Rick Scott
Governor

H. Frank Farmer, Jr., M.D., Ph.D.
State Surgeon General

May 2, 2011

Elizabeth Callaghan, Administrator

Hernando County Health Department
Brooksville, FL 34601

RE: Evaluation of Harar Avenue Soil Test Results

Dear Ms. Callaghan:

At your request, the Florida Department of Health's Hazardous Waste Site Health Risk Assessment Program (Assessment Program) examined possible health risks associated with incidental ingestion (swallowing) of soil at a residential property on Harar Avenue in Brooksville, Hernando County. The Assessment Program evaluates the public health risk of hazardous waste sites through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). This report was supported by funds from a cooperative agreement with ATSDR. This document however, has not been reviewed and cleared by ATSDR.

A resident of Harar Avenue has expressed concerns about possible health effects associated with arsenic in the soil on his property. The former S&B Go hazardous waste site is located directly across the street north of his property.

Background and Statement of Issues

The S&B Go site was a bulk petroleum fueling facility that operated from 1927 to 2003. The facility had eight aboveground storage tanks (ASTs) containing diesel fuel, kerosene and unleaded gasoline and two underground storage tanks (USTs) holding leaded gasoline and waste oil. Dispensers were on the southwestern and north central portion of the property (Figure 1). All tanks and dispensers have been removed from the site.

In 2004, after two reported discharges, consultants for the Florida Department of Environmental Protection (DEP) identified petroleum hydrocarbon contamination in the soil and groundwater at the S&B Go site (Figure 2) [Handex 2004]. In April 2005, DEP's consultant removed 1473 tons of contaminated soil from five locations on the site. Post-excavation testing did not include arsenic analysis but found some petroleum hydrocarbon compounds remained above Florida DEP soil cleanup target levels (SCTLs).

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Between 2005 and 2007, consultants for DEP identified two additional petroleum hydrocarbon contaminated areas on the site. In September 2009, they removed an additional 318 tons of soil from the site. In December 2009, they found soil petroleum hydrocarbon levels had actually increased. Arsenic analysis was not done [ES 2010].

In 2010, a resident on Harar Avenue across the street south of S&B Go complained of arsenic-contaminated soil in his yard. In August and December 2010, consultants for DEP collected 22 surface soil (0-6 inches below land surface) and subsurface soil (2 feet below land surface) samples on-site, in the adjacent ditch, and at the Harar Avenue residence. They analyzed for arsenic, chromium, copper, and iron (Figure 3). They, however, did not analyze any of the samples for petroleum hydrocarbons. For the purpose of this assessment, it has been determined that DEP has not fully assessed soil quality on the Harar Avenue property.

Discussion

At the Harar Avenue residence, incidental ingestion (swallowing) of very small amounts of surface soil is a possible route of exposure (Table 1). Because homes in this neighborhood are connected to municipal water, groundwater is not a potential exposure pathway. In order to determine the risk of illness from soil, the Assessment Program used exposure models and risk factors developed by ATSDR and the United States Environmental Protection Agency (EPA). The Assessment Program estimated exposure to the highest concentrations found in the top layer of soil (0-6 inches below land surface). People typically are <u>only</u> exposed to the top layer of soil. Because in the future subsurface soil could be brought to the surface, the Assessment Program also estimated the risk of exposure to the highest concentrations 2 feet below land surface.

If the concentration of a contaminant meets or exceeds a health-related comparison value then it is considered for further analysis. If a contaminant does *not* meet or exceed its appropriate comparison value, it needs no further analysis because it does not pose a health risk at that concentration [ATSDR 2005]. For cancer causing chemicals, we evaluate the theoretical cancer risk for adults regardless of the contaminant concentration. Even though arsenic and chromium are not associated with petroleum contamination, the Assessment Program selected these contaminants for further analysis because the levels found were above screening values. The Assessment Program considers the risk of both cancer and non-cancer illness.

