community Health Concerns Evaluation

1. At least one resident of the neighborhood near the site is concerned about the health risk from contaminated soil.

> DOH does not expect contamination from the surface soil at this site to harm the health of workers, park visitors, or nearby residents.

2. At least one resident of the neighborhood near the site is concerned about the health risk from eating fruit from the MRTP.

> DOH does not expect eating fruit from trees at this site to harm the health of workers or park visitors.

DOH did not review area cancer rates (health outcome data) because the increased risk is "very low" to "extremely low."

Conclusions

Overall, DOH finds the former Bloom's Nursery/ Middle River Terrace Park site is no apparent public health hazard. DOH has reached the following four conclusions.

1. DOH concludes that incidental ingestion (swallowing) of arsenic and pesticides in on-site surface soils is not likely to harm workers' health.

2. DOH concludes that incidental ingestion (swallowing) of arsenic and pesticides in on-site surface soils is not likely to harm the health of Middle River Terrace Park visitors.

3. DOH concludes that if park visitors consume fruit from trees at the park, it is not likely to harm their health.

4. DOH concludes that incidental ingestion (swallowing) of arsenic and pesticides in surface soils is not likely to harm the health of future residents at1325 NE 7th Avenue.

Public Health Action Plan

Actions Planned

DOH will solicit public comment on this draft report and will address any comments and health concerns in the final report. DOH will consider review of new data when requested.

Report Preparation

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Appendices

Appendix A

Tables

Table 1. Completed Human Exposure Pathways at the Former Bloom's Nursery Site

Completed Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population	
Worker on-site soil ingestion	Former Nursery	Surface soil	On-site	Incidental ingestion	Workers	Past, present, and future
Park visitor on-site soil ingestion	Former Nursery	Surface soil	On-site	Incidental ingestion	Park visitors	Past, present, and future
Eating fruit from on-site trees	Former Nursery	Fruit	On-site	Ingestion	Park visitors	Past, present, and future

Table 2. Potential Human Exposure Pathways at Properties Adjacent to the Former Bloom's Nursery Site

Potential Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population	
Incidental ingestion (swallowing) of off-site soil at 1325 NE 7th Ave	1325 NE 7th Ave	Surface soil	1325 NE 7th Ave	Ingestion	Residents	Future
Incidental ingestion (swallowing) of off-site soil other than 1325 NE 7th Ave	Unknown	Surface soil	Off-site residential areas other than 1325 NE 7th Ave	Ingestion	Residents	Future

Table 3. Eliminated Human Exposure Pathways at the Former Bloom's Nursery Site

Eliminated Pathway Name	Exposure Pathway Elements				
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population
On-site subsurface soil	Former Bloom's Nursery	Soil	On-site	Ingestion	None
Off-site subsurface soil	Former Bloom's Nursery	Soil	Off-site	Ingestion	None
Drinking water from municipal wells	Former Bloom's Nursery	Deep aquifer groundwater	Tap water	Ingestion	None

Table 4. Arsenic Concentrations in Surface Soil (0 to 0.5 feet Deep) at the Off-site Location (1325 NE 7th Ave)

Contaminants	Concentration Range (mg/kg)	Location of Maximum Concentration	Soil Screening Guideline (mg/kg)*	Source of Screening Guideline	# of Samples Above Screening Guideline/Total # Samples
Arsenic	0.2U – 34.6	SB-42	0.47	CREG	40/45
Dieldrin	Not analyzed	--	--	--	--
Toxaphene	Not analyzed	--	--	--	--

Data Source = [DEP 2014]

CREG = ATSDR cancer risk evaluation guide

mg/kg = milligrams per kilogram

U = the analyte was not detected at or above the reporting limit

***** Screening guidelines only used to select chemicals for further scrutiny, not to judge the risk of illness.

Table 5. Contaminant Concentrations in On-Site Surface Soil (0 to 0.5 Feet Deep)at the Former Bloom's Nursery Site

Contaminants	Concentration Range (mg/kg)	Location of Maximum Concentration	Soil Screening Guideline (mg/kg)*	Source of Screening Guideline	# of Samples Above Screening Guideline/Total # Samples
Arsenic	0.43U – 7.0	BN010	0.47	CREG	22/31
Dieldrin	0.0061 – 0.23	BN002	0.044	CREG	1/32
Toxaphene	2.6 – 5.5	BN002	0.64	CREG	2/32

