Health Consultation

DEFENSE SUPPLY CENTER RICHMOND
[a/k/a DEFENSE GENERAL SUPPLY CENTER (DLA)]

CHESTERFIELD, CHESTERFIELD COUNTY, VIRGINIA

EPA FACILITY ID: VA3971520751

APRIL 4, 2002

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR, which in the Agency's opinion indicates a need to revise or append the conclusions previously issued.

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Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Statement of Issue

In May 2001, the Agency for Toxic Substances and Disease Registry (ATSDR) was requested by the Virginia Department of Environmental Quality (VDEQ) to provide a public health consultation on the public health significance of environmental contaminants found in surface water at and near the Defense Supply Center Richmond (DSCR), formerly known as the Defense General Supply Center (DGSC). In this health consultation, ATSDR evaluates the potential risk to people who could be exposed to contaminants in surface water on or near DSCR in No Name and Kingsland Creeks. The data on No Name and Kingsland Creeks were provided by VDEQ and DSCR.

ATSDR previously completed a public health assessment (pha) for the U.S. Defense General Supply Center Richmond, Chesterfield County, Virginia (CERCLIS No. VA3971520751) on April 21, 1993 (ATSDR, 1993). The pha concluded the facility posed no apparent public health hazard.

Background

The Defense Supply Center Richmond (DSCR) is a Defense Logistics Agency (DLA) federal facility that comprises 631 acres in Chesterfield County, Virginia, approximately 12 miles south of the city of Richmond, Virginia. The DSCR has been managing and furnishing military general supplies to the Armed Forces and several federal civilian agencies since 1942. Current operations at the facility include the management and storage of military supplies, material handling, and storage of chemicals such as pesticides, herbicides, lubricants and petroleum products (Law, 2001a). As a result of past activities, environmental contamination exists at the facility. The facility is listed on the United States Environmental Protection Agency's (EPA) National Priority List (NPL). The responsibility for facility environmental cleanup belongs to the DLA, with oversight by the EPA and state regulatory agencies, such as VDEQ.

The area within a one-mile radius of DSCR is populated by 16,228 people. Of those residents, 2,129 are children aged six and younger (U.S. Census, 1990, see Figure 1). The area to the northeast and east of DSCR has been developed as both single family and multi-family housing. A housing subdivision called Rayon Park is located directly east of DSCR. Rayon Park consists of 74 buildings, including duplexes and single-family homes. Most of the residents' homes have been served by the public water supply since June 1987. Some of the homes also have private groundwater supply wells. Three homes and a rental duplex continued to use well water as their drinking water source. The residents did not hook up to the public water supply for financial and personal reasons. The rental unit was inadvertently not connected to public water until 2001. All four of these wells were tested in 2001 and no levels of organic pollutants tested for were found.

The various cleanup sites at DSCR have been divided into 13 Operable Units (OU) and the PX Gas Station. Operable Unit 6 (OU 6) consists of the Area 50/Open Storage Area/National Guard

Area Groundwater. Historical activities at DSCR have caused contamination of the groundwater from solvents and metals. There are two contamination plumes extending from Area 50 eastward through the National Guard Area. Contamination in the upper aquifer is primarily volatile organic compounds (VOCs), as well as some semi-volatile organic compounds (SVOCs) and metals. In general, these same contaminants are also found in the lower aquifer. Area 50 is a former landfill suspected to be the source of the groundwater contamination. The groundwater in the upper aquifer moves toward and discharges into No Name Creek, but the primary source of flow for No Name Creek is surface water runoff from DSCR and the area west of DSCR (Law, 2001a). The primary source of flow for Kingsland Creek is surface water runoff from the area west of DSCR. Operable Unit 9 (OU 9) consists of the Interim Action System for OU 6. OU 9 is a groundwater treatment system that was installed to remove volatile organic compounds from groundwater via air stripping. Residual vapors are treated with activated carbon. The remedial system is in place to intercept, remove, and treat impacted groundwater from both the upper and lower aquifers on-site, prior to migrating off site and coming into contact with No Name Creek (Law, 2001a).

The Virginia Department of Environmental Quality (VDEQ) Piedmont Regional Office conducted surface water sampling of No Name Creek near DSCR on May 14, May 21, and May 30, 2001. Three samples and one field blank were taken on May 14. Two samples were taken on May 21. Two samples and two field blanks were taken on May 30. DSCR conducted surface water sampling of No Name Creek on May 14, May 16, and July 20, 2001. Seven samples, one equipment blank, and one trip blank were taken on May 14. Six samples were taken on May 16. Seven samples and one equipment blank were taken on July 20. Data was also reviewed from a June 13, 2001 sampling event at No Name Creek. Barium was the only compound detected in the June sampling event. Barium was found at 29 ppb, which is lower than the barium detected in the May and July sampling events, and also lower than the comparison value. Therefore, the June sampling results are not discussed in this consultation.

