soils

HEALTH CONSULTATION

WINGATE ROAD MUNICIPAL INCINERATOR AND LANDFILL

FORT LAUDERDALE, BROWARD COUNTY, FLORIDA

CERCLIS NO. FLD981021470

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Prepared By

The Florida Department of Health and Rehabilitative Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Background and Statement of Issues

At the request of the Florida Department of Environmental Protection and the U.S. Environmental Protection Agency (EPA), the Florida Department of Health and Rehabilitative Services (FHRS), under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), has prepared this health consultation to evaluate contaminant levels in and determine the public health threat from residential soils surrounding the Wingate Road Municipal Incinerator and Landfill Superfund site in Fort Lauderdale, Broward County, Florida (Figure 1).

The Wingate Road Municipal Incinerator and Landfill operated from 1954 to 1978. A chain-linked fence divides this 60-acre site into two portions (Figure 2). The northern portion is a 40-acre landfill, 25 feet above the surrounding grade, and densely covered by vegetation. Although the landfill contains mostly bottom ash, the City of Fort Lauderdale also disposed of sludges containing a variety of substances in the landfill. The 20-acre southern portion is a process area including two inactive incinerator buildings, cooling water treatment structures, a vehicle maintenance area, various other buildings, and an old percolation pond. Because of fine ash buildup, this percolation pond lost its permeability and became known as Lake Stupid. The City periodically removed the ash from the bottom of Lake Stupid and deposited it in the landfill and along the banks of the pond. Eventually, the City connected Lake Stupid to Rock Pit Lake (Figure 2), an old borrow pit adjacent to the northeast corner of the site, by an overflow ditch running along the eastern edge of the site. After site investigations began, the City reportedly filled in this ditch, eliminating the connection between the two lakes. Currently, a film production company leases the site from the City. The site is in a well-populated area (Figure 3). There is a commercial area immediately west of the site, a junk yard north of the site, and residential areas east and south of the site (1-3).

In 1990, FHRS, under a cooperative agreement with ATSDR, published a public health assessment for the Wingate Road Municipal Incinerator and Landfill Superfund Site. This assessment evaluated available ground water, soil, sediment, and surface water data. Based on this information, the public health assessment found the site was not of public health concern from current exposure conditions (4).

In 1991, the City of Fort Lauderdale entered into an Administrative Order on Consent with the EPA to conduct a Remedial Investigation/Feasibility Study (RI/FS). Four phases of field investigations detected heavy metals, polynuclear aromatic hydrocarbons, pesticides, dioxins, and furans in ash residue, soil and sediment; heavy metals and pesticides in surface waters; heavy metals, volatile organic compounds, and phthalates in groundwater; and dioxins in fish (1, 2). Under EPA's cleanup proposal, most of the current site area will be covered by a landfill cap and the accompanying storm water retention pond (1).

EPA's 1994 Baseline Risk Assessment estimated the present-day increased cancer risk to workers and child trespassers to be within the limits EPA considers protective (3). EPA estimated the present-day increased risk of noncancer illnesses is negligible. For hypothetical residents living on-site in the future, EPA estimated the increased cancer risk to be within the protective range; however, they estimated there could be an increased risk of noncancer illnesses to children and, in some circumstances, to adults (1, 3).

Throughout the site investigation and cleanup proposal processes, nearby residents have been concerned about whether or not contaminants in residential soils poses a health threat. During a February 24, 1994 public meeting, nearby residents asked EPA officials to sample residential soils and determine if there were a health threat from exposure to contaminants in these soils (5). FHRS staff performed windshield surveys of the site and the surrounding neighborhood on February 25 and June 22, 1994, and on June 13 and 20, 1996. During all visits, staff noticed the yard cover at area homes varied greatly from well-vegetated to mostly bare soil (5-7).

EPA collected the residential soil samples in September 1994. FHRS received a copy of the results in April 1995 (8). After receiving the data, FHRS staff reviewed the soil concentrations and informally determined adverse health effects were unlikely from exposure to residential soils. A more formal evaluation was recently requested by EPA and FDEP, therefore this health consultation describes our evaluation methods and findings in more detail.