Arsenic

Arsenic is a naturally occurring metal that is a common component of the earth's crust. Low levels of arsenic are found throughout the environment. Natural levels of arsenic in soil usually range from 1 to 40 mg/kg, with a mean of 5 mg/kg. The concentrations of arsenic in 445 Florida surface soils ranged from 0.01 to 50.6 µg/g. While arsenic can be released into the environment from natural sources, releases from anthropogenic (man-made) sources are more prevalent. Man-made sources can include metal mining and smelting, wood combustion, coal combustion, waste incineration and pesticide application. To be protective of human health we assumed that the arsenic found in the surface soils at the Harar Avenue property was in the more toxic inorganic form [ATSDR 2007].

Chromium

Chromium is a naturally occurring element found in rocks, animals, plants, and soil. Total chromium concentrations in U.S. soils range from 1 to 2,000 mg/kg, with a mean of 37.0 mg/kg. Chromium is widely used in manufacturing processes. Chromium can be found in many consumer products such as: wood treated with copper dichromate, leather tanned with chromic sulfate and stainless steel cookware. The soil beneath decks treated with chromated copper arsenate (CCA), a wood preservative, had an average chromium content of 43 mg/kg. Chromium can be found in air, soil and water after release from the manufacture, use, and disposal of chromium-based products, and during the manufacturing process. To be protective of human health, we assumed that the chromium found in the soil at the Harar Avenue property was the most toxic chromium VI form [ATSDR 2008].

Public Health Implications

Surface Soil (0-6 inches below land surface):

The maximum surface soil concentrations for arsenic, chromium, copper, and iron were below relevant comparison values for non-cancer illness (Table 2). Therefore, there is no apparent non-cancer risk associated with children or adults incidentally ingesting (swallowing) very small amounts of surface soil at the Harar Avenue property.

However, because arsenic is a carcinogen, the Assessment Program estimated a theoretical increase cancer risk. The exposure dose for an adult was calculated as a necessary step in calculating the cancer risk (Appendix A).That exposure dose is multiplied by the chemical specific cancer slope factor in order to estimate the theoretical increase of cancer over a lifetime. At the maximum surface soil arsenic concentration (2.61mg/kg), there is an “extremely low” theoretical increased cancer risk for incidental ingestion. The additional theoretical cancer risk is approximately six additional cancers in 1 million people. This estimate uses the highest soil concentration measured, higher end estimate of incidental soil ingestion, and the upper range of the cancer potency. Thus, this is the highest estimated increased cancer risk for exposure to arsenic in surface soil. The actual increased cancer risk is likely lower and may be as low as zero.

Subsurface Soil (2 feet below land surface):

People typically are exposed to only the top few inches of soil. The *only* exposure to subsurface soil would be if in the future it was dug up and brought to the surface. The arsenic, copper, and iron concentrations in subsurface soil did not exceed the non-cancer comparison values. The chromium concentration in the subsurface soil did, however, exceed the non-cancer comparison values. ATSDR has estimated exposure levels posing minimal risk level (MRLs) to humans for chromium. An MRL is an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncarcinogenic) over a specified duration of exposure [ATSDR 2008]. In the future, if the subsurface soil was brought to the surface, the estimated chromium incidental ingestion dose for children would be 0.002 mg/kg/day. This is only slightly greater than the chronic ingestion MRL of 0.001 mg/kg/day. Although the estimated level is slightly above the MRL, it none-the-less requires further examination. The estimated dose of chromium from this subsurface soil, however, is 100 times lower than the no adverse effect level (NOAEL) of 0.21 mg/kg/day. Therefore, the highest chromium concentration in Harar Avenue subsurface soil is unlikely to cause any non-cancer health effects in life-long residents.