DSCR conducted surface water sampling of Kingsland Creek on May 16, 2001. Four samples, one equipment blank, and one trip blank were taken on May 16. The No Name and Kingsland Creek samples were analyzed for metals, volatile organic compounds, and semi-volatile organic compounds. A list is of the chemicals sampled for is shown in Table 1. Appropriate quality assurance and quality control procedures were used to validate the sampling data. An evaluation of the data is described in the discussion section.

Discussion

ATSDR identifies and evaluates exposure pathways by considering how people might come into contact with, or be exposed to, a contaminant. For a public health hazard to exist, people must come into contact with areas of contamination, and the amount of contamination must be sufficient to affect human health. For the purpose of evaluating the public health impact of chemical releases into the environment, it is critical to determine if people come into contact with

the chemicals. If so, the duration of the chemical contact is also important.

There are five elements of an exposure pathway: 1) Source of Contamination, 2) Environmental Media, 3) Point of Exposure, 4) Route of Exposure, and 5) Exposed Population. All five of these elements must be present in order for there to be a completed exposure pathway. Operable Units at DSCR are examples of the source of contamination. The environmental media is surface water. The point of exposure would be the location at which human contact is made with contamination. Most residences in the area neighboring DSCR are connected to the public water supply, therefore the only point of exposure is surface water, such as No Name or Kingsland Creeks. The route of exposure is the pathway through which contaminants enter the body. The only routes of exposure would be incidental ingestion or dermal contact with surface water. The exposed population would be residents who come into contact with the creeks, especially children.

In examining environmental data, ATSDR uses comparison values to select environmental contaminants for further evaluation. A comparison value is a concentration of a given contaminant in soil, water, or air below which no adverse human health effects are expected to occur. Most of the comparison values used in this public health consultation assume exposure over a 70-year lifetime, and ingestion of 2 liters of water per day for adults, and 1 liter per day for children. Comparison values have built-in safety factors to ensure that they are protective of human health. ATSDR comparison values represent contaminant concentrations many times lower than levels at which no effects were observed in experimental animals or human epidemiologic studies. If contaminant concentrations are above comparison values, ATSDR further analyzes exposure variables (for example, duration and frequency), the toxicity of the contaminant, other epidemiology studies, and the weight of evidence for health effects.

Several comparison values were used in this public health consultation. Cancer Risk Evaluation Guides (CREG) are derived by ATSDR from the EPA Cancer Slope Factor. They represent an estimated concentration in water, soil, or air that would be expected to cause no more than one excess cancer in a million persons exposed over a lifetime. Maximum Contaminant Levels (MCL) represent contaminant concentrations that EPA deems protective of public health over a lifetime (70 years) at an exposure rate of 2 liters of water per day. MCLs are enforceable standards. Drinking Water Lifetime Health Advisories (LTHA) are derived by EPA from a drinking water equivalent level below which no adverse non-cancer health effects are expected to occur. CREGs, MCLs, and LTHAs are intended for drinking water use over a 70 year lifetime. A Reference Media Evaluation Guide (RMEG) is a concentration in air, soil, or water below which non-cancer health effects are not expected to occur. RMEGs are derived from EPA's reference dose or reference concentration, and are for chronic exposures. A Environmental Media Evaluation Guide (EMEG) is a concentration in air, soil, or water below which no adverse non-cancer health effects are expected to occur. EMEGs are derived from ATSDR's Minimal Risk Level (MRL), and are expressed for acute, intermediate, and chronic exposures. Action Levels are the estimated contaminant concentrations in water which indicate that additional

evaluation is needed to determine whether action is required to eliminate or reduce exposure.

The water in No Name and Kingsland Creeks is not used for drinking water. In the case of No Name and Kingsland Creeks, the only exposure would be through incidental ingestion and dermal contact. Both of these exposures would be limited because of the short period of time spent in the creeks. Because of this, the comparison values used for evaluation are overly protective. They have been developed for the exposure route of ingestion of drinking water. Therefore they are also highly conservative for the dermal route of exposure. Additionally, the low concentration of contaminants found in the creeks does not effectively cross the skin barrier into the body.

The Virginia Department of Environmental Quality (VDEQ) Piedmont Regional Office and DSCR conducted surface water sampling of No Name and Kingsland Creeks in May and July 2001. Table 1 shows the list of chemicals of various classes which were tested for in both No Name and Kingsland Creeks; such as metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). Standard EPA procedures and analyses were used to evaluate the compounds. Samples taken from No Name and Kingsland Creeks were analyzed for many compounds, but very few were detected. Additionally, the frequency of detection was low for most of the detected compounds. Metals are common and expected in surface water. Metals frequently occur naturally both in groundwater and surface water.