Data Source = [AMEC 2015]

CREG = ATSDR cancer risk evaluation guide

mg/kg = milligrams per kilogram

U = the analyte was not detected at or above the reporting limit

***** Screening guidelines only used to select chemicals for further scrutiny, not to judge the risk of illness.

Table 6. Estimated Park Worker Dose and Increased Risk From Inadvertent Ingestion of Surface Soil on the Former Bloom's Nursery Site

Contaminants	Maximum On-Site Soil Concentration (0-0.5' deep) (mg/kg)	Estimated Park Worker Inadvertent Soil Ingestion Dose (noncancer) (mg/kg/day)	ATSDR Minimal Risk Level (mg/kg/day)	Estimated Park Worker Maximum Inadvertent Soil Ingestion Dose (cancer) (mg/kg/day)	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Source of Oral Cancer Slope Factor	Estimated Increased Cancer Risk
Arsenic	7.0	4×10^{-6} (a)	3×10^{-4} (chronic)	1.2×10^{-6} (a)	1.5	EPA IRIS	1.8×10^{-6}
Dieldrin	0.23	2.1×10^{-7}	5×10^{-5} (chronic)	6.6×10^{-8}	17	EPA IRIS	1.1×10^{-6}
Toxaphene	5.5	4.9×10^{-6}	2×10^{-2} (intermediate)	1.6×10^{-6}	1.1	EPA IRIS	1.7×10^{-6}

ATSDR = Agency for Toxic Substances and Disease Registry

EPA IRIS = U.S. Environmental Protection Agency Integrated Risk Information System (EPA 2013b)

mg/kg = milligrams per kilogram

mg/kg/day = milligrams per kilogram per day

(a) = Arsenic dose reflects a bioavailability factor of 0.6 [EPA 2010b]

Table 7. Estimated Park Visitor Dose and Increased Risk From Inadvertent Ingestion of Surface Soil on the Former Bloom's Nursery Site

Contaminants	Maximum On-Site Soil Concentration (0-0.5' deep) (mg/kg)	Estimated Park Visitor Inadvertent Soil Ingestion Dose (noncancer) (mg/kg/day)	ATSDR Minimal Risk Level (mg/kg/day)	Estimated Park Visitor Maximum Inadvertent Soil Ingestion Dose (cancer) (mg/kg/day)	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Source of Oral Cancer Slope Factor	Estimated Increased Cancer Risk
Arsenic	7.0	5.4×10^{-6} (a)	3×10^{-4} (chronic)	6.9×10^{-7} (a)	1.5	EPA IRIS	*
Dieldrin	0.23	3×10^{-7}	5×10^{-5} (chronic)	3.8×10^{-8}	17	EPA IRIS	*
Toxaphene	5.5	7.1×10^{-6}	2×10^{-2} (intermediate)	9.1×10^{-7}	1.1	EPA IRIS	*

*** DOH does not report childhood cancer risks unless it is a mutagen. Slope factors are based upon a chronic, lifetime exposure. It is not biologically plausible to shorten the exposure duration and expect the same dose response.**

ATSDR = Agency for Toxic Substances and Disease Registry

EPA IRIS = U.S. Environmental Protection Agency Integrated Risk Information System (EPA 2013b)

mg/kg = milligrams per kilogram

mg/kg/day = milligrams per kilogram per day

(a) = Arsenic dose reflects a bioavailability factor of 0.6 [EPA 2010b]

Table 8. Estimated Residential Dose and Increased Cancer Risk From Inadvertent Ingestion of Surface Soil on the Off-site Location (1325 NE 7th Ave)

Contaminants	Maximum On-Site Soil Concentration (0-0.5' deep) (mg/kg)	Estimated Residential Maximum Inadvertent Soil Ingestion Dose (noncancer) (mg/kg/day)	ATSDR Minimal Risk Level (mg/kg/day)	Estimated Residential Maximum Inadvertent Soil Ingestion Dose (cancer) (mg/kg/day)	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Source of Oral Cancer Slope Factor	Estimated Increased Cancer Risk
Arsenic	34.6	1.3×10^{-5} (a)	3×10^{-4} (chronic)	5.5×10^{-6} (a)	1.5	EPA IRIS	8.2×10^{-6}