The Assessment Program calculated the exposure dose for an adult as a necessary step in calculating the cancer risk (Appendix A). The maximum subsurface arsenic concentration (7.6 mg/kg) is similar to the U.S. background mean concentration (5mg/kg).At the maximum subsurface soil, arsenic concentration (7.6 mg/kg), a “very low” increased risk of cancer or two additional cancers in 100,000 people could result from swallowing (incidental ingestion) very small amounts of subsurface soil over an entire lifetime. This estimate uses the highest soil concentration measured, a higher end estimate of incidental soil ingestion, and the upper range of the cancer potency. Thus, this is the highest estimated increased cancer risk for exposure to arsenic in subsurface soil. The actual increased cancer risk is likely lower and may be as low as zero.

Conclusions

Based on the available data, incidental ingestion of soil from the Harar Avenue property is not likely to harm people’s health. Because DEP did not test the property south of the site for petroleum hydrocarbons, the data are inadequate to fully assess the health threat.

Recommendations

DEP should test soil in the ditch adjacent to the Harar Avenue property and on the Harar Avenue property for petroleum hydrocarbons.

Public Health Action Plan

The Assessment Program will evaluate additional surface soil data if they become available.

Please contact me (850-245-4444 extension 2080) with any questions or concerns.

Sincerely,

Elizabeth D Tull

Elizabeth Tull
Health Assessor
Florida Department of Health
Bureau of Environmental Public Health Medicine

CC: Concerned resident
Tara Mitchell DEP Program Manager

REFERENCES:

[ATSDR 2005] Agency for Toxic Substance and Disease Registry. Public Health Assessment Guidance Manual (Update). U.S. Department of Health and Human Services, Atlanta, GA. January 2005.

[ATSDR 2007] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Arsenic. U.S. Department of Health and Human Services, Atlanta, GA. August 2007

[ATSDR 2008] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Chromium. U.S. Department of Health and Human Services, Atlanta, GA. September 2008

[ES 2010] Earth Systems Inc. Supplemental Site Assessment Report. December 2010.

[Handex 2004] Handex. Site Assessment Report S& B Go. September 2004.

Table 1: Potential Human Exposure Pathways at the Harar Avenue Property

POTENTIAL PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Incidental ingestion of surface soil in the yard	Contaminated surface soil	Soil	Soil in the yard	Ingestion	About 5 residents on the house on the property	Current and Future
Incidental ingestion of subsurface soil in the yard	Contaminated subsurface soil	Soil	Soil in the yard	Ingestion	About 5 residents on the house on the property	Future

Table 2: 2010 Maximum Concentrations in Harar Avenue Surface Soil (6 inches BLS)

Contaminant of Concern	Maximum Concentration (mg/kg)	Comparison Value* (mg/kg)	Source of Comparison Value	# of samples above comparison value/total # soil samples
Arsenic	2.61	20 (non-cancer) 0.5 (cancer)	ATSDR Chronic EMEG	1/4
Chromium	34.5	50	ATSDR Chronic EMEG	0/4
Copper	9	500	ATSDR Intermediate EMEG	0/4
Iron	8360	55,000	EPA RBC	0/4

mg/kg = milligrams per kilograms
* Comparison values only used to select chemicals for further scrutiny, not to the judge the risk of illness.
Source of data: Earth Systems Inc. 2010
EMEG= Environmental Media Evaluation Guide
EPA= United States Environmental Protection Agency
RBC= Risk Based Concentration
BLS= below land surface

Table 3: 2010 Maximum Concentrations in Harar Avenue Subsurface Soil (2 feet BLS)

Contaminant of Concern	Maximum Concentration (mg/kg)	Comparison Value* (mg/kg)	Source of Comparison Value	# of samples above comparison value/total # soil samples
Arsenic	7.6	20 (non-cancer) 0.5 (cancer	ATSDR Chronic EMEG	1/4
Chromium	124	50	ATSDR Chronic EMEG	1/4
Copper	2	500	ATSDR Intermediate EMEG	0/4
Iron	33,600	55,000	EPA RBC	0/4

mg/kg = milligrams per kilograms
* Comparison values only used to select chemicals for further scrutiny, not to the judge the risk of illness.
Source of data: Earth Systems Inc. 2010
EMEG= Environmental Media Evaluation Guide
EPA= United States Environmental Protection Agency
RBC= Risk Based Concentration
BLS =below land surface