VDEQ conducted surface water sampling of No Name Creek on May 14, May 21, and May 30, 2001. DSCR conducted surface water sampling of No Name Creek on May 14, May 16, and July 20, 2001. Table 2 shows those compounds that were detected in No Name Creek in concentrations above the methodological detection limits. Seven compounds detected in No Name Creek were found in concentrations above the most conservative drinking water comparison values used by ATSDR for human health effects. The water in No Name Creek is not used for drinking water. Exposure to water from No Name Creek would be through dermal contact and incidental ingestion for a relatively short period of time. The seven compounds were evaluated for incidental ingestion and dermal absorption exposure doses and then compared to health guidelines. Tables 4 and 5 show the estimated exposure doses for incidental ingestion and dermal absorption. All of the estimated exposure doses were well below available health guidelines.

ATSDR estimated the human exposure doses from incidental ingestion and dermal absorption of surface water. The equations used to derive exposure doses can be found in Appendix A. Deriving exposure doses requires evaluating the concentrations of the contaminants to which people may have been exposed, and how often and how long exposures to those contaminants occurred. Together, these factors help influence the individual's physiological response to chemical contaminant exposure and the potential for noncancer or cancer outcomes. In the absence of exposure specific information, ATSDR applied several conservative assumptions to define site-specific exposures as accurately as possible for people contacting contaminated media.

The estimated exposure doses were used to evaluate potential noncancer effects associated with contaminants detected in site media. When evaluating noncancer effects, ATSDR first compared the estimated exposure dose to standard toxicity values, including ATSDR's minimal risk levels (MRLs) and EPA's reference dose (RfDs), to evaluate whether adverse effects may occur. The chronic MRLs and RfDs are estimates of daily human exposure to a substance that is likely to be without appreciable risk of adverse noncacer effects over a specified duration. The chronic MRLs and RfDs are conservative values, based on the levels of exposure reported in the literature that represent no-observed-adverse-effects-levels (NOAEL) or lowest-observed-adverse-effects-levels (LOAEL) for the most sensitive outcome for a given route of exposure (e.g., dermal contact, ingestion). In addition, uncertainty (safety) factors are applied to NOAELs or LOAELs to account for variation in the human population and uncertainty involved in extrapolating human health effects from animal studies. When comparing dermal absorption exposure doses to health guidelines, a gastrointestinal (GI) factor is applied to the Oral RfD or Oral MRL. This accounts for the difference in absorption through skin as compared to the absorption through the gastrointestinal wall. If estimated exposure doses are greater than the MRL or RfD, ATSDR reviews the toxicological literature to determine the likelihood of adverse effects. None of the exposure doses of contaminants detected in No Name Creek were greater than the MRLs or RfDs. ATSDR health guidelines are not available for lead or thallium, but toxicological and epidemiological information is available.

The maximum thallium concentration found in surface water in No Name Creek was 2.0 ppb. Using this maximum concentration, ATSDR estimated that incidental ingestion of water from No Name Creek would result in an exposure dose of 8.90e-7 mg/kg/day for children, and 4.07e-7 mg/kg/day for adults. EPA has RfDs for several thallium compounds. Each RfD covers a particular compound and is based on animal studies for that compound. For example, the RfD for thallium sulfate is based on a *failure to observe harmful effects* in rats that were administered as much as 0.25 mg/kg/day of thallium by gavage. EPA divided this number by an uncertainty factor of 3000 to account for humans being more sensitive than rats to thallium, for some humans being more sensitive than others, and for a lack of chronic toxicity data. This gave EPA an RfD of 8.0e-5 mg/kg/day. The thallium dose that did *not* cause toxicity to rats (i.e., 0.25 mg/kg/day) was 280,000 times *higher* than the maximum exposure dose that ATSDR estimated for surface water ingestion from No Name Creek, despite the fact that ATSDR used *very* conservative assumptions to estimate dose. If more realistic exposure assumptions were used, estimated doses would be even lower. Therefore, ATSDR concluded that ingestion of thallium in surface water from No Name Creek is not expected to result in adverse human health effects.

The maximum lead concentration found in surface water in No Name Creek was 35.8 ppb. Using this maximum concentration, ATSDR estimated that incidental ingestion of water from No Name Creek would result in an exposure dose of 1.59e-5 mg/kg/day for children, and 7.29e-6 mg/kg/day for adults. ATSDR determined that incidental ingestion for 365 days at the highest detected concentration of lead in water (35.8 ppb) does not pose a public health hazard. ATSDR estimated blood lead levels using the Integrated Exposure Uptake Biokinetic Model (IEUBK) for Lead for children, adults, and fetuses (EPA, 1996). The Centers for Disease Control and

Prevention (CDC) have determined that health effects are more likely to be observed if actual blood lead levels are at or above 10 micrograms per deciliter (µg/dl). Using the IEUBK model, estimated blood lead levels were found to be below 10 µg/dl for all populations. Health effects are not expected from exposure to the levels of lead and thallium in No Name Creek.