ATSDR = Agency for Toxic Substances and Disease Registry

EPA IRIS = U.S. Environmental Protection Agency Integrated Risk Information System (EPA 2013b)

mg/kg = milligrams per kilogram

mg/kg/day = milligrams per kilogram per day

(a) = Arsenic dose reflects a bioaccumulation factor of 0.6 [EPA 2010b]

Appendix B

Figures

Figure 1. Former Bloom's Nursery Site Location

Figure 2. Former Bloom's Nursery and Adjacent 1325 NE 7th Avenue Property

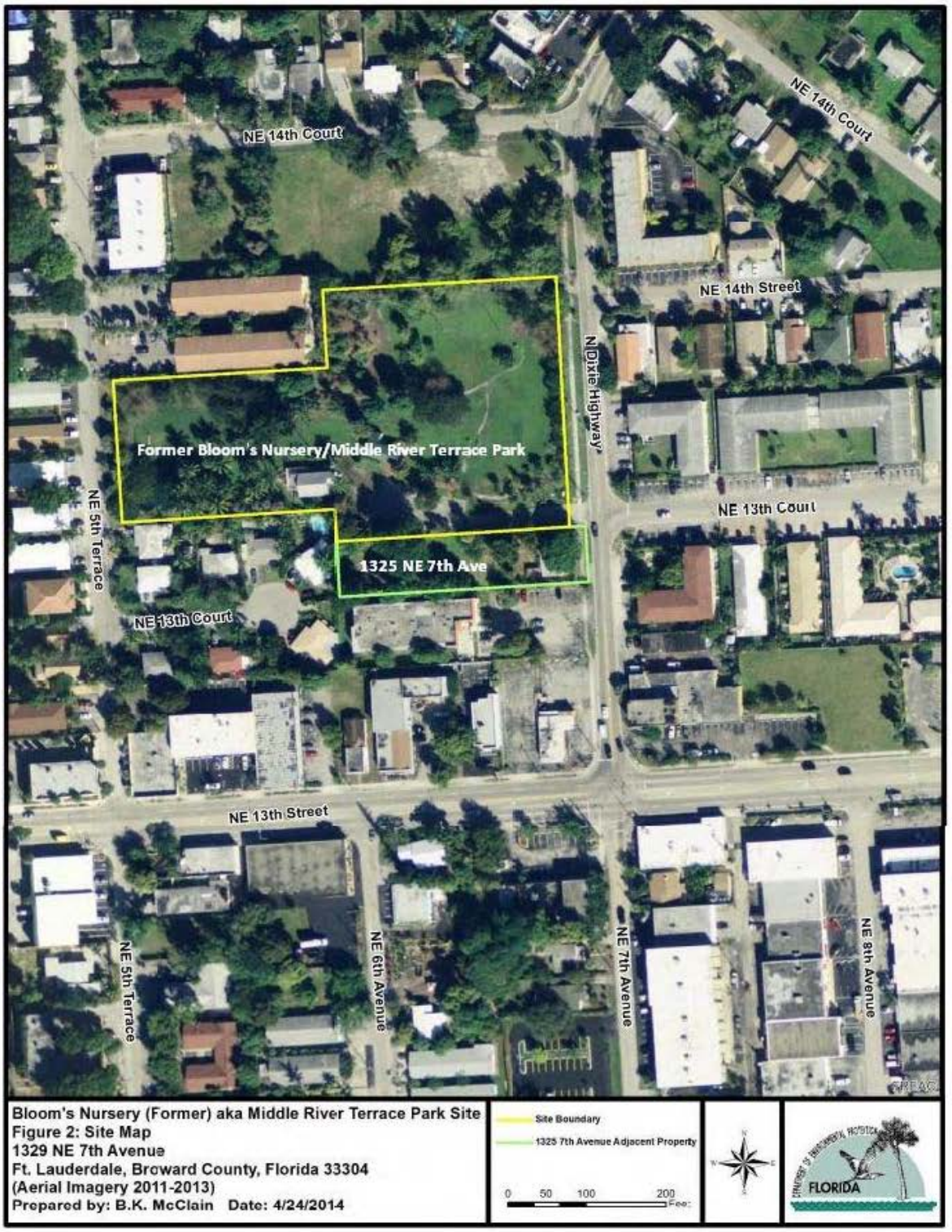


Figure 3. 1325 NE 7th Avenue Soil Boring/Sample Locations

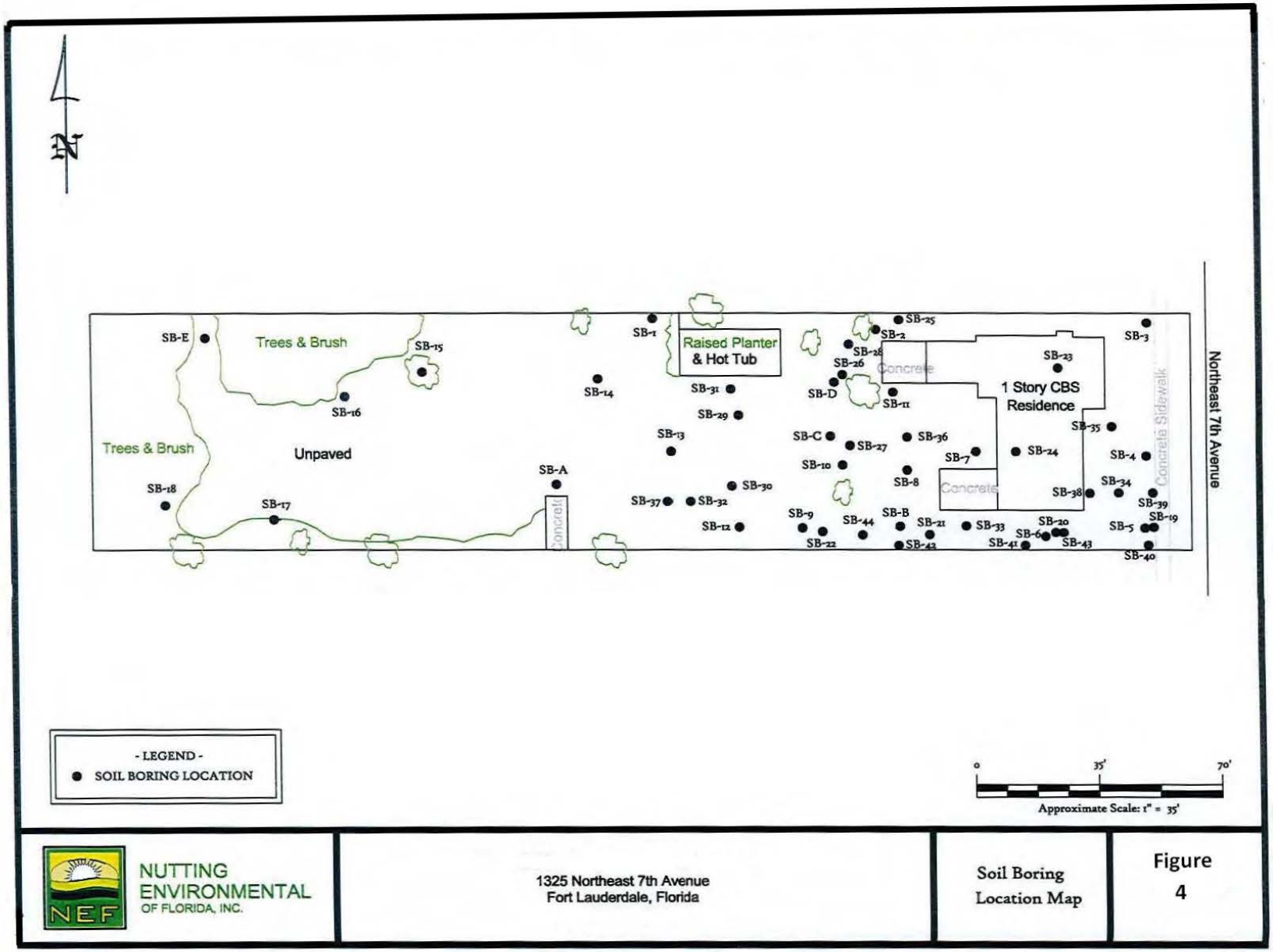
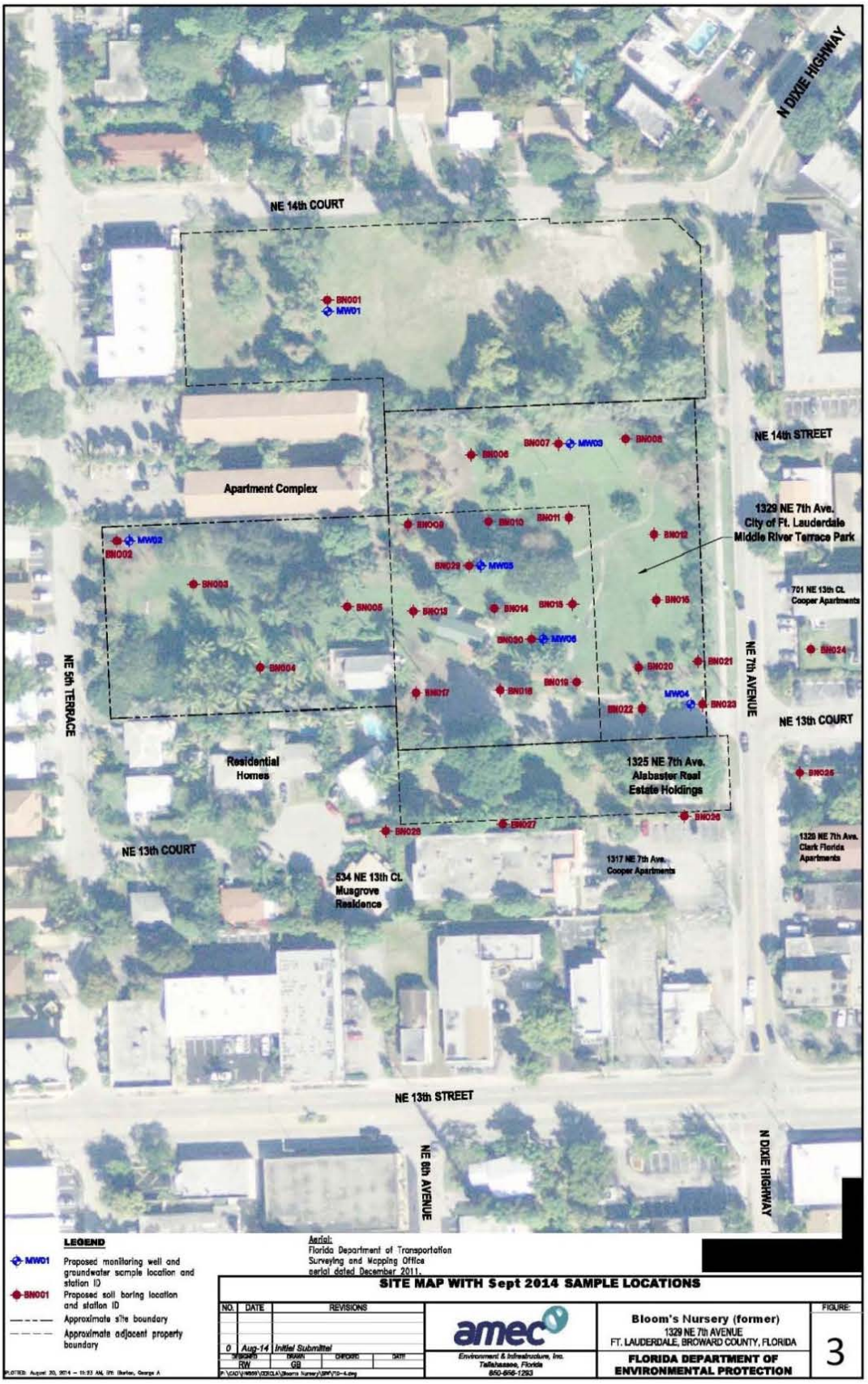


Figure 4. Former Bloom's Nursery September 2014 Sample Locations



Appendix C

Photographs

Photo 1. Former Bloom's Nursery/Middle River Terrace Park Site

Photo 2. Adjacent property at 1325 NE 7th Avenue

Photo 3. Adjacent property at 1325 NE 7th Avenue

Photo 4. The Annie Beck House at the Middle Terrace River Park

Glossary

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

Acute
Occurring over a short time (compare with **chronic**).

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

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

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

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

Carcinogen
A substance that causes cancer.

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

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

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

Completed exposure pathway (see **exposure pathway**).

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

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

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

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

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

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

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

EPA
United States Environmental Protection Agency.

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

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

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

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

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

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

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

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

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

Inhalation
The act of breathing. A hazardous substance can enter the body this way (see **route of exposure**).

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

mg/kg
Milligram per kilogram.

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

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

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

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

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

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

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

Receptor population
People who could come into contact with hazardous substances (see **exposure pathway**).

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases.

Risk
The probability that something will cause injury or harm.

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

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

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

Substance
A chemical.

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

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

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

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