Methodology

To evaluate contaminants for this health consultation, we first listed the maximum concentration of all contaminants detected in residential yards (Table 1). Then we compared the maximum concentrations of the 15 detected contaminants with ATSDR screening values. Because we did not know if the chromium detected was chromium(III) or the more toxic chromium(VI), we evaluated each chromium species separately using the maximum detected value. After making the comparisons, we eliminated from further consideration those contaminants that were below their applicable ATSDR screening values (Table 2). We categorized the remaining contaminants as common soil nutrients (Table 3) or contaminants of concern (Table 4). We eliminated the four soil nutrients from further evaluation because the residential soil nutrient concentrations around the Wingate site are not unusually high, and incidental (accidental) eating of these nutrient concentrations in soil is not likely to harm the residents' health. We then focused our analysis on the remaining five contaminants of concern. Identification of a contaminant of concern does not necessarily mean exposure to this contaminant will be associated with illness. Identification simply serves to narrow the focus of the analysis to those contaminants most likely to be important to public health.

Contact with hazardous substances is key to assessing the public health significance of a site. Exposure is another name for contact with a substance. Chemical contaminants in the environment have the potential to harm human health. However, human health can only be affected if people are exposed to the contaminants. Exposure to chemicals can occur in three ways: by ingestion, the eating or drinking of a substance; by inhalation, the breathing in of a contaminant; or by skin contact, including the absorption of a chemical. These ways of being exposed are called exposure routes.

For the five contaminants of concern, we evaluated exposure levels and associated health effects that might occur in residents exposed to these substances. To evaluate exposure, we estimated the daily dose of each contaminant of concern found at the site. Kamrin (10) explains a dose in this manner:

> "...all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus the amount of a chemical a person is exposed to is crucial in determining 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 that the size of an organism has to be taken into account. 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 organism. Thus it could be said that an amount of 1 ounce administered to a 1-pound rat is equivalent to 2000 ounces to a 2000-pound (1-ton) elephant. In each case, the amount per weight is the same: 1 ounce for each pound of animal.
>
> This amount per weight is known as the dose. It is used to determine the amount of drug to prescribe to patients of differing weights and is used in toxicology to compare the toxicity of different chemicals in different animals."

Because some body functions work differently in adults and children, we estimated contaminant doses for four hypothetical residents: an adult, an older child, a young child, and a young child with pica behavior. We defined a young child as a child 0-6 years of age. A pica child eats large amounts of non-food substances including soil. Although all children accidentally eat soil as a part of normal mouthing behavior, this activity usually stops around 18 months of age. Pica behavior is rare. However, when it occurs, pica behavior is usually established by 18 months of age and may persist until a child is six years old (11). In terms of exposure, pica children are likely to eat abnormally large amounts of soil, making their daily dose of a soil-borne contaminant much higher than that of other children or adults. We defined an older child by using mid-range values for all parameters for children between 0-14 years of age. We assumed average children did not exhibit pica behavior and accidentally ate less soil than young children. To calculate the daily dose of each contaminant, we used Risk*Assistant™ software (12). We used standard assumptions about body weight, ingestion rates, exposure time length, and other factors needed for the dose calculations in these four individuals (Table 6) (13). For our dose estimates, we used the maximum measured concentration of each contaminant in the environment to estimate exposure. Since we did not have environmental data available for contaminants in indoor or outdoor dust, we used dust inhalation models in Risk*Assistant™ to determine if breathing in dust might be a health problem and if residential dust sampling is necessary.