DSCR conducted surface water sampling of Kingsland Creek on May 16, 2001. Table 3 shows those compounds that were detected in Kingsland Creek in concentrations above methodological detection limits. Although some compounds were detected, the analytical results showed all detected compounds in Kingsland Creek to be below the most conservative drinking water comparison values used by ATSDR for human health effects.

Child Health Initiative

ATSDR is committed to protecting children's health. ATSDR recognizes that infants and children may be more sensitive than adults to environmental exposure in communities faced with water, soil, air, or food contamination. This sensitivity is the result of several factors, including: 1) children are smaller than adults, resulting in higher doses of chemical exposure per unit body weight; 2) children's bodies may be more sensitive to the effects of chemical exposures. Children have developing body systems which can sustain permanent damage if toxic exposures occur during critical growth stages. Because of these sensitivities, ATSDR uses health guidelines that are protective for children. ATSDR did not find contaminants present at levels that would present a public health hazard to children.

Conclusions

ATSDR's evaluation of the data does not indicate a current human health hazard exists from exposure to surface water. Surface water sampling of No Name Creek detected seven compounds above the most conservative comparison values for drinking water. No compounds were detected in Kingsland Creek above comparison values. These comparison values are intended for drinking water. No Name and Kingsland Creeks are not used for drinking water. Any exposure to compounds in surface water would be through short-term incidental ingestion and dermal contact. Maximum single detection values were used to estimate exposure doses for the seven compounds detected above comparison values in No Name Creek. All of the estimated exposure doses are below health guidelines. Therefore, adverse health effects are not expected from exposure to surface water.

Recommendations

1) If future groundwater monitoring results on the installation indicate that concentrations are increasing and might affect the creeks, periodically monitor No-Name and Kingsland Creeks adjoining the installation. Use appropriate quality assurance and quality control procedures to validate the sampling data.

2) If any extraordinary releases of groundwater from the treatment system or other sources of chemicals occur that could impact No Name and Kingsland Creeks, surface water sampling should be conducted to evaluate the potential effect on public health.

Table 1. Chemicals Sampled for in No Name and Kingsland Creeks

Chemical	Defense Supply Center Richmond (Law Environmental Inc.)	Virginia Department of Environmental Quality
Metals		
Arsenic	X	X
Cadmium	X	X
Lead	X	X
Antimony	X	
Selenium	X	X
Silver	X	
Aluminum	X	
Barium	X	
Beryllium	X	
Calcium	X	
Cobalt	X	
Chromium	X	X
Copper	X	X
Iron	X	X
Potassium	X	
Magnesium	X	
Manganese	X	X
Molybdenum	X	
Sodium	X	
Nickel	X	X
Vanadium	X	
Zinc	X	X
Mercury	X	X

Chemical	Defense Supply Center Richmond (Law Environmental Inc.)	Virginia Department of Environmental Quality
Thallium	X	
Volatile Organic Compounds		
Acetone	X	
Benzene	X	X
Bromobenzene	X	
Bromochloromethane	X	X
Bromodichloromethane	X	X
Bromodichloropropane		X
Bromoform	X	X
Bromomethane	X	X
2-Butanone	X	
n-Butylbenzene	X	X
sec-Butylbenzene	X	X
tert-Butylbenzene	X	X
Carbon disulfide	X	
Carbon tetrachloride	X	X
Chlorobenzene	X	X
Dibromochloromethane	X	
Chloroethane	X	X
2-Chloroethylvinyl ether		X
Chloroform	X	X
Chloromethane	X	X
2-Chlorotoluene	X	X
4-Chlorotoluene	X	
p-Chlorotoluene		X
Dibromochloromethane		X

Chemical	Defense Supply Center Richmond (Law Environmental Inc.)	Virginia Department of Environmental Quality
1, 2-Dibromo-3-chloropropane	X	X
1, 2-Dibromoethane	X	
Dibromomethane	X	
1, 2-Dichlorobenzene	X	X
1, 3-Dichlorobenzene	X	X
1, 4-Dichlorobenzene	X	X
Dichlorodifluoromethane	X	
1, 1-Dichloroethane	X	X
1, 2-Dichloroethane	X	X
cis-1, 2-Dichloroethene	X	X
trans-1, 2-Dichloroethene	X	X
1, 1-Dichloroethene	X	X
Dichlorofluoromethane		X
1, 2-Dichloropropane	X	X
1, 3-Dichloropropane	X	X
2, 2-Dichloropropane	X	X
cis-1, 3-Dichloropropene	X	X
trans-1, 3-Dichloropropene	X	X
1, 1-Dichloropropene	X	X
Ethylbenzene	X	X
1, 2-Ethylenedibromide		X
Hexachlorobutadiene	X	X
2-Hexanone	X	
Isopropylbenzene	X	X
4-Isopropyltoluene		X
p-Isopropyltoluene	X	
Methylene chloride	X	X

