February 25, 2016

Mr. Tim Mayer
Environmental Health Director
Florida Department of Health in Palm Beach County
800 Clematis Street
West Palm Beach, Florida 33401

Re: Letter Health Consultation: G-Star School

Dear Mr. Mayer:

The Florida Department of Health (DOH), Public Health Toxicology Section is committed to ensuring that people at contaminated sites have the best information available to understand the chemicals and the health risk.

We understand that former students and parents at the G-Star School in West Palm Beach, Florida, are concerned that contamination at the school could be linked to illnesses such as blood-borne cancers (leukemia, lymphoma); thyroid, throat, and breast cancer; thyroid disease; breathing issues; and seizures. DOH investigated these concerns to ensure the health and safety of students and staff.

Based on a review of available environmental data at the site, DOH does not expect that exposure to contamination since 2003, when the school opened, caused any of these illnesses in students or staff.

This assessment 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 therefore overestimate the risk.

The following paragraphs explain how we assessed the risk.

Site Description

The G-Star School is at 2065 Prairie Road in West Palm Beach, Palm Beach County, Florida, 33406 (Figure 1). Historical reports also list the site's address as 2030 S. Congress Avenue.

Palm Beach County occupied the site from the 1950s to the late 1970s [Ardaman and Associates 2000]. Operations included the Mosquito Control Department, Motor Pool, Roads and Bridges Department, Traffic Control, and Solid Waste Field Operations. Between the early 1980s to the early 2000s, the Palm Beach County Water Utilities Department (PBCWUD) occupied the site. In 1990, contractors removed underground storage tanks (USTs) near the former mosquito control facility and

the western portion of the site (Figure 2) [Ardaman and Associates 2000]. The history of the USTs is unclear, but the mosquito control facility tanks may have contained diesel fuel [Whyte 1990]. In the 1990s, the PBCWUD built an administration building where the mosquito control facility USTs used to be.

In 2001, a PBCWUD contractor found pesticide and hydrocarbon contamination in soil and groundwater north of the PBCWUD administration building and near the former mosquito control facility/former USTs [Nodarse 2001]. In 2003, a contractor for PBCWUD removed 3,371 tons of contaminated soils from the site and capped remaining soils. [ARCADIS 2014]. Contractors for the county continue to monitor pesticides in groundwater, as required by the Florida Department of Environmental Protection (DEP).

In 2004, Palm Beach County entered into an agreement that restricts digging and groundwater use and requires maintenance of the impermeable cap over contaminated soils [PBC 2004]. The G-Star School of the Arts, a public charter high school established in 2003, currently owns and occupies the site [ARCADIS 2014]. A 2014 audit found that the school is complying with the agreement [ARCADIS 2014].

Demographics
Approximately 13,617 people live within one mile of the site. Eighty-nine percent (89%) are white, 6% are African-American, 2% are Hispanic origin, and 3% report more than one race or some other race. Eighteen percent (18%) are less than 18 years old and 82% are older than 18. Forty-five percent (45%) of those over 25 years of age have a high school diploma or less and 55% make less than $50,000 a year [EPA 2015a].

Land Use
The current land use is a school. Surrounding land use is commercial/residential.

Exposure Pathways

Potential Exposure Pathways
The potential exposure pathway of concern at the G-Star School site is soil vapor intrusion (Table 1). Soil vapor intrusion requires a subsurface source of vapor-forming (volatile) chemicals in soil or groundwater underneath buildings [EPA 2015b]. At this site, the former USTs and former mosquito control building are potentially sources of contaminants in soil and groundwater that could volatilize in air. The point of exposure is the former PBCWUD administration building. Inhalation is the route of exposure and the exposed population would be current or former students and staff at the G-Star School. The time period of the potential exposure would be between 2003 and the present.

Eliminated Exposure Pathways
Groundwater Ingestion – Groundwater ingestion is an eliminated exposure pathway. Water was municipally-supplied to these building before 2000 [Ardaman and Associates 2000], and the Village of Palm Springs continues to provide water to the property today.

Exposure to Surface Soil – Exposure to surface soil is an eliminated exposure pathway. Contractors removed exposed surface soils in 2001. Although contaminated soils remain under buildings and other impervious surfaces, school students and staff do not have access to these soils.

Exposure to Subsurface Soil– Exposure to subsurface soil is an eliminated exposure pathway. Although contaminated subsurface soils may exist, students and staff do not have access. A restrictive covenant prevents demolition of buildings or other activities that would allow access.