We evaluated potential noncancer and cancer health effects separately for each contaminant. To evaluate possible noncancerous health effects from our dose estimates, we compared our estimated doses to contaminant-specific health values, when they existed. When health values did not exist for a contaminant, we compared our estimated doses to experimental doses used in animal studies or to estimated doses observed in human studies. To evaluate possible health effects related to cancer, we used standard equations to calculate an adult's additional risk of developing cancer over a lifetime after exposure to a suspected or known cancer-causing agent. Because these cancer risk calculations are made for a lifetime, and because some cancers don't develop until many years after exposure, we did not estimate a separate cancer risk for children.

There is uncertainty in our risk estimates. We've incorporated uncertainties into this analysis by using worst-case assumptions when estimating or interpreting health risks, and by using health values with wide safety margins. Because of our assumptions, the dose calculations may overestimate the actual health risk. By potentially overestimating the health risk from contaminant exposure, this health consultation tends to err on the side of protecting public health. This means the actual health threat from residential surface soil is unlikely to be worse than we estimate in this health consultation.

Discussion

In this health consultation, we evaluate the risk of illness from exposure to hazardous substances. The risk of illness is the likelihood exposure to a contaminant might cause a harmful health effect or illness. In general, as a person's exposure to a contaminant increases, the risk of illness increases (14). However, the exposure dose, duration, and route influence how great the contaminant exposure is. Age, sex, diet, genetics, lifestyle, and general health also influence responses to contaminant exposure, and hence the risk of illness.

To evaluate the risk of illness, we use information from available studies of people and animals. The strongest evidence that exposure to a contaminant may be related to illness comes from studies of people. However, human information is limited for most contaminants, and most studies of people examine work exposures which typically are much higher than residential exposures. Because of the limited availability of relevant human information, scientists may use animals to study the relationship between the dose of a contaminant and illness. Yet, animal studies can have limitations when determining likely illnesses in people. The reason is the animals studied may be more sensitive or less sensitive than people to a particular contaminant, and scientists usually don't know if or how the animal sensitivity differs.

The assumptions behind risk estimates for noncancer and cancer effects differ. Based on studies of people and animals, there appears to be a minimum dose (threshold) for each contaminant where health effects first appear. This threshold dose differs from animal to animal, and may differ from animals to people. Still, among people or an animal species, noncancer health effects are unlikely for exposure doses below the threshold level. If an exposure dose exceeds the threshold, then the severity of illness tends to increase as the dose increases. For cancer, increasing the exposure dose is not related to the severity of illness, but to its frequency of occurrence. Therefore, as the exposure dose increases, the number of cancer cases seen in a group of exposed people or animals also increases. Because of this, we express the risk of cancer illness as a probability, or the number of extra cancer occurrences that could occur in the exposed population. We consider an extra cancer risk of 1 in 1,000,000 to be negligible. There are two other things to consider when evaluating cancer risk. First, when examining the cancer risk number, it is important to recognize there is a background cancer rate of around 25% in the United States (13). This means that in a group of a million people, 250,000 people can be expected to develop cancer in their lifetime without exposure to contaminants at a particular site. When we discuss the increased cancer risk related to a contaminant at the Wingate site, we are talking about a cancer risk above the 25% background rate. Second, equations estimating the risk of cancer illness assumes there is no threshold for exposure. There is scientific controversy about the accuracy of this assumption for certain contaminants (10, 13, 14).

To evaluate risk of noncancer illness near the Wingate site, we compared our estimated exposure doses from accidentally eating residential soil to contaminant-specific health values (Minimal Risk Levels and Reference Doses), when available, or to threshold values from human and animal studies. Contaminant-specific health values are derived by applying safety factors to threshold values from human and animal studies. The safety factors make the health values very much smaller than the threshold values. We had health values for cadmium, chromium(VI), and mercury. Our dose estimates for each of the four hypothetical residents were below health values for each of these contaminants (15-17). This means noncancer illnesses are unlikely from accidental eating of cadmium, chromium, or mercury in residential soil. Copper and aluminum don't have established health values (18, 19). Therefore, we compared our estimated exposure doses with threshold values found in studies. Only copper had human data available. Our dose estimate for a pica child, the hypothetical resident most likely to be affected by eating soil, was about 10 times smaller than the doses for which two studies of people showed mild health effects (18). This indicates health effects are unlikely for a pica child eating copper in residential soil. Aluminum had only animal data available for evaluation. Our dose estimate for a pica child was about 100 times smaller than the "no effects" dose seen in one study of mice exposed to aluminum for more than a year, and in two studies of rats and dogs exposed to aluminum for less than a year (19). This suggests health effects are unlikely for a pica child eating aluminum in residential soil.