Chemical	Defense Supply Center Richmond (Law Environmental Inc.)	Virginia Department of Environmental Quality
4-Methyl-2-pentanone	X	
Methyl t-butyl ether (MTBE)		X
Napthalene	X	X
n-Propylbenzene	X	X
Styrene	X	X
1, 1, 1, 2-Tetrachloroethane	X	X
1, 1, 2, 2-Tetrachloroethane	X	X
Tetrachloroethene	X	X
Toluene	X	X
1, 2, 3-Trichlorobenzene	X	X
1, 2, 4-Trichlorobenzene	X	X
1, 1, 1-Trichloroethane	X	X
1, 1, 2-Trichloroethane	X	X
Trichloroethene	X	X
Trichlorofluoromethane	X	X
1, 2, 3-Trichloropropane	X	X
1, 2, 4-Trimethylbenzene	X	X
1, 3, 5-Trimethylbenzene	X	X
Vinyl chloride	X	X
m-Xylene & p-Xylene	X	
o-Xylene	X	
Xylenes (total)	X	X
Semi-Volatile Organic Compounds		
Acenaphthene	X	X
Acenaphthylene	X	X
Anthracene	X	X
Benzo(a)anthracene	X	X

Chemical	Defense Supply Center Richmond (Law Environmental Inc.)	Virginia Department of Environmental Quality
Benzo(b)fluoranthene	X	X
Benzo(k)fluoranthene	X	X
Benzoic acid	X	
Benzo(ghi)perylene	X	X
Benzo(a)pyrene	X	X
Benzyl alcohol	X	
Benzylbutylphthalate		X
bis(2-Chloroethoxy)methane	X	X
bis(2-Chloroethyl)-ether	X	X
bis(2-Chloroisopropyl)ether	X	X
bis(2-Ethylhexyl)phthalate	X	X
4-Bromophenyl phenyl ether	X	X
Butyl benzyl phthalate	X	
n-Butyl benzyl phthalate		X
4-Chloroaniline	X	
4-Chloro-3-methylphenol	X	X
2-Chloronaphthalene	X	X
2-Chlorophenol	X	X
4-Chlorophenyl phenyl ether	X	X
Chrysene	X	X
Dibenz(a,h)anthracene	X	X
1, 2, 5, 6-Dibenzanthracene		X
Dibenzofuran	X	
Di-n-butyl phthalate	X	X
1, 2-Dichlorobenzene	X	X
1, 3-Dichlorobenzene	X	X
1, 4-Dichlorobenzene	X	X

Chemical	Defense Supply Center Richmond (Law Environmental Inc.)	Virginia Department of Environmental Quality
3, 3'-Dichlorobenzidine	X	
2, 4-Dichlorophenol	X	X
Diethyl phthalate	X	X
2, 4-Dimethylphenol	X	X
Dimethyl phthalate	X	X
4, 6-Dinitro-2-methylphenol	X	
2, 4-Dinitrophenol	X	X
2, 4-Dinitrotoluene	X	X
2, 6-Dinitrotoluene	X	X
Di-n-octyl phthalate	X	X
Fluoranthene	X	X
Fluorene	X	X
Hexachlorobenzene	X	X
Hexachlorobutadiene	X	X
Hexachlorocyclopentadiene		X
Hexachloropentadiene	X	
Hexachloroethane	X	X
Hexachloroethate		X
Hexachloropropene	X	
Indeno(1, 2, 3-cd)pyrene	X	X
Isophorene		X
Isophorone	X	X
2-Methyl-4, 6-dinitrophenol		X
2-Methylnaphthalene	X	
2-Methylphenol	X	
3-Methylphenol & 4-Methylphenol	X	
Naphthalene	X	X

Chemical	Defense Supply Center Richmond (Law Environmental Inc.)	Virginia Department of Environmental Quality
2-Nitroaniline	X	
3-Nitroaniline	X	
4-Nitroaniline	X	
Nitrobenzene	X	X
2-Nitrophenol	X	X
4-Nitrophenol	X	X
N-Nitrosodimethylamine		X
N-Nitrosodiphenylamine	X	X
N-Nitrosodi-n-propylamine	X	X
Pentachlorophenol	X	X
Penanthrene		X
Phenanthrene	X	X
Phenol	X	X
Pyrene	X	X
1, 2, 4-Trichlorobenzene	X	X
2, 4, 5-Trichlorophenol	X	
2, 4, 6-Trichlorophenol	X	X