Environmental Data

In 2001, PBCWUD contractors found benzene and chloroform in shallow groundwater adjacent to the PBCWUD administration building at concentrations that exceed current Agency for Toxic Substances and Disease Registry (ATSDR) vapor intrusion screening levels (VISLs) (Table 2/Figure 3) [Nodarse 2001]. The PBCWUD report stated that groundwater would be tested again after contaminated soil removal. DOH did not find any record of re-testing. DOH also could not locate groundwater or soil hydrocarbon analytical data taken under the building.

Early in 2002, PBCWUD contractors sampled soil below the PBCWUD administration building (Figure 4) and found elevated levels of 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethylene (DDE) and chlordane (Table 3) [CDM 2002a]. Although they detected other pesticides, such as DDT, these pesticides are not volatile (vapor-forming), and therefore people cannot come into contact with these substances.

Later in 2002, Environment, Safety and Health (ESH), monitored the air in the administration building above the soil samples. Concentrations of total hydrocarbons and pesticides, including chlordane, in air were below detection limits. ESH did not analyze air samples for benzene or DDE [ESH 2002]. Levels of semivolatile pesticides in groundwater near the former administration building are below ATSDR VISLs.

Public Health Implications

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

Exposure Concentration

For this health consultation, DOH used the EPA Vapor Intrusion Screening Level (VISL) calculator to estimate cancer risk. The calculator uses the following equation to estimate the exposure concentration for subchronic to chronic exposure to carcinogens [EPA 2009].

$$EC = (C \times ET \times EF \times ED \times CV)/AT$$

Where:
EC = exposure concentration in air ($\mu g/m^3$)
C = contaminant concentration in air ($\mu g/m^3$)
ET = exposure time (hours/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
CV = conversion factor (1 day/24 hours)
AT = averaging time (days) (70 years × 365 days/year)

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

$$Risk = EC \times IUR$$

Risk = Cancer risk

EC = Exposure concentration ($\mu g/m^3$)
IUR = Inhalation Unit Risk $(\mu g/m^3)^{-1}$

This results in a high-end 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 increased cancer risk may be as low as zero. To put the cancer risk into perspective, we use 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

Identifying Contaminants of Concern

We select contaminants with maximum concentrations above ATSDR comparison values for further evaluation. 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. We do not further evaluate contaminants with maximum concentrations below comparison values. It is unlikely these lower contaminant concentrations would cause illness.

DOH compared the highest concentrations of contaminants measured to ATSDR VISLs. Because levels of benzene and chloroform exceeded ATSDR cancer risk evaluation guide comparison values, DOH considers them contaminants of concern. ATSDR does not have vapor screening values for volatile contaminants in soil. Contractors found DDE, a semi-volatile compound, in soil under the building. ESH did not test for DDE in air; therefore DDE is also a contaminant of concern.

Benzene
Benzene is a hydrocarbon and a component of gasoline. It is a colorless liquid that evaporates easily into the air and dissolves in water. Like other hydrocarbons, it can degrade in the environment [ATSDR 2007; ATSDR 2015].

Benzene is a known carcinogen. Breathing high levels of benzene for many years can cause blood-borne cancers, such as leukemia. Benzene inhalation has not, however, been shown to cause thyroid cancer or non-cancer thyroid issues, breast cancer, throat cancer, or cause seizures. Breathing problems associated with benzene inhalation are associated with exposures at extremely high levels over a short duration of time, such as occupational or intentional inhalation exposures.

Indoor Air
Consultants tested three air samples in the former PBCWUD administration building for total hydrocarbons. Concentrations were below detection limits (<1,930 $\mu g/m^3$). They did not measure benzene in air, but benzene is one of the many compounds that make up total hydrocarbons. DOH estimated a "worst case scenario" maximum exposure concentration of benzene assuming that the concentration of total hydrocarbons was ½ the detection limit and that benzene made up 100% of the total hydrocarbons in the air samples. This is an extremely conservative (health-protective) assumption, as benzene tends to make up a very small portion of total petroleum hydrocarbons in soil vapor at petroleum-contaminated sites (Brewer et al. 2013). DOH estimated the exposure concentration using a

building occupancy of 5 days a week, 8 hours a day for 180 days per year (school calendar year) and an exposure duration of 15 years.

Cancer risk: If staff and students at the school were to breathe air in the former PBCWUD administration building containing the DOH's "worst case scenario" estimated exposure concentration of benzene (34 µg/m^3) for 15 years they would be, at most, at a "low" increased risk of cancer (Table 4).