Certain vitamins and nutrients in the diet seem to have a protective effect against the potential harmful effects of cadmium, chromium, copper, and mercury. These protective substances include: calcium, zinc, iron, Vitamin C, Vitamin E, protein, and fiber (15-18). Residents concerned about their exposure to metals in yard soils may wish to ensure they eat sufficient quantities of these substances in their diet.

Although chromium(VI) is a known cancer-causing agent and cadmium is a suspected cancer-causing agent via inhalation (breathing in the metal), there is no conclusive evidence that eating soils with these metals is linked with cancer (15, 16). Therefore, we did not evaluate the potential increase in cancer risk from accidentally eating soil with these two metals.

We attempted to evaluate the potential health effects from skin contact with soil containing the contaminants of concern. Studies show chromium (III and VI), cadmium, and inorganic mercury may be able to cross the skin. However, skin absorption studies for these metals are few and typically involve people exposed to relatively high contaminant concentrations in substances other than soil. None of the studies examined the relationship between these metals in soil or dust and illness (15-19). Therefore, we cannot evaluate the potential health effects from skin absorption of these three metals. Nevertheless, each of the contaminants of concern can cause skin irritations in individuals who are especially sensitive to these metals. However, we don't know the exposure doses at which sensitive people might experience skin irriatation (15-19).

To examine possible exposure from the breathing in of contaminated dust, we calculated exposure doses for our hypothetical residents using a dust model in Risk*Assistant™. We compared the modeled exposure doses to health values and threshold doses from inhalation studies. For all five of the contaminants of concern, our estimated exposure doses were much smaller than the corresponding health or threshold value. This suggests noncancer health effects are unlikely from exposure to residential dust. For the potential cancer-causing agents chromium(VI) and cadmium, the modeled increased cancer risk was negligible (less than or equal to 1 in 1,000,000 extra cancer cases over a lifetime). These findings indicate residential dust sampling is not needed in the Wingate area at this time.

Conclusions

Based on the information we reviewed and cited in this health consultation, FHRS concludes the following:

1 Residential soils have detectable levels of some contaminants that seem to be associated with the site. The contaminant levels are far below those associated with illness in studies of people or animals. Residents who are especially sensitive to certain metals may experience skin irritation. Therefore, residential soil around the Wingate site does not appear to be of public health concern.

2. Our modeled dust inhalation values suggest harmful health effects are unlikely from exposure to contaminants in dust.

Recommendations

The recommendations and advice in this health consultation are based upon the referenced data and information, and are specific to FHRS' review of the residential soil data collected in September, 1994. Additional data could alter these recommendations.

1 No further follow-up actions are necessary in residential soils near the site.

2. We do not recommend dust sampling in residential yards at this time.

If clarification is necessary, please call Carolyn Voyles in FHRS' Environmental Toxicology Section at (904) 488-3385. If information becomes available indicating additional exposures at levels of concern, FHRS will evaluate that information to determine what additional actions, if any, are necessary.

References

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8. EPA. 1995. Memo (February 3) from Diane Guthrie to John Zimmerman (EPA-RIV) with attached residential soil sample results collected in September 1994. U.S. Environmental Protection Agency, Region IV Environmental Services Division, Athens, GA.

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15 ATSDR. 1993. Update Toxicological Profile for Cadmium (April). Atlanta, GA: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry. ATSDR/TP-92/06.

16. ATSDR. 1993. Update Toxicological Profile for Chromium (April). Atlanta, GA: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry. ATSDR/TP-92/08.