Table 2. Chemicals Detected in No Name Creek

Chemical	Chemical Concentration Range (ppb)	Frequency of Detections	Frequency above Standards	Drinking Water Standards (ppb)	Standard Used
Metals					
Aluminum	65.2-2010	7/27	0	20000	Intermediate EMEG-Child
Antimony	3.5	1/27	0	4	Chronic RMEG-Child
Arsenic	8.0-12.4	3/27	3	0.02	CREG
Barium	44.4-74.6	13/27	0	700	Chronic RMEG-Child
Cadmium	2.1-3.4	2/27	2	2	Chronic EMEG-Child
Calcium*	4540-49500	12/27	NA	NA	NA
Chromium	2.6	2/27	0	100	LTHA
Cobalt	1.4-3.2	7/27	0	100	Intermediate EMEG-Child
Copper	11.9-117	4/27	0	1300	Action Level
Iron*	175-22800	15/27	NA	NA	NA
Lead	3.2-35.8	4/27	2	15	Action Level
Magnesium*	1530-4910	13/27	NA	NA	NA
Manganese	45.1-293	15/27	0	500	Chronic RMEG-Child

Chemical	Chemical Concentration Range (ppb)	Frequency of Detections	Frequency above Standards	Drinking Water Standards (ppb)	Standard Used
Molybdenum	3.3	1/27	0	50	Chronic RMEG-Child
Nickel	2.5-4.5	2/27	0	100	LTHA
Potassium*	157-10900	14/27	NA	NA	NA
Sodium*	5900-12300	13/27	NA	NA	NA
Thallium	1.7-2.0	2/27	1	0.5	LTHA
Vanadium	2.1-4.6	3/27	0	30	Intermediate EMEG-Child
Zinc	12.3-84.7	14/27	0	3000	Chronic EMEG-Child
Volatile Organic Compounds					
Acetone	0.66-0.79	2/27	0	3000	Chronic RMEG-Child
n-Butylbenzene	0.19	1/27	NA	NA	NA
sec-Butylbenzene	0.26	1/27	NA	NA	NA
Chlorobenzene	0.14	1/27	0	200	Chronic RMEG-Child
Chloroform	0.20	1/27	0	6	CREG
Trichloroethene	0.26-21	17/27	2	5	MCL
1,4-Dichlorobenzene	0.19	1/27	0	75	LTHA
cis-1,2-Dichloroethene	0.28-45	14/27	0	70	LTHA

Chemical	Chemical Concentration Range (ppb)	Frequency of Detections	Frequency above Standards	Drinking Water Standards (ppb)	Standard Used
bis (2-Ethylhexyl) phthalate	6.4	1/27	1	3.0	CREG
Tetrachloroethene	0.54-2.1	8/27	0	10	LTHA
Toluene	0.36	1/27	0	200	Intermediate EMEG-Child
1,2,4-Trimethylbenzene	0.80	1/27	NA	NA	NA
1,3,5-Trimethylbenzene	0.20	1/27	NA	NA	NA
Vinyl Chloride	1.5-6.1	4/27	3	0.03	CREG

* = NA-Not Available. Many metals do not have drinking water standards because they are common and naturally occurring.
Reference: VDEQ, 2001. Law, 2001b.

Table 3. Chemicals Detected in Kingsland Creek

Chemical	Chemical Concentration Range (ppb)	Frequency of Detections	Frequency above Standards	Drinking Water Standards (ppb)	Standard Used
Metals					
Barium	34.1-57.1	4/4	0	700	Chronic RMEG-Child
Calcium*	4210-6170	4/4	NA	NA	NA
Copper	8.2	1/4	0	1300	Action Level
Iron*	1430-2320	4/4	NA	NA	NA
Potassium*	1900-2540	4/4	NA	NA	NA
Magnesium*	1590-2200	4/4	NA	NA	NA
Manganese	23.8-82.7	4/4	0	500	Chronic RMEG-Child
Sodium*	8050-12100	4/4	NA	NA	NA
Zinc	12.7-17.4	2/4	0	3000	Chronic EMEG-Child
Mercury*	0.079	1/4	NA	NA	NA
Volatile Organic Compounds					
cis-1,2-Dichloroethene	1.1-2.9	3/4	0	70	LTHA
Tetrachloro-ethene	0.43-0.44	2/4	0	10	LTHA
1,1,1-Trichloroethane	0.66-0.68	2/4	0	200	LTHA
Trichloroethene	1.2-2.4	3/4	0	5	MCL

* = NA-Not Available. Many metals do not have drinking water standards because they are common and naturally occurring.
Reference: Law, 2001b.

Table 4. Water Incidental Ingestion Exposure Doses

Compound	Contaminant Concentration (ppb)	Exposure Dose-Child (mg/kg/day)	Exposure Dose-Adult (mg/kg/day)	Frequency above Guideline	Health Guide-line (mg/kg/day)	Health Guideline Used
Arsenic	12.4	5.52e-6	2.52e-6	0	3.0e-4	Oral RfD
Cadmium	3.4	1.51e-6	6.92e-7	0	2.0e-4	Chronic Oral MRL
Lead	35.8	1.59e-5	7.29e-6	NA	NA	NA
bis (2-Ethylhexyl) phthalate	6.4	2.85e-6	1.30e-6	0	1.0e-2	Inter-mediate Oral MRL
Thallium	2.0	8.90e-7	4.07e-7	NA	NA	NA
Trichloro-ethene	21.0	9.35e-6	4.27e-6	0	2.0e-1	Acute Oral MRL
Vinyl Chloride	6.1	2.72e-6	1.24e-6	0	3.0e-3	Oral RfD