Using the estimated benzene exposure concentration (34 µg/m^3) and an inhalation unit risk of 7.8 x 10^{-6} (µg/m^3)$^{-1}$, the increased cancer risk is "low", approximately 3 in 10,000 or 3 x 10^{-4}. To put this into context, the Oregon Cancer Foundation estimates that one out of every three Americans (or 3,333 in 10,000) will be diagnosed with some form of cancer in their lifetime [Oregon Cancer Foundation 2015]. Adding the estimated increased cancer risk from exposure to benzene would increase the cancer incidence from 3,333 in 10,000 to 3,336 in 10,000. The actual risk, if any, is likely far lower.

Chloroform

Chloroform is a colorless liquid. Most chloroform in the environment comes from industry. It was once used as an inhaled anesthetic, but is no longer used for that purpose [ATSDR 1997]. Chloroform easily evaporates into the air and dissolves in water. It is slow to break down in the environment [ATSDR 1997]. The source of the low levels of chloroform found in groundwater under the G-Star School property is not clear.

Breathing very high levels of chloroform may be associated with kidney and liver problems in people. Ingesting very high levels of chloroform causes kidney and liver cancer in animals. Chloroform exposure is not associated with blood-borne cancers; thyroid, throat, and breast cancer; thyroid disease; breathing issues; and seizures.

DDE

DDE (1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethylene) is a breakdown product of DDT. DDT is an organochlorine pesticide commonly used in the 1940s to 1960s for mosquito control. The U.S. banned use of DDT in the 1970s. DDE and DDT are very persistent and can stay in the environment for many years. They are not very soluble in water and tend to stick to soils. Breakdown and volatilization of DDT and its by-products tend to slow down over time. [ATSDR 2002].

Although theoretically DDE vapors could intrude from soil into indoor air [EPA 2015c], DOH could not locate any examples of this occurring at other sites, possibly because DDE's volatility is not high, and its volatilization slows as DDE ages. In addition, the highest concentration of DDE in soil at the site was only slightly over the ATSDR screening value for direct soil exposure (Table 3).

Some epidemiology studies report correlations between organochlorine pesticide exposure and changes in thyroid hormone levels [Friere 2013; Friere et al. 2012; Meeker et al. 2007]. The findings of such studies are, however, inconsistent [Friere 2013; Meeker et al. 2007]. Also, while some of these studies may show an association between organochlorine pesticides and thyroid hormone level changes, they do not prove causation. DOH relies more on laboratory studies that show causation for assessment of the health risk.

Laboratory inhalation studies of DDE are limited; little is known about the health risk from inhalation of DDE [ATSDR 2002; ATSDR 2008]. In animal studies, ingestion of DDE has been associated with liver cancer, but not in humans [ATSDR 2008]. DDE has not been shown conclusively to be associated with blood-borne cancers, with thyroid cancer, non-cancer thyroid conditions, throat cancer, breast cancer, or breathing problems [ATSDR 2002, ATSDR 2008]. DOH did not find any evidence that DDE exposure causes seizures.

DOH does not expect DDE at the G-Star School to cause blood-borne cancers; thyroid, throat, and breast cancer; thyroid disease; breathing issues; and seizures. Students and staff are not likely to be exposed to DDE. Also, researchers have not found conclusive evidence that DDE causes these illnesses.

Child Health Considerations

In communities faced with air, water, soil, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults for certain kinds of exposure to hazardous substances. Children play outdoors and sometime engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults are; this means they breathe dust, soil, and vapors closer to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body system of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, access to medical care, and risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

This assessment considers risks to children, as ATSDR's screening values are based on safety of vulnerable populations, such as children.

Summary

DOH understands the health concerns of some former G-Star School students and parents. DOH is committed to protecting the health of students and staff who attended or worked at the school or who will in the future.

DOH finds that exposure to site contaminants would not likely cause blood-borne cancers, such as leukemia or lymphoma. DOH also does not expect that exposure to contamination caused thyroid cancer, thyroid disease, throat cancer, breast cancer, breathing problems, or seizures in students or staff.

Please contact me at 877-798-2772 if I can answer any questions about this assessment.

Sincerely,

Deborah Tipton

Deborah Tipton
Health Assessor

ERM/erm
Enclosures

This report was supported in part by funds provided through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. The findings and conclusions in these reports are those of the Florida Department of Health and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services. This document has not been revised or edited to conform to ATSDR standards.