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18. ATSDR. 1990. Toxicological Profile for Copper (December). Atlanta, GA: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry. ATSDR/TP-90/08.

19. ATSDR. 1992. Toxicological Profile for Aluminum (July). Atlanta, GA: U.S. Public Health Service, Agency for Toxic Substances and Disease Registry. ATSDR/TP-91/01.

CERTIFICATION

This Wingate Road Municipal Incinerator and Landfill Health Consultation was prepared by the Florida Department of Health and Rehabilitative Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

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

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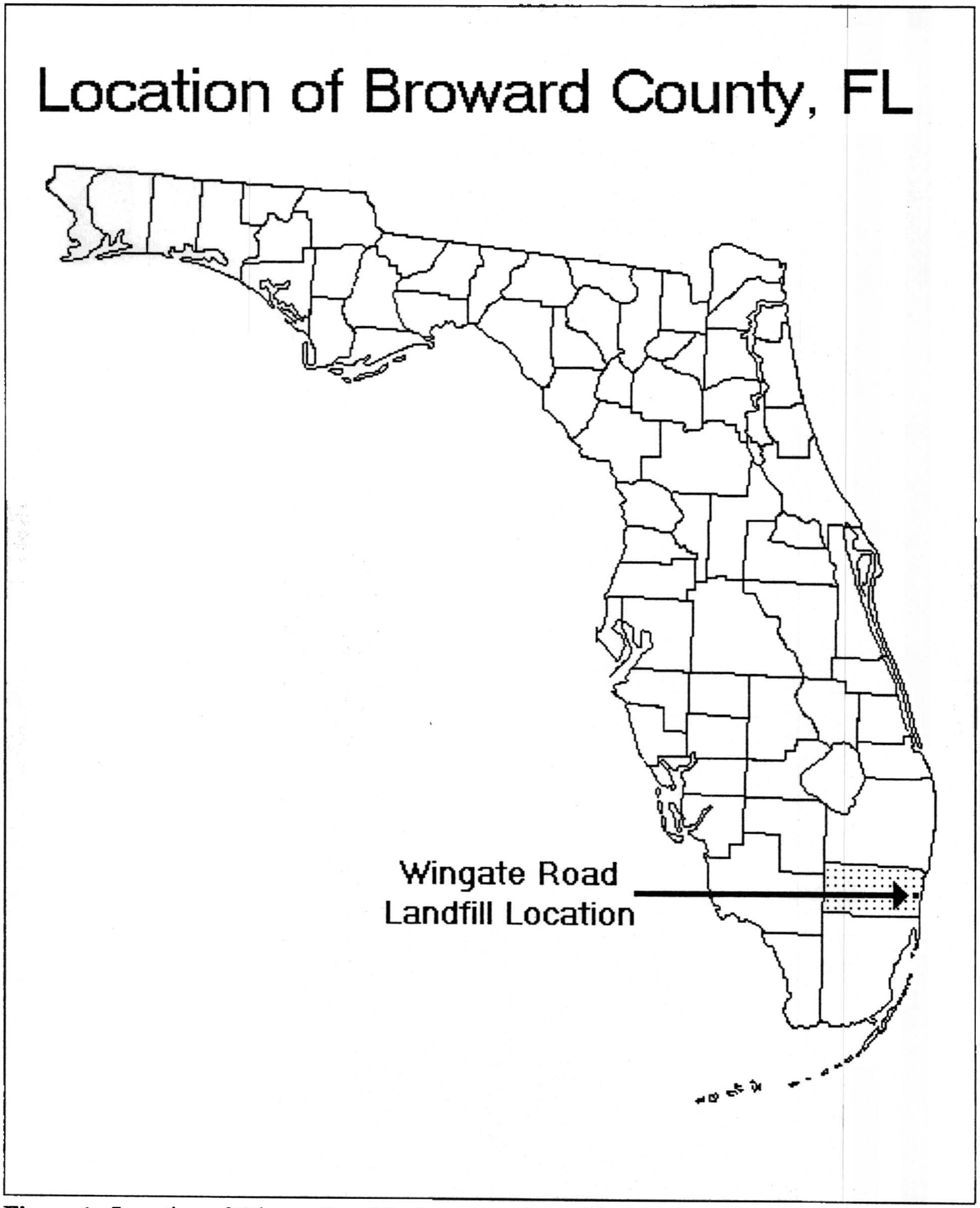

Figure 1. Location of Wingate Road Incinerator and Landfill in Broward County, FL.