Table 5. Dermal Absorption Exposure Doses

Compound	Contaminant Concentration (ppb)	Exposure Dose-Child (mg/kg/day)	Exposure Dose-Adult (mg/kg/day)	Frequency above Guideline	Health Guide-line (mg/kg/day)	Health Guideline Used
Arsenic	12.4	1.21e-5	6.11e-6	0	6.0e-5	Oral RfD x GI Factor
Cadmium	3.4	3.32e-6	1.67e-6	0	4.0e-5	Oral MRL x GI Factor
Lead	35.8	3.50e-6	1.76e-6	NA	NA	NA
bis (2-Ethylhexyl) phthalate	6.4	2.06e-4	1.04e-4	0	8.0e-3	Inter-mediate Oral MRL x GI Factor
Thallium	2.0	1.96e-6	9.85e-7	NA	NA	NA
Trichloro-ethene	21.0	4.72e-3	2.38e-3	0	1.6e-1	Oral MRL x GI Factor
Vinyl Chloride	6.1	4.35e-5	2.19e-5	0	2.4e-3	Oral RfD x GI Factor

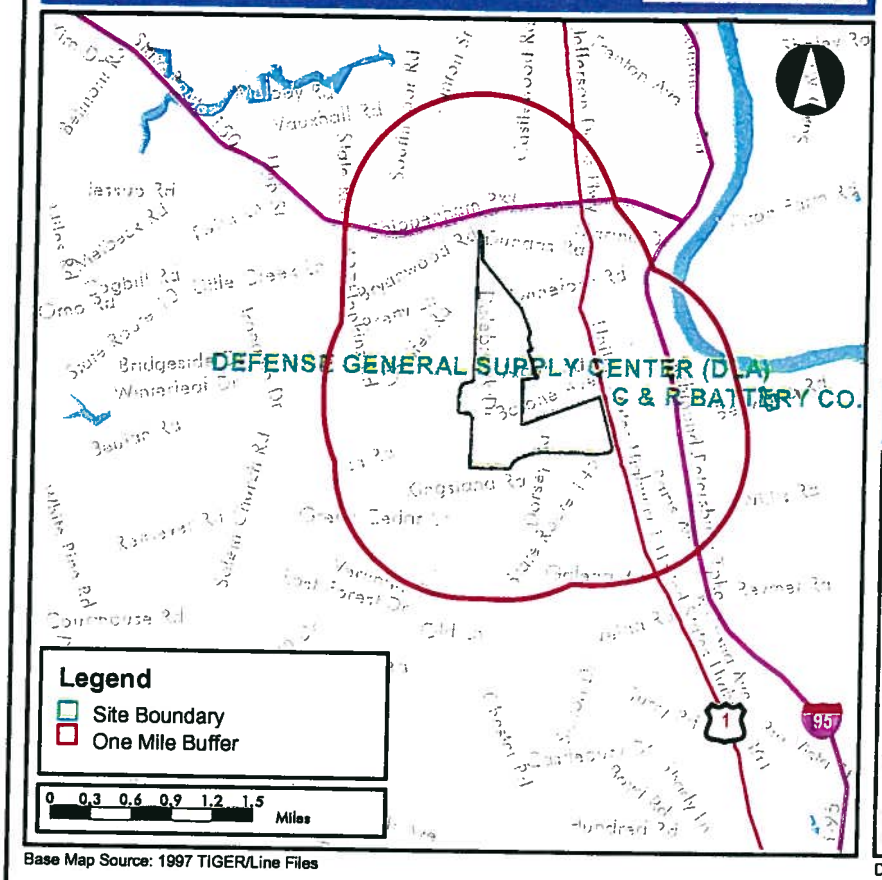
Defense General Supply Center (DLA)

Richmond, Virginia

VA3971520751

GATHER

Geographic Analysis Tool for Health and Environmental Research



Base Map Source: 1997 TIGER/Line Files

Site Location
Chesterfield County, Virginia

Demographic Statistics

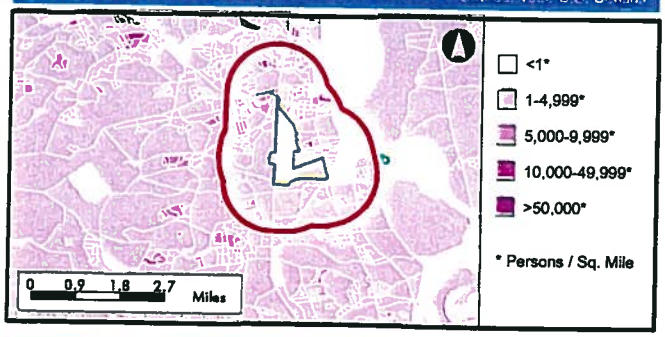
Within One Mile of Site*

Total Population	16,228
White	12,145
Black	3,269
American Indian, Eskimo, Aleut	71
Asian or Pacific Islander	578
Other Race	164
Hispanic Origin	371
Children Aged 6 and Younger	2,129
Adults Aged 65 and Older	1,056
Females Aged 15 - 44	4,388
Total Housing Units	6,697