References

[ARCADIS 2014] ARCADIS U.S. Inc. Institutional Controls and Engineering Controls Audit Program Palm Beach County Water Utilities Department ICR IC#446 West Palm Beach, Palm Beach County, FL. April 29, 2014.

[Ardaman and Associates 2000] Ardaman and Associates. Phase I Environmental Site Assessment, Palm Beach County, 2030 Congress Avenue, West Palm Beach, Florida. October 16, 2000.

[ATSDR 1997] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Chloroform. Atlanta: U.S. Department of Health and Human Services; September 1997.

[ATSDR 2002] Agency for Toxic Substances and Disease Registry. Toxicological Profile for DDT/DDD/DDE. Atlanta: U.S. Department of Health and Human Services; September 2002.

[ATSDR 2007] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Benzene. Atlanta: U.S. Department of Health and Human Services; August 2007.

[ATSDR 2008] Agency for Toxic Substances and Disease Registry. Toxicological Profile for DDT/DDD/DDE (Addendum). Atlanta: U.S. Department of Health and Human Services; September 2008.

[ATSDR 2015] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Benzene (Addendum). Atlanta: U.S. Department of Health and Human Services; June 2015.

Brewer, R; Nagashima, J; Kelley, M; Heskett, M; and Rigby, M. Risk-Based Evaluation of Total Petroleum Hydrocarbons in Vapor Intrusion Studies. International Journal of Environmental Research and Public Health: 10(6). 2013.

[CDM 2002a] Camp Dresser and McKee Inc. Letter to James Harmon, Florida Department of Environmental Protecton, Palm Beach County Facility - 2065 Prairie Road Administration Building Site. February 2002.

[ESH 2002] Environment, Safety, and Health. Industrial Hygiene Survey, Administration Building, Water Utilities Department. February 23, 2002.

[EPA 2009] U.S. Environmental Protection Agency. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Available online: http://www.epa.gov/oswer/riskassessment/ragsf/pdf/partf_200901_final.pdf

[EPA 2015a] U.S. Environmental Protection Agency. Environmental Justice “EJView” website. Available online: http://cfpub.epa.gov/ncea/iris/compare.cfm. Accessed August 20, 2015.

[EPA 2015b] U.S. Environmental Protection Agency. OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. Available online: http://www.epa.gov/oswer/vaporintrusion/documents/OSWER-Vapor-Intrusion-Technical-Guide-Final.pdf.

[EPA 2015c] U.S. Environmental Protection Agency. Vapor Intrusion Screening Level calculator. Available online: http://www.epa.gov/oswer/vaporintrusion/guidance.html.

[Freire 2012] Freire, Carmen, Koifman, RJ, Sarinelli, P. Rosa, AC, and Clapauch, R. Long-term exposures to organochlorine pesticides and thyroid function in Children from Cidade dos Meninos, Rio de Janeiro, Brazil. Environmental Research: 117. 68-74.

[Freire 2013] Freire, Carmen, Koifman, RJ, Sarinelli, P. Rosa, AC, Clapauch, R and Koifman, S. Long-Term Exposures to Organochlorine Pesticides and Thyroid Status in Adults in a Heavily Contaminated Area in Brazil. Environmental Research: 127. 5-15.

[Nodarse 2001] Nodarse and Associates Inc. Contamination Assessment Report, Palm Beach County Water Utilities, Department Administrative Complex, 2030 South Congress Avenue, Palm Beach County, Florida. July 26, 2001.

[Oregon Cancer Foundation 2015] Oregon Cancer Foundation. Available from: http://www.oregoncancerfoundation.org/.

[PBC 2004] Palm Beach County. Declaration of Restrictive Covenant for a portion of 2065 Prairie Road. On file with the Clerk of County, Palm Beach County, Florida, January 12, 2004.

[Whyte 1990] Whyte, Jeffery. Palm Beach County Interoffice Communication to 2030 S. Congress Fuel Facility File, Tank Closure Report. September 17, 1990.