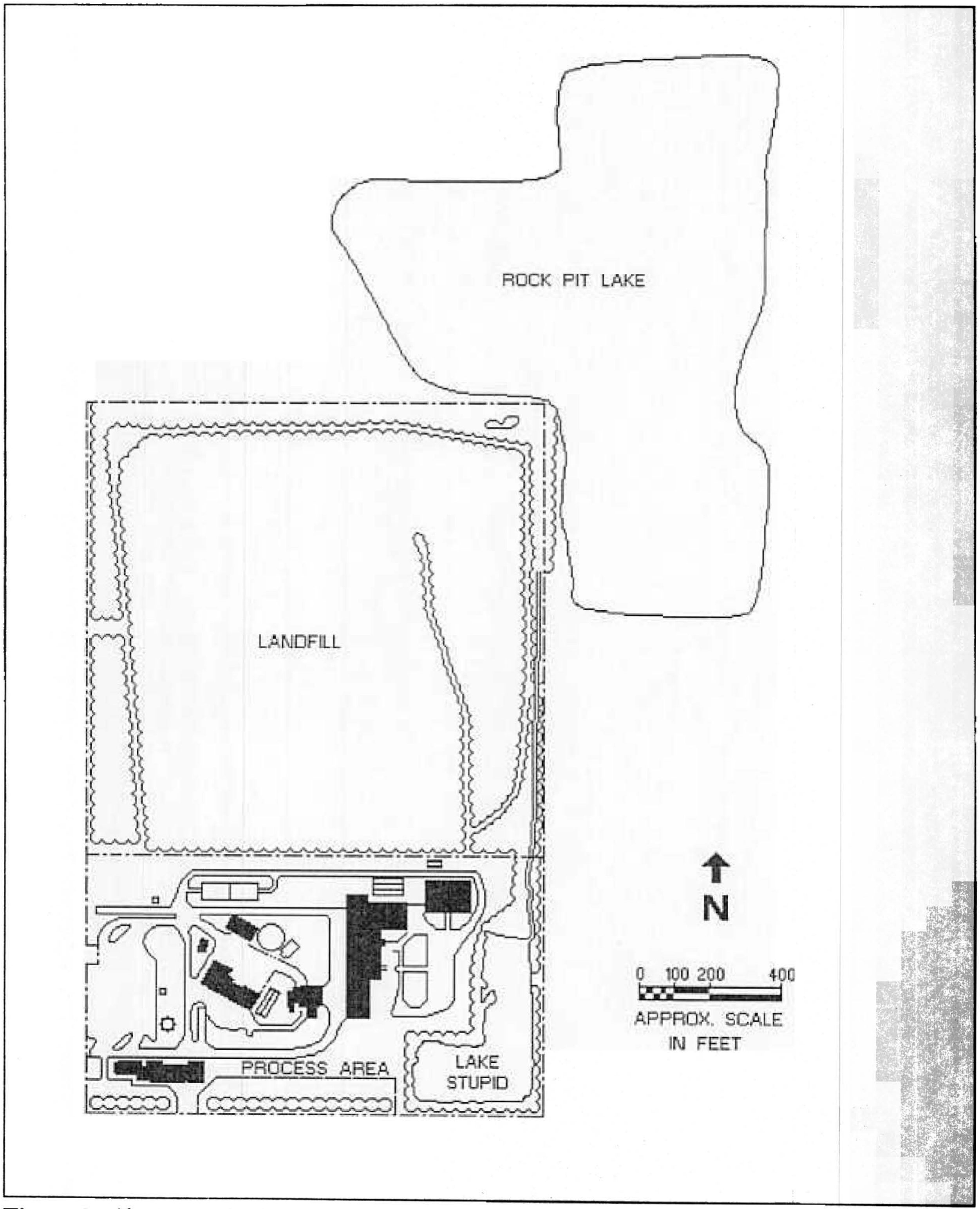

Figure 2. Site Map of Wingate Road Landfill (adapted from the BRA).