Figure 1: S&B Go Site Plan

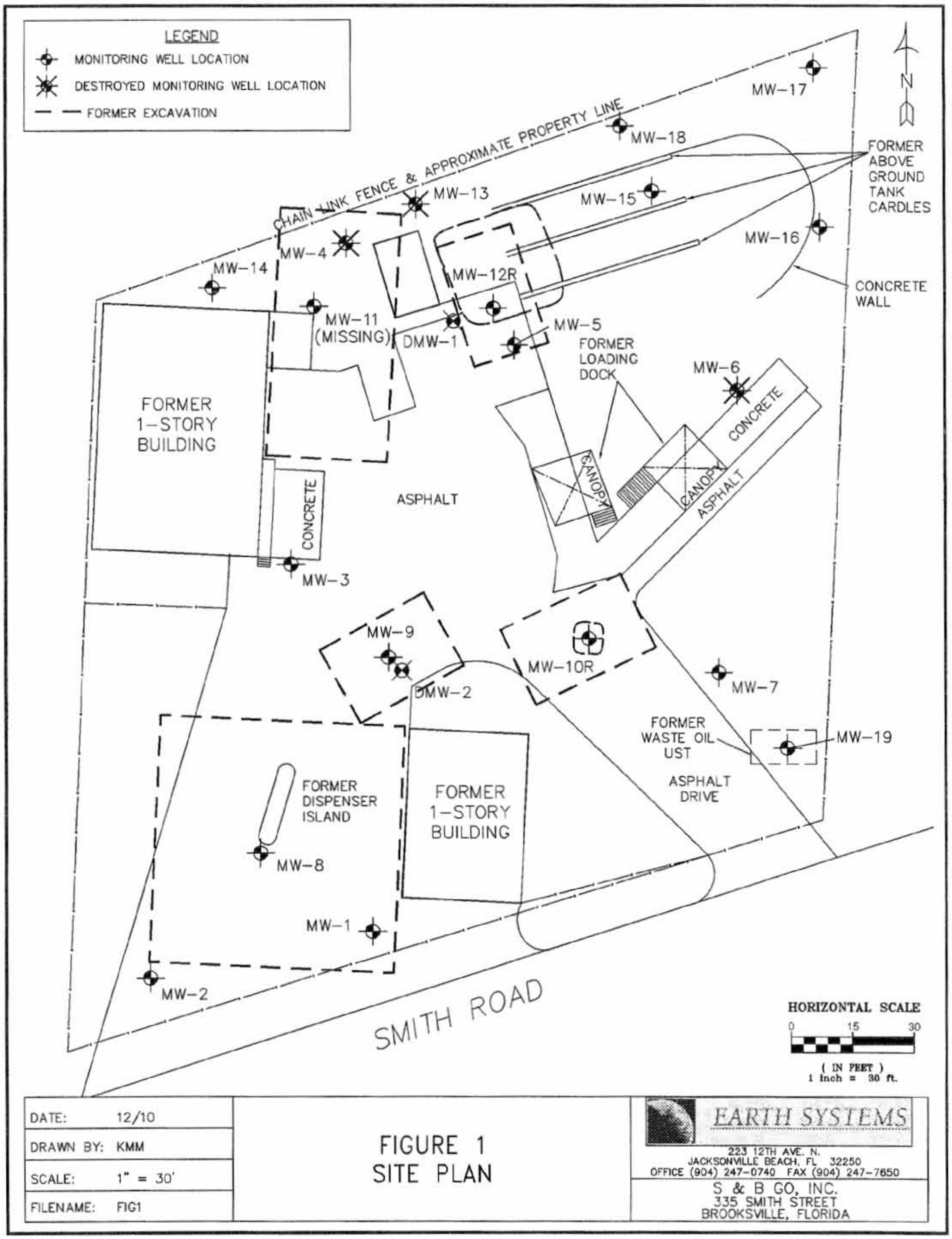