Table 1. Potential Human Exposure Pathway

POTENTIAL PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Soil vapor intrusion	Former underground storage tanks and/or mosquito control facility	Air	Inside the former PBCWUD administration building	Inhalation	G-Star School students and staff	2004 to present and future

Table 2. Contaminants in Shallow Groundwater

Contaminants	Concentration Range (ppb)	Vapor Intrusion Screening Level** (ppb)	Source of Screening Guideline**	Number Above Screening Guideline/Total Number
Benzene	BDL – 46	0.57	ATSDR CREG	4/7
Chloroform	BDL – 2.8	0.287	ATSDR CREG	2/7

ATSDR = Agency for Toxic Substances and Disease Registry
BDL = below detection limits
CREG = ATSDR cancer risk evaluation guide for 10^{-6} excess cancer risk
ppb = parts per billion
** Guidelines only used to select chemicals for further scrutiny, not to the judge the risk of illness.
Source of data: [Nodarse 2001]

Table 3. Contaminants in Shallow Soils (0 to 1 Foot Deep) Under the Building

Contaminants	Concentration Range (mg/kg)	Direct Soil Screening Guideline** (mg/kg)	Source of Screening Guideline**	Number Above Screening Guideline/Total Number
Chlordane	BDL – 5.7	2	ATSDR CREG	1/3
DDE	0.023 – 3.3	2.1	ATSDR CREG	1/3

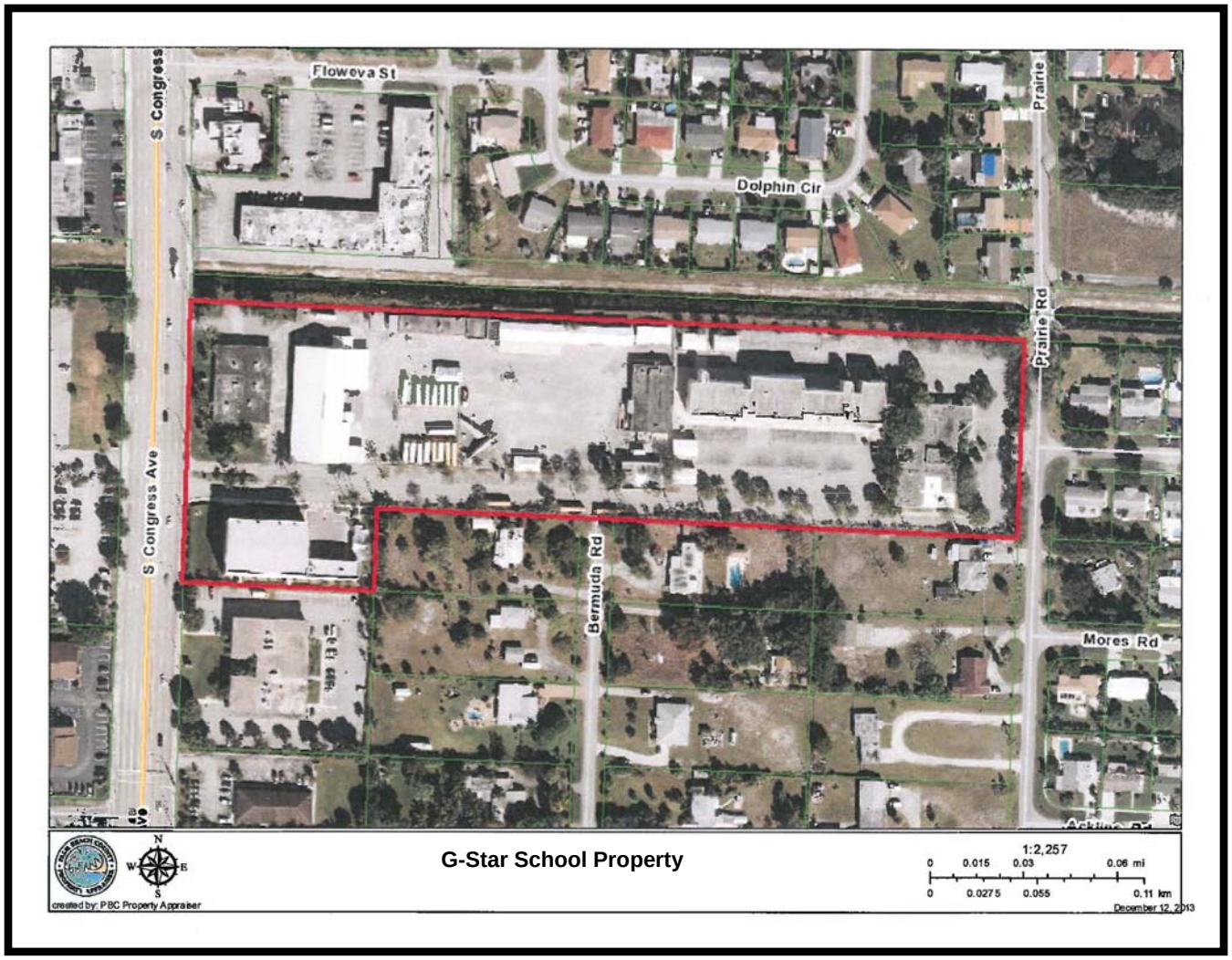
ATSDR = Agency for Toxic Substances and Disease Registry
BDL = below detection limits
CREG = ATSDR cancer risk evaluation guide for 10^{-6} excess cancer risk
mg/kg = milligrams per kilogram
** Guidelines only used to select chemicals for further scrutiny, not to the judge the risk of illness.
Source of data: [CDM 2002a]