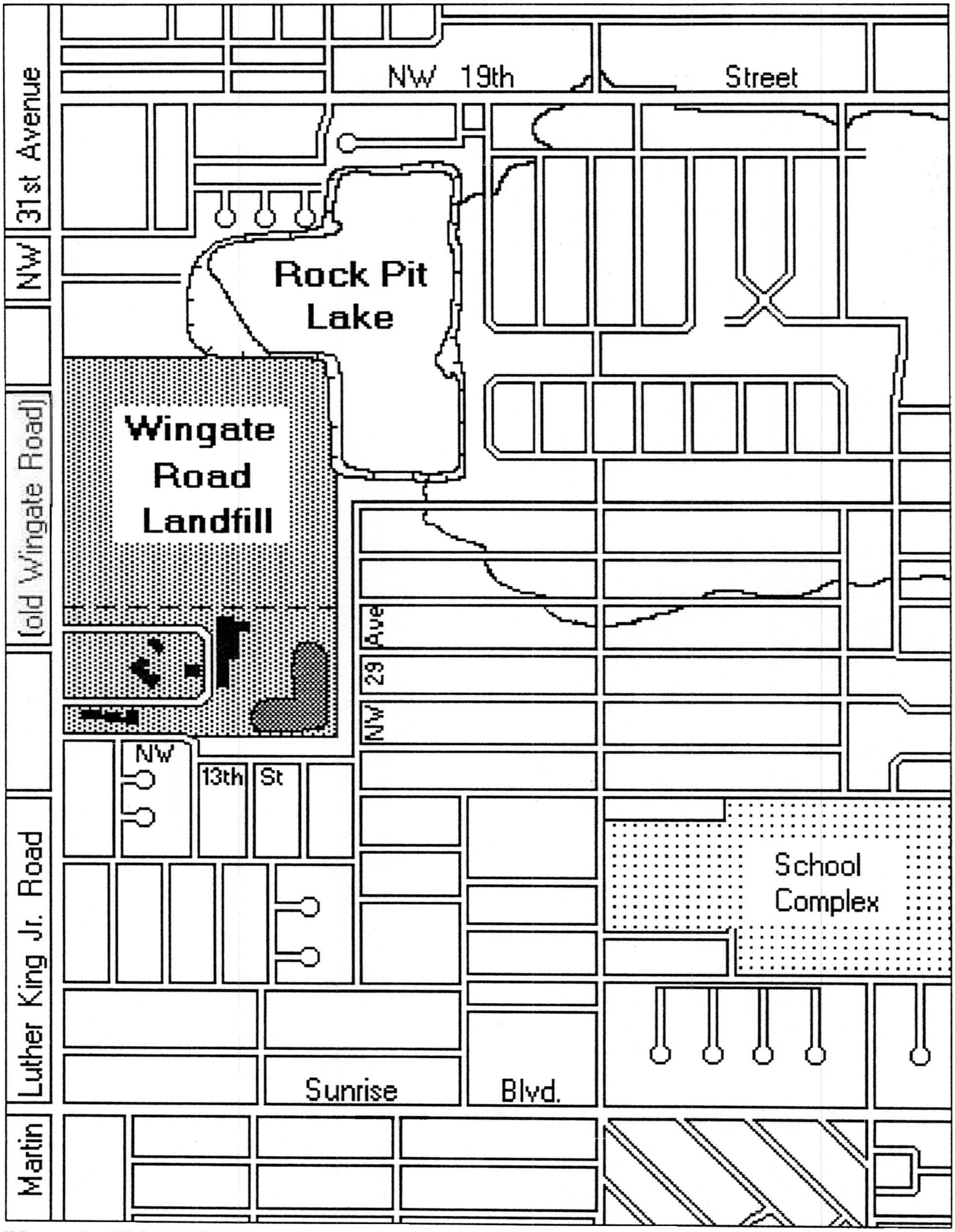

Figure 3. Neighborhood Surrounding the Wingate Road Landfill (adapted from the BRA).