Figure 2: S&B Go Soil Field Screening Summary

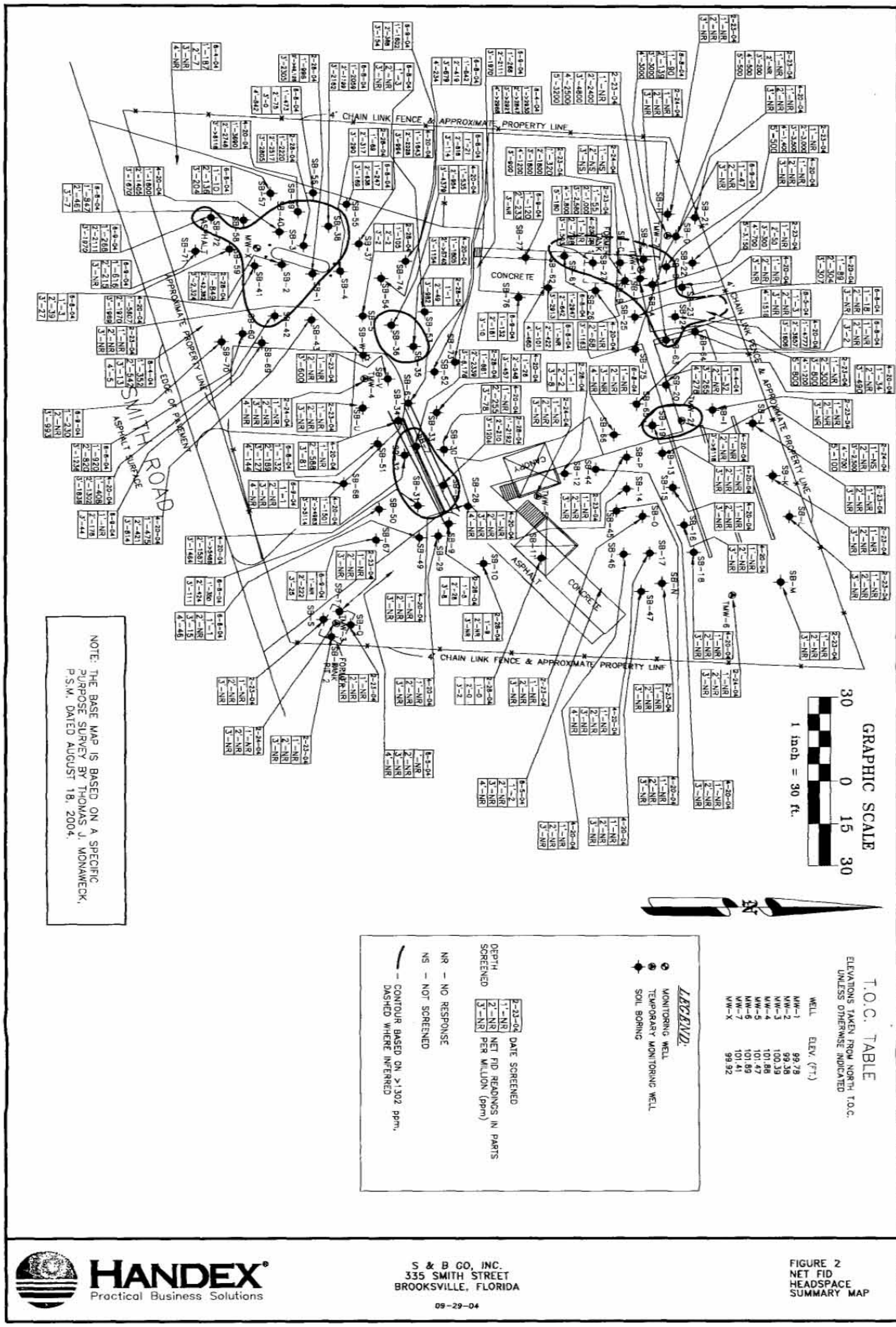
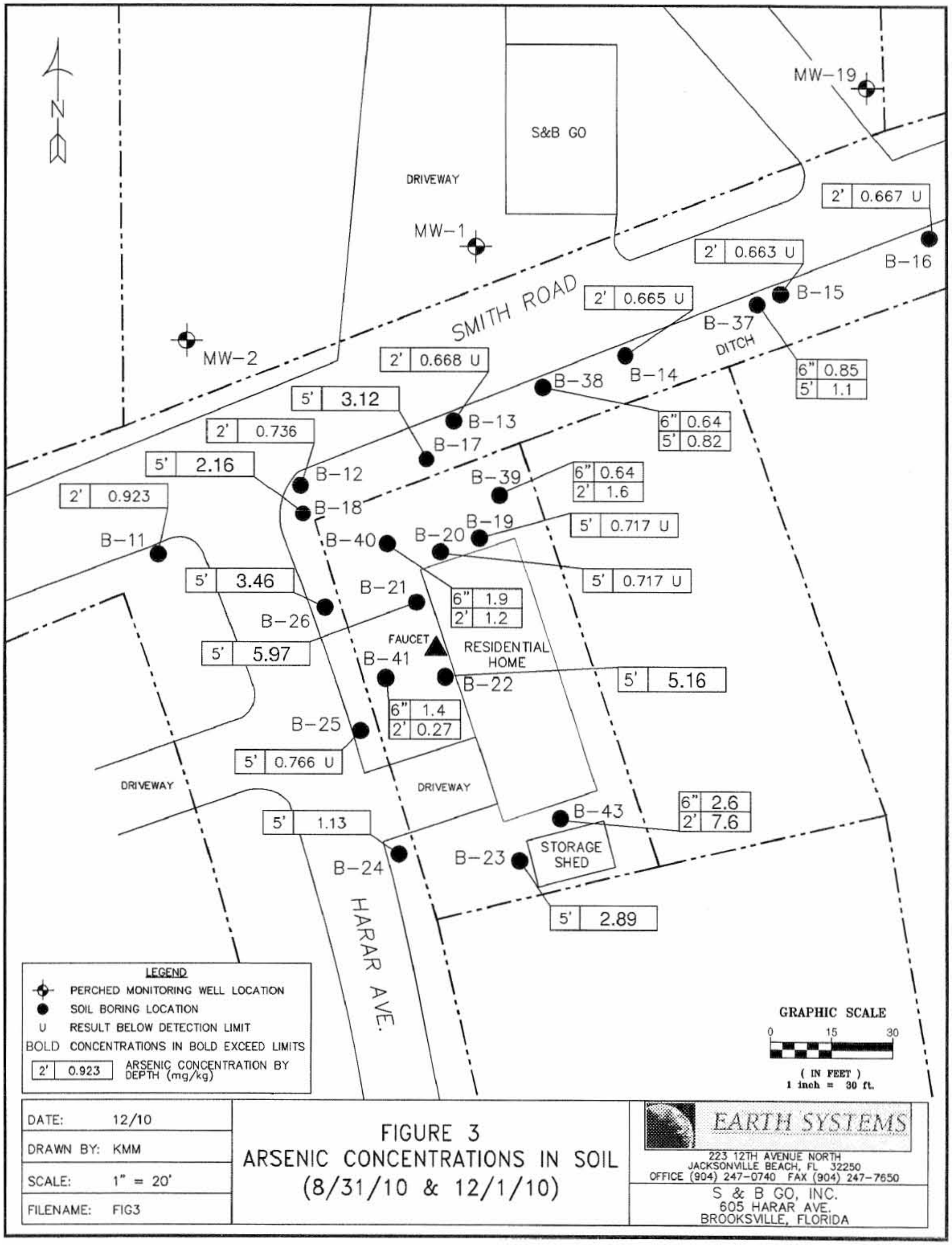