Table 4. Estimated Increased Cancer Risk

Carcinogenic Contaminants	Estimated Maximum Exposure Concentration ($\mu g/m^3$)	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Source of Inhalation Unit Risk	Estimated Increased Cancer Risk
Benzene	34*	7.8×10^{-6}	EPA IRIS	2.7×10^{-4} (low)

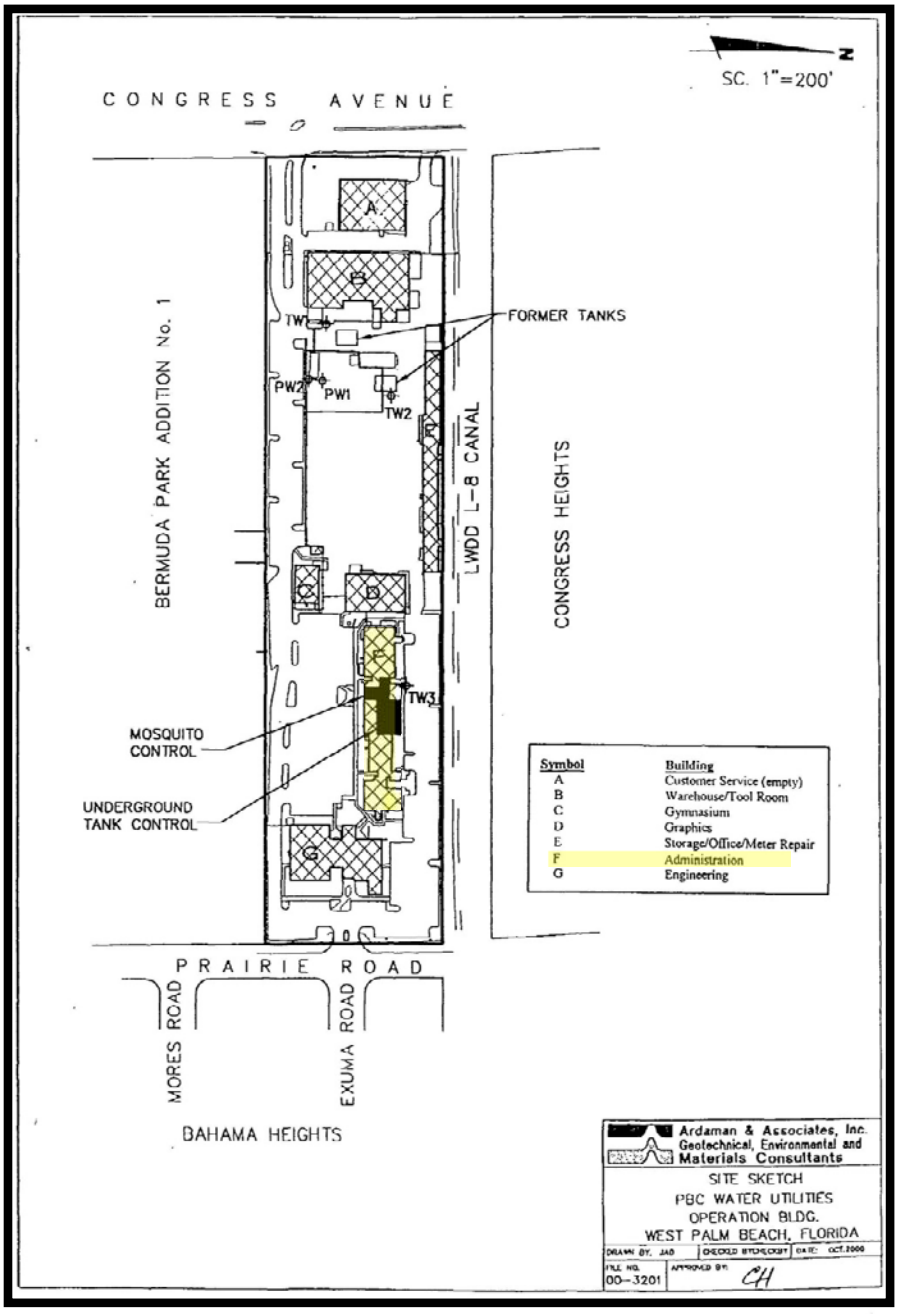
EPA IRIS = U.S. Environmental Protection Agency Integrated Risk Information System (EPA 2014b)
$\mu g/m^3$= micrograms per cubic meter
*This represents a “worst case scenario concentration”; see Contaminants of Concern section for details.