Table 1. Detected Contaminants in Residential Surface Soils

Contaminant Name	
Aluminum Barium Calcium Cadmium Chromium (total) Copper Dioxins* Iron	Lead Magnesium Manganese Mercury Sodium Vanadium Zinc

* We used TCDD (tetrachlorodibenzo-p-dioxin) equivalents for the dioxin concentration in this health consultation

Data Sources: 8

Table 2. Contaminants Below ATSDR Screening Values for Soil

Contaminant Name	
Barium Chromium(III) Dioxins Lead†	Manganese Vanadium Zinc

† We used EPA's residential soil guideline of 400 mg/kg as the lead screening value in this health consultation

Table 3. Common Soil Nutrients

Contaminant Name	
Calcium Iron	Magnesium Sodium

Table 4. Contaminants of Concern

Contaminant Name	
Aluminum Cadmium Chromium(VI)	Copper Mercury

Table 5. Contaminants of Concern - Detected Concentrations in Residential Surface Soil

Contaminants of Concern	Detected Concen-tration Range (mg/kg)	Total # Detected/ Total # Samples	Total # Exceeding Comparison Value/ Total # Samples	Back-ground Concen-tration Range (mg/kg)	Comparison Value	
					(mg/kg)	Source
Aluminum	170-1200	18/18	--	NA	--	--
Cadmium	1.2J	1/18	1/18	NA	1.0	EMEG, Carcinogen
Chromium(VI)	2.2-25	17/18	4/18	NA	10.0	RMEG, Carcinogen
Copper	1.8-16	18/18	--	NA	--	--
Mercury	0.13	1/18	--	NA	--	--

mg/kg - milligrams per kilogram
NA - not analyzed
J - estimated value
EMEG - Environmental Media Evaluation Guide for a pica child
Carcinogen - classified as a potential or known cancer-causing agent
RMEG - Reference Dose Media Evaluation Guide for a pica child

Data Sources: 8, 9

Table 6. Parameters Used for Ingestion and Inhalation Dose Calculations for Hypothetical Residents

	Hypothetical Resident			
Parameter	Adult	Older Child	Young Child	Pica Child
Age	Over 18 y	0-14 y	0-6 y	0-6 y
Body Weight	70 kg	35 kg	13 kg	13 kg
Lifetime Expectancy	70 y	70 y	70 y	70 y
Ingestion/Inhalation Frequency	350 d/y	350 d/y	350 d/y	350 d/y
Exposure Period	25 y	14 y	6 y	6 y
Soil Ingestion Rate	100 mg/d	100 mg/d	200 mg/d	5,000 mg/d
Contaminated Fraction of Soil	1.00	1.00	1.00	1.00
Respirable Fraction of Dust	0.73	0.73	0.73	0.73
Proportion of Contaminated Dust - Inside	0.80	0.80	0.80	0.80
Dust Concentration - Inside	56 $\mu g/m^3$	56 $\mu g/m^3$	56 $\mu g/m^3$	56 $\mu g/m^3$
Proportion of Contaminated Dust - Outside	1.00	1.00	1.00	1.00
Dust Concentration - Outside	75 $\mu g/m^3$	75 $\mu g/m^3$	75 $\mu g/m^3$	75 $\mu g/m^3$

y - year
kg - kilogram
d/y - days per year
mg/d - milligrams per day
$\mu g/m^3$ - micrograms per cubic meter