Figure 3: 2010 Harar Avenue Soil Arsenic Test Results



Appendix A: Calculations

I). Exposure dose:

Incidental soil ingestion

<u>Non-cancer</u>

To estimate exposure from incidental ingestion of contaminated soil, Florida DOH uses the following standard assumptions:

- children incidentally ingest (swallow) an average of 200 milligrams (mg) of soil per day (about the weight of a postage stamp),
- adults incidentally ingest (swallow) an average of 100 mg of soil per day,
- children weigh an average of 16 kilograms (kg) or about 35 pounds,
- adults weigh an average of 70 kg, or about 155 pounds,
- children and adults incidentally ingest (swallow) contaminated surface soil at the maximum concentration measured for each contaminant
- exposure factor is 1 (reflecting chronic daily exposure of 365 days 24 hours per day)

Abbreviations:

D= exposure dose (mg/kg/day)
C= contaminant concentration (mg/kg)
IR= intake rate of contaminated soil (mg/day)
EF= exposure factor (unit less)
CF= conversion factor (10^{-6} kg/mg)
BW= body weight
mg= milligram
kg= kilogram
d= day

D= (CxIRxEFxCF)/BW

It is important to note that no arsenic levels were found to exceed non-cancer comparison values. The non-cancer exposure dose for an adult is only performed as a necessary step in completing the later cancer risk calculation.

<u>Arsenic</u> **<u>surface soil exposure dose:</u>**
maximum surface soil concentration = 2.61 mg/kg

D= (2.61mg/kg x100mg/d x 1 x 10-6 kg/mg)/ 70 kg = .0000037 mg/kg/d

***Arsenic* subsurface soil exposure dose:**
maximum subsurface soil concentration = 7.6 mg/kg

D= (7.6 mg/kg x100mg/d x 1 x 10-6 kg/mg)/ 70 kg = .00001mg/kg/d

***Chromium* subsurface soil exposure dose:**
maximum subsurface soil concentration = 124 mg/kg

It is important to note that *chromium* levels were found to exceed non-cancer comparison values. The non-cancer exposure dose for a child was calculated as a worst-case scenario. Chromium is not listed as a carcinogen for the ingestion route of exposure; therefore, no cancer calculation was performed.

D= (124mg/kg x 200mg/d x 1 x 10-6 kg/mg)/ 16 kg = .00155 mg/kg/d

II). Cancer risk

To estimate the theoretical cancer risk from incidental ingestion of contaminated soil, Florida DOH uses the following standard program assumptions:

- An average lifetime is 70 years

To put the cancer risk into perspective, Florida DOH uses the following descriptors for the different numeric cancer risks:

1 in	10 (10^{-1})	"very high" increased risk
1 in	100 (10^{-2})	"high" increased risk
1 in	1,000 (10^{-3})	"moderate" increased risk
1 in	10,000 (10^{-4})	"low" increased risk
1 in	100,000 (10^{-5})	"very low" increased risk
1 in	1,000,000 (10^{-6})	"extremely low" increased risk

ER=CSF x dose

ER= estimated theoretical cancer risk (unit less)
CSF=cancer slope factor from Environmental Protection Agency (EPA)
Dose= estimated exposure dose

***Arsenic* <u>surface</u> soil theoretical cancer risk:**

Arsenic ingestion cancer slope factor: 1.5 (mg/kg/d)-1
Arsenic ingestion dose for surface soil: .0000037 mg/kg/d

(1.5 $(mg/kg/d)^{-1}$) x .0000037mg/kg/d) = .0000055 or approximately 6×10^{-6}

This would be interpreted as an increased risk of 6 people in every 1,000,000.

***Arsenic* <u>subsurface</u> soil theoretical cancer risk:**
Arsenic ingestion cancer slope factor: 1.5 (mg/kg/d)-1
Arsenic ingestion dose for surface soil: .00001mg/kg/d

(1.5 $(mg/kg/d)^{-1}$) x .00001mg/kg/d) = .000015 or approximately 2×10^{-5}

This would be interpreted as an increased risk of 2 people in every 100,000.