Figure 1. Site Location



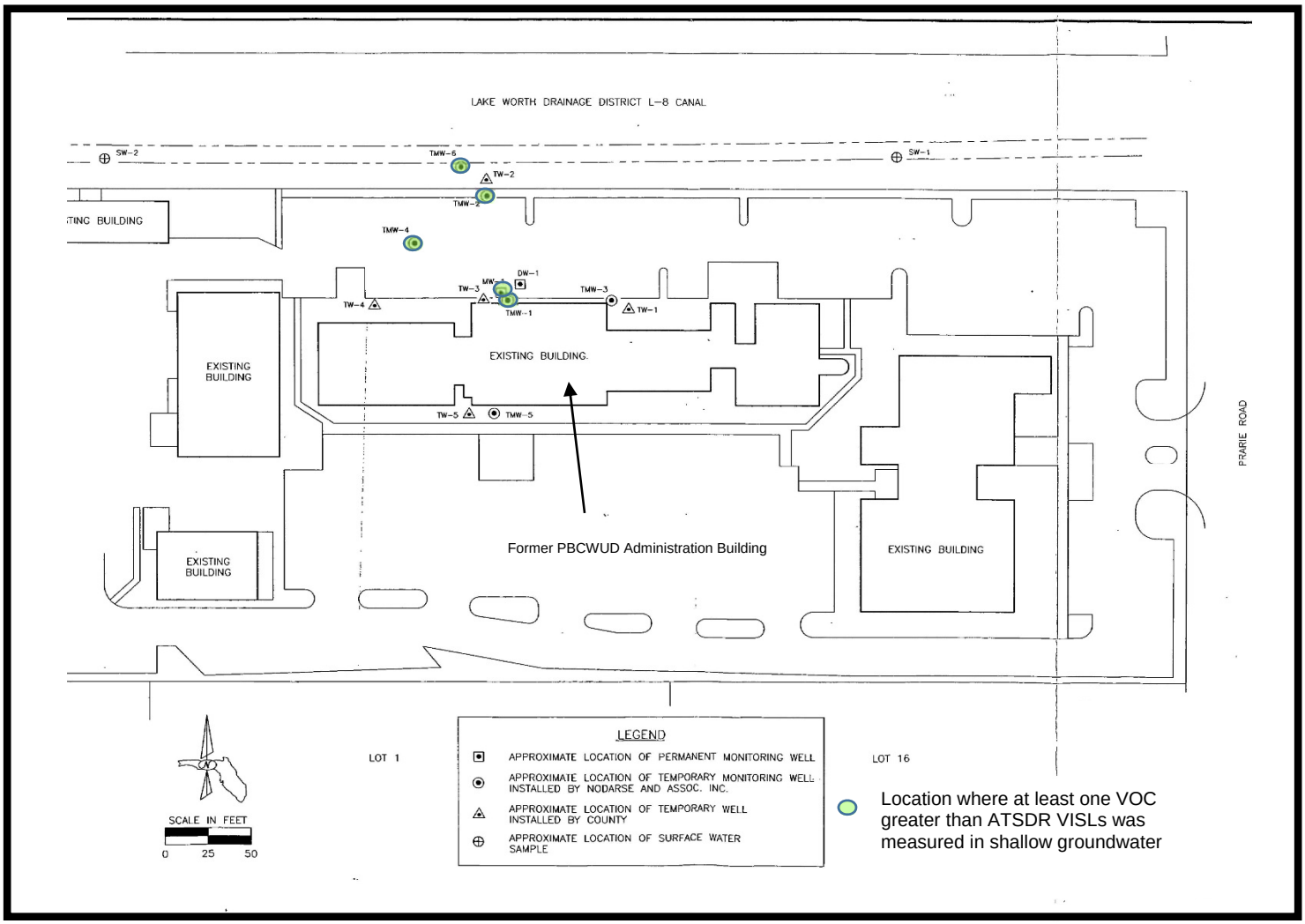
Source: [ARCADIS 2014]