Demographic Statistics Source: 1990 U.S. Census
*Calculated using an area-proportion analysis technique

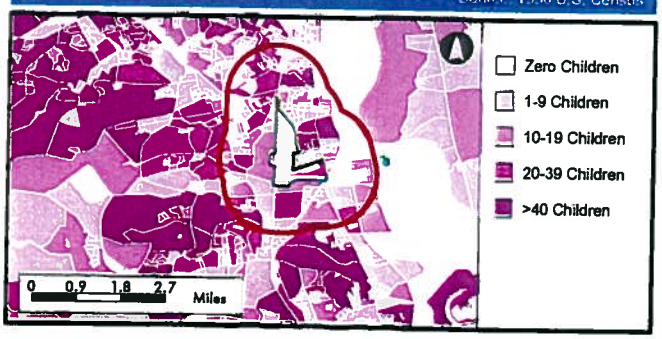
Population Density

Source: 1990 U.S. Census



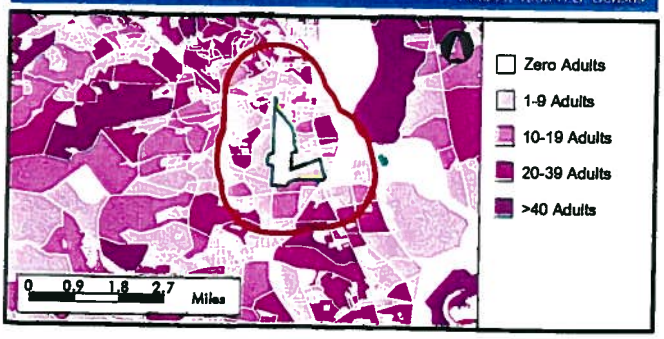
Children Aged 6 and Under

Source: 1990 U.S. Census



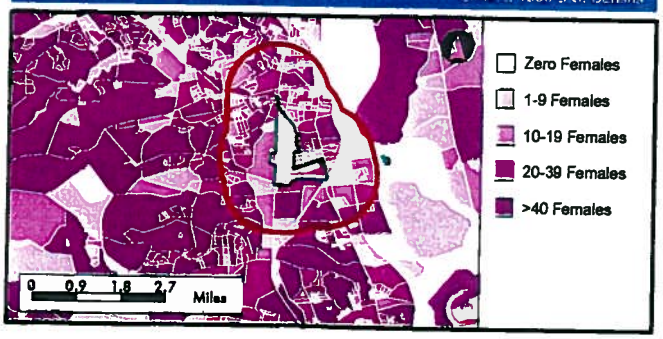
Adults Aged 65 and Older

Source: 1990 U.S. Census



Females Aged 15 to 44

Source: 1990 U.S. Census



Preparer of Report

Agency for Toxic Substances and Disease Registry
Department of Health Assessment and Consultation
Federal Facilities Assessment Branch
Defense Section A

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Appendix A: Exposure Dose Equations

Exhibit 1. Water Incidental Ingestion Exposure Dose Equation

Exposure doses from incidental ingestion of water can be calculated as follows:

$$ED = (C * IR * EF) / BW$$

where,

ED	=	exposure dose (mg/kg/day)
C	=	contaminant concentration (mg/L)
IR	=	intake rate of contaminated water (L/day)
EF	=	exposure factor (unitless)
BW	=	body weight (kg)

Default Incidental Ingestion Water Intake Rates[3]

.02 L/day - adult
.01 L/day - child

Note:
L/day - liters per day

Exhibit 2. Water Dermal Contact Exposure Dose Equation

Exposure doses from dermal contact with water can be calculated as follows:

$$ED = (C * P * SA * ET * CF) / BW$$

where,

ED	=	exposure dose (mg/kg/day)
C	=	contaminant concentration (mg/L)
P	=	permeability coefficient (cm/hr)
SA	=	exposed body surface area (cm^2)
ET	=	exposure time (hours/day)
CF	=	conversion factor (1 L/1,000 cm^3)
BW	=	body weight (kg)

Default Dermal Exposure Values
50th Percentile Body Part-Specific Surface Area for Males
(square centimeters [cm^2])

Age (years)	Arms	Hands	Legs
3<4	960	400	1800
6<7	1100	410	2400
9<10	1300	570	3100
18-70	2300	820	5500

Source: EPA 1997