Figure 2: Site Plan and Former Mosquito Control Facility



Source: [Ardaman and Associates 2000]

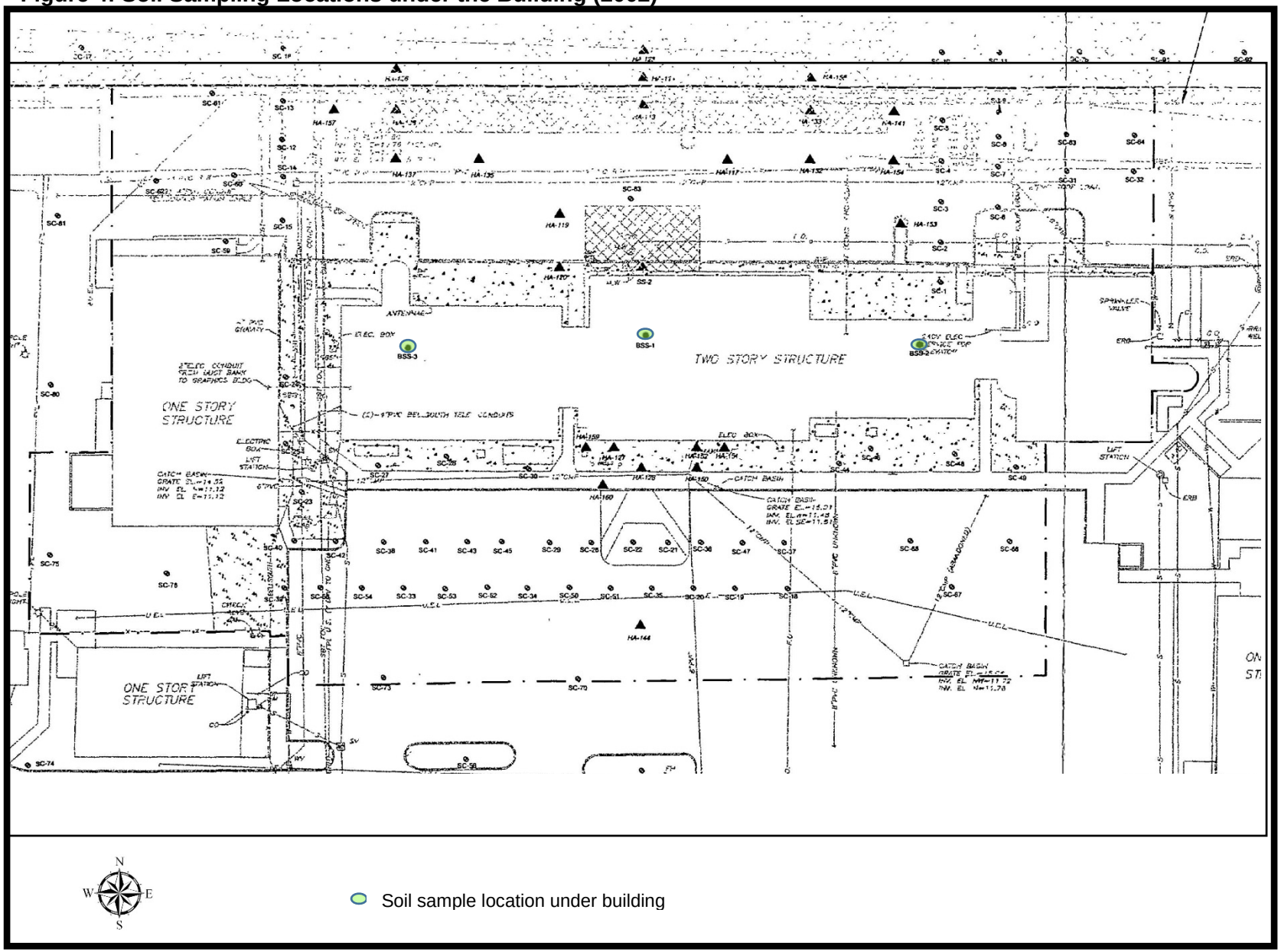
Figure 3: Groundwater Monitoring Well Locations – Hydrocarbon Investigation (2001)



ATSDR = Agency for Toxic Substances and Disease Registry
VISL = Vapor Intrusion Screening Level
VOC = Volatile Organic Compounds

Source: [Nodarse 2000]

Figure 4: Soil Sampling Locations under the Building (2002)



Source: [CDM 2002a]